Nutrition related health status and associated factors in juvenile male and female on remand detainees at entry into Pollsmoor correctional service facility in the Western Cape

by
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DECLARATION

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Abstract

Background: International and national (South African constitution) laws mandate that the Department of Correctional Services (DCS) ensure that on remand detainees receive the same medical treatment as those who are not incarcerated, as well as adequate nutrition while incarcerated. Literature across the globe indicates that inmates are at an increased risk of health problems and malnutrition, with juveniles being at an even higher risk than the adult inmate population. To our knowledge no research on the nutritional status of juveniles at entry into correctional facilities in South Africa or internationally has been published to date. The aim of this research was to determine and compare the nutrition related health status, associated factors and predictors in juvenile male and female on remand detainees at entry into Pollsmoor correctional service facilities in the Western Cape.

Methods: In this cross-sectional comparative study of 67 male and 52 female juvenile on remand detainees the following was assessed using an interviewer based questionnaire: socio-demographic information including age, ethnicity, language spoken at home, a hunger score, meal pattern and food choices in the week prior to entry into the facility using a non-quantified FFQ, understanding of healthy eating, physical activity and sedentary behaviour before entry using the GPAQv2, risk taking behaviours (smoking and alcohol an illicit substance use), body shape perception, and symptoms of depression and anxiety using the K10 tool. The following physical measures were taken: weight, height, triceps-skinfold, mid-upper arm circumference (MUAC) and maximum handgrip strength (MHGS). BMI and the corrected arm muscle area (cAMA) were calculated. All variables were analysed descriptively and compared between male and female juveniles using Pearson Chi-square test, independent samples t-test or Mann-Whitney U test as appropriate. Association tests (Spearman Rank correlation coefficient for continuous and cross-tabulations and the Pearson's Chi square test for categorical variables) were furthermore undertaken with BMI, cAMA and MHGS as the dependent variables within each gender group. The same tests were used to conduct association analysis between socio-demographic variables, dietary intake, physical activity, risk taking behaviour and symptoms of depression and anxiety within each gender group. Multiple linear regression analyses were conducted to identify predictors of BMI, cAMA and MHGS within each gender groups. The clinical significance of statistically significant predictors was assessed using novel criteria.

Results: A summary of the profiles of juvenile female and male on remand detainees are shown in Table A, while the predictors of malnutrition in the same population are shown in Table B following the abstract conclusion. Juvenile female on remand detainees were characterised by a double burden of malnutrition, namely undernutrition (15.4%) and overweight/obesity (23.1%). Coloured (55.8%) and black African ethnicities (42.3%) were equally represented in the sample, with Afrikaans being the most common (46.2%) and isiXhosa the second most common home language reported (32.7%). Only a few had completed grade 12, and half had given birth to one or more children. Food insecurity was reported by 30.8%. Food choices showed frequent intake of low nutrient high-energy food items (table sugar, crisps, white bread, fizzy drinks that contain sugar and non-fibre containing starches) and less frequent intake of nutrient dense foods (fruits, vegetables, dairy and quality proteins). Physical activity levels were high (67.3% classified as active with ≥3000 MET minutes/week), with walking/cycling to get to places being a major contributor to time spent doing physical activity median (IQR) 106 (51-300) minutes/day. Daily illicit substance use was the most common risk taking behaviour, especially amongst the females from the coloured ethnic group (48%). Daily smoking was also common, also specifically amongst those from the coloured ethnic group (83%), while alcohol use seemed to be less prominent. Female detainees were also characterized by the presence of depression and anxiety symptoms (74.5% moderate to very high score). The prevalence of infectious disease was reportedly low (13.7%), but may have been an underestimation

Juvenile male on remand detainees were characterised by undernutrition (17.9%), but none of them were overweight or obese. The majority of males were from the coloured ethnic group (65.7%) and reported that they had Afrikaans as home language (65.7%). As was the case for the females, only a few had completed grade 12. Food insecurity was reported by 43.3%. Similar to females, food choice data showed frequent intake of low nutrient high-energy food items and less frequent intake of nutrient dense foods. Physical activity levels were high (83.6% active with ≥3000 MET min/week), with both walking/cycling to get to places (60 min/day) and recreational physical activity (26 min/day) contributing to time spent doing physical activity. Smoking was the most common risk taking behaviour followed by illicit substance use (smoking was highest in the coloured males 82%). Both smoking and illicit substance use was more frequent in the male sample, while daily alcohol intake was not common in either gender. Male detainees were also characterized by the presence of depression and anxiety symptoms (74.6%) that were positively associated with illicit substance use. As for females, the prevalence of infectious disease was reportedly low (9%).

Predictors of probable clinical significance for juvenile female on remand detainees were as follows: BMI - frequency of vegetable intake (+), frequency of high-fat snack intake (+), frequency of dairy food intake (-), illicit substance use (-), physical activity in MET minutes (-) and availability of fruit juice in the home (-); cAMA - having Afrikaans as home language and depression and anxiety symptoms (-); and MHGS having Afrikaans as home language (-) and anxiety and depression symptoms (-). Predictors of probable clinical significance juvenile male on remand detainees were as follows: BMI -having Afrikaans as home language (-); cAMA - frequency of snacking between meals per week (+) and having Afrikaans as home language (-); and MHGS - hunger score (-) and having Afrikaans as home language or isiXhosa as home language (-).

Conclusions and recommendations: The key conclusion of this research is that both female and male juveniles were prone to be malnourished at admission to the correctional facility (Pollsmoor correctional facility). Females had a double burden of malnutrition, with both underweight and overweight/obesity being present, while underweight was the key malnutrition problem in males.

It can further be concluded that being from the coloured ethic group and having Afrikaans as a home language increased the risk of being underweight at admission to the correctional facility for both male and female on remand detainees.

For female detainees it can be concluded that low frequency of intake of vegetables, high levels of physical activity, frequent use of illicit substances and the presence of depression and anxiety in the month preceding the study also increased the risk of being undernourished, while greater frequency of consumption of high fat snacks increased the risk for being overweight/obese. For male detainees it can be concluded that food insecurity and lower snacking between meals also increased the risk of being undernourished.

The main recommendation from this study is for the Department of Correctional Services (DCS) to implement a nutritional status screening procedure at the point of entry of a juvenile into a correctional facility for identification/diagnosis of nutrition related problems and associated factors for referral for nutrition and other health support within the facility.

Table A: Summary of key findings on the profiles of juvenile female and male on remand detainees

Female	Male
Socio-demographics	
Coloured and black African ethnicities approximately equally represented.	Majority were from the coloured ethnic group.
Majority Afrikaans home language.	Majority Afrikaans home language.
Only 3.9% completed grade 12.	Only 4.5% completed grade 12.
One in two females report having a child.	Not applicable.
Majority lived with their parents.	Majority lived with their parents.
Majority were in the correctional facility for less than a week.	Majority were in the correctional facility for less than a week.
Nutrition status and body image	
Double burden of malnutrition: 15% underweight 17.3% overweight 5.8% obese.	Single burden of malnutrition: 18% underweight 0% overweight 0% obese.
Underweight more prevalent amongst detainees from the coloured ethic group and those who had Afrikaans as home language.	Underweight more prevalent amongst detainees from the coloured ethic group and those who had Afrikaans as home language.
Fat stores and LBM compromised, although LBM to a lesser extent.	Both fat stores and LBM compromised.
1 in 5 may have suffered from chronic undernutrition.	1 in 10 may have suffered from chronic undernutrition.
Body image distortion: 1 in 2 overweight females perceived their weight as normal or underweight. Half of the normal and underweight females perceived their weight correctly.	Body image distortion: 1 in 2 underweight males perceive their weight as normal or overweight. Half of the normal and underweight males perceived their weight correctly.
Meal pattern and food choices	
Skipping of meals was not common.	Skipping of breakfast and lunch was present.
Six most frequently consumed foods in descending order: table sugar, crisps, white bread, fizzy drinks that contain sugar, non-fibre containing starches (e.g. white rice, pasta, mealie pap) and eggs	Six most frequently consumed foods in descending order: table sugar, crisps, brown bread, white bread, fruit (apples, bananas) and oils.
Fruit, vegetables and dairy not consumed daily.	Fruit, vegetables and dairy not consumed daily.
Intake of quality proteins was low at approximately one time a day.	Intake of quality proteins was low at approximately one time a day.
Food security	
30.8% reported to have experienced either moderate (23.1%) or severe (7.7%) hunger.	43.3% reported to have experienced either moderate (27%) or severe (16%) hunger.

Lower food security associated with lower availability of fruit, vegetables and milk in the home. Lower frequency of vegetables being served at meal times.	Lower food security associated with lower frequency of intake of all eight food groups.
Risk taking behaviours	
Smoking daily 65% Alcohol daily 0% Illicit substance use daily 31%.	Smoking daily 76% Alcohol daily 1.5% Illicit substance use daily 39%.
Coloured ethnic group was more likely to have used illicit substances daily than black Africans.	Illicit substance use was equally common among black African and coloured ethnic groups.
Coloured ethnic group was more likely to smoke than black Africans.	Coloured ethnic group was more likely to smoke than black Africans.
75% experienced moderate to very-high and depression and anxiety symptom levels.	75% experienced moderate to very-high depression and anxiety symptom levels.
No association between illicit substance use and the level of symptoms of depression and anxiety	Frequency of illicit substance use increased as the level of symptoms of depression and anxiety increased.
14% reported to have HIV or TB (possible underestimation).	9% reported to have HIV or TB (possible underestimation).
Physical activity 5 times higher than WHO recommendations. Walking/cycling to get to places contributed majorly to time spent doing physical activity (60 MET min); recreational physical activity minimal.	Physical activity 7 times higher than WHO recommendations. Both walking/cycling to get to places (60 MET min) and recreational physical activity (26 MET min) contributed to time spent doing physical activity.

Table B: Malnutrition predictors in juvenile female and male on remand detainees

Predictors of probable clinical significance	
Females	**Males**
Afrikaans as home language: lower MHGS and lower cAMA	Afrikaans as home language: lower BMI, cAMA and MHGS.
Not significant	Snacking between meals: greater cAMA.
Higher frequency of intake of vegetable food group: higher BMI	Not significant
Higher frequency of intake of dairy food group: lower BMI.	Not significant
Higher frequency of intake of high-fat snacks: higher BMI	Not significant
Not significant	Higher hunger score: lower MHGS
More frequent illicit substance use: lower BMI	Not significant
Higher anxiety and depression score: lower cAMA and a lower MHGS	Not significant

Higher physical activity MET minutes per week: lower BMI.	Not significant
Statistically significant but probably not clinically significant predictors	
Better knowledge of healthy eating: reduced LBM	Better knowledge of healthy eating: increased MHGS
Higher frequency of intake of vegetables food group: greater cAMA.	Higher frequency of intake of starch food group: lower cAMA Higher frequency of intake of the fats and oils group: greater cAMA and MHGS Higher frequency of intake of the quality protein group intake: lower MHGS
Not significant	Availability of milk in the home: lower MHGS
Availability of fruit juice in the home: lower BMI	Availability of fruit juice in the home: greater BMI
Not significant	Increased time spent being sedentary: lower BMI and cAMA.
Not significant	Higher school grade achieved: higher MHGS

"A nation should not be judged by how it treats its highest citizens, but its lowest ones." Nelson Mandela.

Dedicated to my friend and partner for life Jannie and the most precious gift of all, my son Jacques.

With great appreciation to all the juvenile remand detainees who gave their time and information.

To the DCS officials who supported me in the research at Pollsmoor juvenile facilities I thank every one of you!

Thanks to the wonderful statistician Prof. Hannelie Nel for assisting with the stats and for all your patience.

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Acronyms

AI	*Adequate intake*
AIDS	*Acquired immunodeficiency syndrome*
BMI	*Body mass index*
cAMA	*Corrected arm muscle area*
DRI	*Dietary reference intakes*
EAR	*Estimated average requirement*
EER	*Estimated energy requirements*
FBDG	*Food based dietary guidelines*
FFQ	*Food frequency questionnaire*
GPAQ-1	*General physical activity questionnaire version 1*
HIV	*Human immunodeficiency virus*
HSB	*High sugar containing beverages*
LBM	*Lean body mass*
MET min	*Metabolic equivalent of task minutes*
MHGS	*Maximum hand-grip strength*
MUAC	*Mid upper arm circumference*
MUFA	*Mono-unsaturated fatty acids*
PA	*Physical activity*
PTSD	*Post-traumatic stress disorder*
PUFA	*Poly-unsaturated fatty acids*
RDA	*Recommended dietary allowances*
TB	*Tuberculosis*

Definition of terms

Associated factors

Factors associated with the nutritional health of juvenile remand detainees were derived from the literature (Stang & Larson, 2016; Brown, 2007) and are presented in **Error! Reference source not found.**.

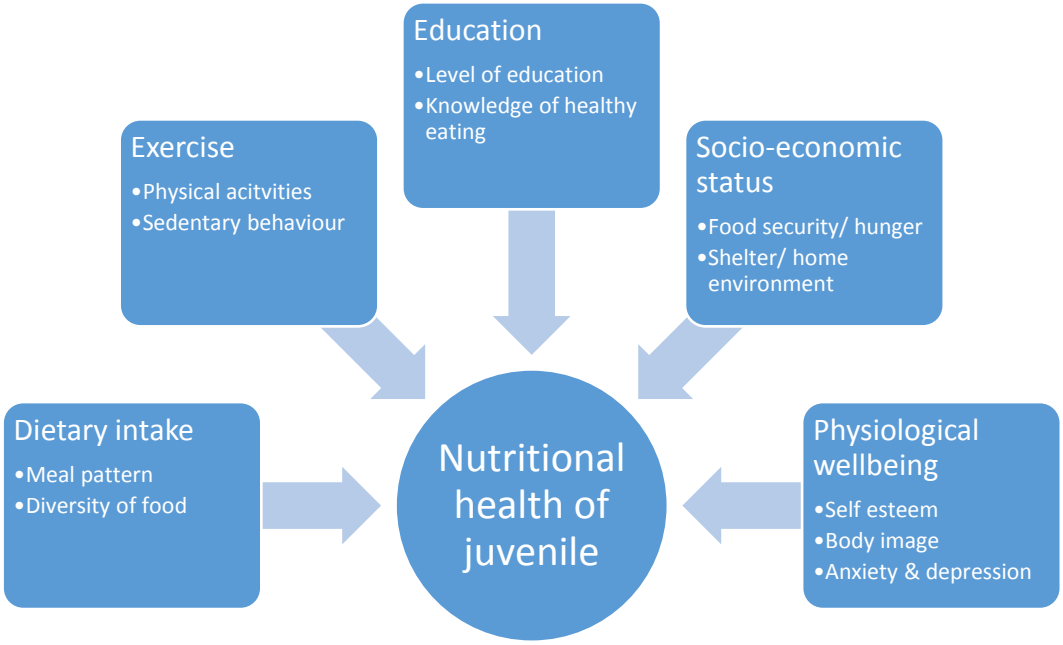

Figure 1: Factors associated with the nutritional health of juveniles

Remand detention facility

According to the Correctional Matters Amendment Act the term 'Remand detention facility' is defined as follows: "a place established under this Act as a place for the reception, detention or confinement of a person liable to detention in custody, and all land, branches, outstations, camps, buildings, premises or places to which any such persons have been sent for the purpose of detention, protection, treatment or otherwise, and all quarters used by correctional officials in connection with any such remand detention facility, and for the purpose of sections 115 and 117 includes every place used as a police cell or lock-up." (Correctional Services Act, 1998, p.11).

Remand detainees

According to the Correctional Services Act, 111 (Correctional Services Act, 1998) 'remand detainees' refers to all categories of un-sentenced people who are in the DCS facilities. The definition excludes sentenced offenders (even when returned from parole break) as well as state patients (where a decision by a court has already been made) and persons awaiting deportation.

Juveniles

The Department of Correctional Services (DCS) defines a 'juvenile' as a young person under the age of 21 (DCS 1998). The 2015/16 Annual Report of DCS reports on child and youth detention by separating this population into three categories: 'children' who are under 18 years of age; 'juveniles' who are between 18-20 years of age; and 'youth and adults' who are 21 years of age and older (DCS 2015).

Overview of the dissertation

An overview of the six chapters that make up this dissertation is presented in the figure below.

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Chapter 1: Introduction

1.1 Introduction

International and national research confirm that adolescents, including late adolescents, are prone to making poor food choices that may increase their risk for excess/inadequate energy and micronutrient intake, resulting in increased nutritional risk (Gitau et al., 2014; Mould et al., 2011; Crews & Duka, 2007; White et al., 2004; Kant, 2003). The most recent prevalence figures for underweight and overweight for the 15-24-year-old age group in South Africa is 15.8% and 5.8% for underweight, 8.9% and 24.4% for overweight, 2.3% and 15.5% for obesity for males and females respectively (NDoH et al., 2017). Research undertaken in the Gauteng province on South African adolescents' micro-nutrient deficiencies show that calcium, iron, zinc, vitamin A, riboflavin (B2), nicotinic acid/ niacin (B3), pantothenic acid (B5) and biotin intake of the 10-13-year-old South Africans were 75% below the RDA (MacKeown, 2007). According to the SADHS (2016) data 33% of young females (18-24 years old) and 13% of males of the same age group suffered from anaemia. According to Shisana et al. (2012) 18 to 24 year olds who are in the late adolescence or young adult development phases, may be at higher risk for food insecurity, a measure of hunger, as 67% of this age group in the SANHANES sample reported having no income.

Adolescents and young adults are also characterized by further risk taking behaviours such as sexual activity that could result in sexually transmitted disease and unwanted pregnancies, smoking, alcohol and illicit substance use and delinquency, all of which could potentially affect the nutritional status of this age group (Pradeilles et al., 2015; Ramsoomar et al., 2013; Delisle, 2005; Spear, 2002). Juvenile delinquency may result in arrest for offences committed and subsequent admission into a correctional facility. Nutrition related health problems on admission to such a facility may be more prevalent in this population than in the general population as a result of greater engagement with risk taking behaviours and possibly food insecurity (Ballard, C. Civil Society Prison Reform Initiative, 2011; Committee on Adolescence, 2011; Fazel & Baillargeon, 2011; Fazel et al., 2006; Forrest et al., 2000).

It is interesting to note that statistics reported by the Community Law Centre in South Africa (1997) show that crimes committed by children 20 years ago were mostly economic in nature (48%) (Community law centre, 1997). Research on sentenced South African youth shows that the nature of these offences are changing, with economic crimes having decreased to 28% and aggressive crimes increasing to 45% from 1997 to 2011 (Munthingh & Ballard, 2012;

Maderthaner, 2009). There is a paucity of information on the reasons for the increase in the aggressive crimes, but Maderthaner (2009) maintains that poor economic conditions play a role in the crimes committed by youth.

According to the International Centre for Prison Studies (ICPS) web site, South Africa has the 10th highest incarcerated population total in the world (ICPS, 2014) . The country has a total of 153 000 individuals who are incarcerated, of whom 17% are being held in the Western Cape (DCS, 2013). The Judicial Inspectorate for Correctional Services Annual Report (JICSAR) shows that 36% of the incarcerated population in South Africa comprises of on-remand (not yet sentenced) detainees, of whom 43% are juveniles (inmates between 18 to 21 years of age). The juvenile population of remand detainees consist of 98% males and only 2% females (DCS, 2015).

Literature also shows that inmates may be at increased risk for health problems (Bautista-Arredondo et al., 2015; Fazel & Seewald, 2012; Fazel & Baillargeon, 2011). There is thus a clear need for good insights in the health and nutritional status of inmate populations of all age groups to assist correctional facilities in providing appropriate health and nutrition care to inmates.

International research on incarcerated populations is focused mostly on the elderly and people with mental illness. Health research in South African correctional facilities and other incarcerated populations is mainly focused on the investigation of tuberculosis (TB) and human immune deficiency virus (HIV). It is important to note that neither key correctional facility studies nor annual reports of DCS or the JICSAR have included an assessment of the nutritional status of on-remand or sentenced inmates. This paucity of information needs to be addressed to advise the DCS on the specific nutritional status and nutrition education needs of remand detainees at correctional facilities. International and national laws determine that all inmates have the right to the same medical treatment as those who are not incarcerated (Møller et al., 2007). This is also mentioned in Section 35(2)(e) of the South African Constitution that makes provision for the conditions under which inmates are to be detained, namely: “every prisoner who is detained, including every sentenced prisoner, has a right to conditions of detention that are consistent with human dignity, including at least exercise and the provision, at state expense, of adequate accommodation, nutrition, reading material and medical treatment” (Constitution of the Republic of South Africa, Act 108 of 1996, 1996). Gaining further insights in the health and nutritional status of incarcerated juveniles at admission and during their period of incarceration is thus a constitutional duty of the Department of correctional services.

Personal observations of the researcher, who worked as a dietitian in the food service unit in Pollsmoor, a correctional facility in Cape Town, South Africa, that provide some insights in nutrition related matters affecting inmates (see Box 1.1).

A court case between a remand detainee who contracted TB whilst in a correctional centre and the Minister for Correctional Services placed the health of inmates in South African correctional facilities in the spot light (Dudley Lee vs Minister for correctional services 2012).The judgement in the case stated that "the Department Correctional Services (DCS) pay close attention to their health care obligations to inmates" (DCS, 2013). This is thus an opportune time to advocate for the importance of healthy eating for good health, to ensure that it is included in the health package in correctional facilities under their auspices.

Box 1.1: Researcher reflections on observed nutritional status of juveniles at admission to Pollsmoor prison.

During my work as a dietitian at Pollsmoor for a two-year period, I gained insights in the functioning of the facility and the nutrition related health problems the inmates seem to experience

It was clear to me that some of the juveniles were undernourished, sickly and vulnerable on admission. Many wardens raised their concern with me that inmates were undernourished on admission. They also mentioned that inmates seemed to gain weight after a few weeks in the facility. It was evident to me that implementation of a nutrition screening process may be necessary to identify those at nutrition risk at admission for identification of nutrition support needs, however, such an intervention should be evidence based. Perusal of the literature at the time provided no information on the nutritional status of juveniles (or adults) at admission to correctional facilities in South Africa.

The time a juvenile spends in remand custody could provide the correctional service system with a two to nine-month window period to address nutrition-related health problems that juveniles may present with at entry to the facility (DCS, 2014b; Ballard & Civil Society Prison Reform Initiative, 2011). This period may also be seen as a 'teachable moment' to educate juveniles regarding a healthy lifestyle and food choices to prevent micronutrient deficiencies and energy imbalances (underweight, overweight and obesity) in the short-term, and reduce NCDs in the long term (Curd et al., 2013).

Molebatsi and Letsoana (2009) stated in their review paper on the youth in South Africa that the problems and needs of the youth should be addressed by research. The researchers propose that at this point in time a comprehensive formative assessment of the nutritional status and associated factors of juvenile offenders on admission to correctional facilities is essential to identify the unique nutrition and nutrition education needs in this vulnerable population (Molebatsi & Lesoana, 2009; Merzel & D'Afflitti, 2003). This research may provide the Department of Correctional Services with crucial insights into the nutrition related health

needs and associated factors of juveniles at entry to Pollsmoor correctional facilities to guide decision making regarding intervention development and implementation.

1.2 Aims and objectives

1.2.1 Aim

The aim of this research was to determine and compare the nutrition related health status, associated factors and predictors in juvenile male and female on remand detainees at entry into Pollsmoor correctional service facilities in the Western Cape.

1.2.2 Objectives

The objectives stated for this research are as follows:

A. To assess and describe the following in juvenile male and female remand detainees at entry into correctional facilities in the Western Cape:
    - Socio-demographic factors;
    - Weight status: Weight, height and body mass index (BMI);
    - Body composition: triceps skinfold; mid-upper arm muscle circumference (MUAC), bone free arm muscle area and maximum hand-grip strength (MHGS);
    - Body shape perception and satisfaction and weight loss attempts;
    - Food choices and meal pattern before entry to facility;
    - Understanding of healthy eating;
    - Physical activity and sedentary behaviour before entry to the facility;
    - Risk taking behaviours;
    - Psychological well-being (level of distress).

B. To compare all variables between juvenile male and female remand detainees.

C. To determine predictors of BMI, cAMA and MHGS **within** the juvenile male and female remand detainee groups.

D. To investigate associations between food choices and meal pattern, availability of healthy foods in the home, food security, risk taking behaviours, knowledge of healthy eating, psychological well-being and physical activity within juvenile male and female detainees.

E. To compare the profile of predictors and associated factors **between** the juvenile male and female remand detainees descriptively.

1.2.3 Hypotheses

Ho1 = There are no underweight, overweight or obese juvenile male or female remand detainees

Ho2 = There are no differences between juvenile male and female remand detainees for investigated variables.

Ho3 = There are no predictors for BMI, cAMA or MHGS and within each of the gender groups.

Ho4 = There are no associations between dietary intake and associated factors within each of the gender groups

Chapter 2: Literature review

2.1 Development stages of adolescents

Humans progress through various life stages from infancy, toddlerhood, childhood, adolescence and adulthood in their lifetime (Newman & Newman, 2006). Each life stage is accompanied by various unique developmental tasks.

According to Stang and Larson (2016) adolescence is defined as the period of life between 11 and 21 years of age. This life phase is characterized by profound biological, emotional, social and cognitive changes as the adolescent progresses towards adulthood (Stang & Larson, 2016). Psychosocial development in adolescents can be separated into three stages including early-adolescence (11-14 years), middle-adolescence (15-17 years) and late-adolescence (18-21 years). These three stages are described in more detail in

Table 1 (McAnarney, 1992).

Table 1: Psychosocial processes and sub-stages of adolescent development (McAnarney, 1992)

Sub stage	***Emotional***	***Cognitive***	***Social***
Early adolescence 11-14 years	*Adjustment to new body image; emerging sexuality.*	*Development of concrete thinking and early moral concepts.*	*Subject to strong peer effect.*
Middle adolescence 15-17 years	*Establishment of emotional separation from parents.*	*Emergence of abstract thinking; expansion of verbal abilities and conventional morality.*	*Increased health risk behaviour; heterosexual peer interests; early vocational plans.*
Late adolescence 18-21 years	*Establishment of a personal sense of identity; further separation from parents.*	*Development of abstract, complex thinking, emergence of post-conventional morality*	*Increased impulse control; emerging social autonomy, establishment of vocational capability.*

The key developmental tasks of late-adolescence described by Newman and Newman (2006) are similar to those described by McArney in 1992; namely autonomy from parents, gender identity, internalised morality and career choice. During late adolescence, the development of

an own identity may cause heightened levels of anxiety because of the lack of certainty of what the future might bring (Newman & Newman, 2006). It is important to note that a person's identity is not fixed and may change during his/her lifetime. Late adolescence is thus the time during which a person formulates his/her moral ideology, gender identity and decides on a set of behaviours and goals to follow in relation to work (Newman & Newman, 2006).

The key physiological changes in adolescents in this life stage is the growth spurt that they experience, characterized by increasing blood volume, muscle building, commencement of menses (females) and increased bone development (Stang & Larson, 2016).

Although this research focuses on late-adolescents, information included in the literature review is not restricted to the late-adolescent, especially in areas where very little or no information is available for this particular age group.

2.2 Nutrition related health status of adolescents

2.2.1 Introductory perspectives

Recent developmental theories emphasize the importance of neonatal growth and factors that affect the early development of humans even before conception and birth for future health (Hertzman & Power, 2003). Halfon et al. (2014) describe four functional phases of health as is illustrated in Figure 2. From this figure it is evident that nutrition plays an important role in the future health of an individual starting at the point where eggs are being formed in the ovaries of a female prior to conception and continues during the prenatal period. This theory is referred to as the developmental origins of health and disease (DoHAD) and underpins the life course of disease model that indicates that a person's health trajectory is determined not only by genetics and the lifestyle choices, but also by factors such as social, psychological and environmental factors throughout life (Hertzman & Power, 2003).

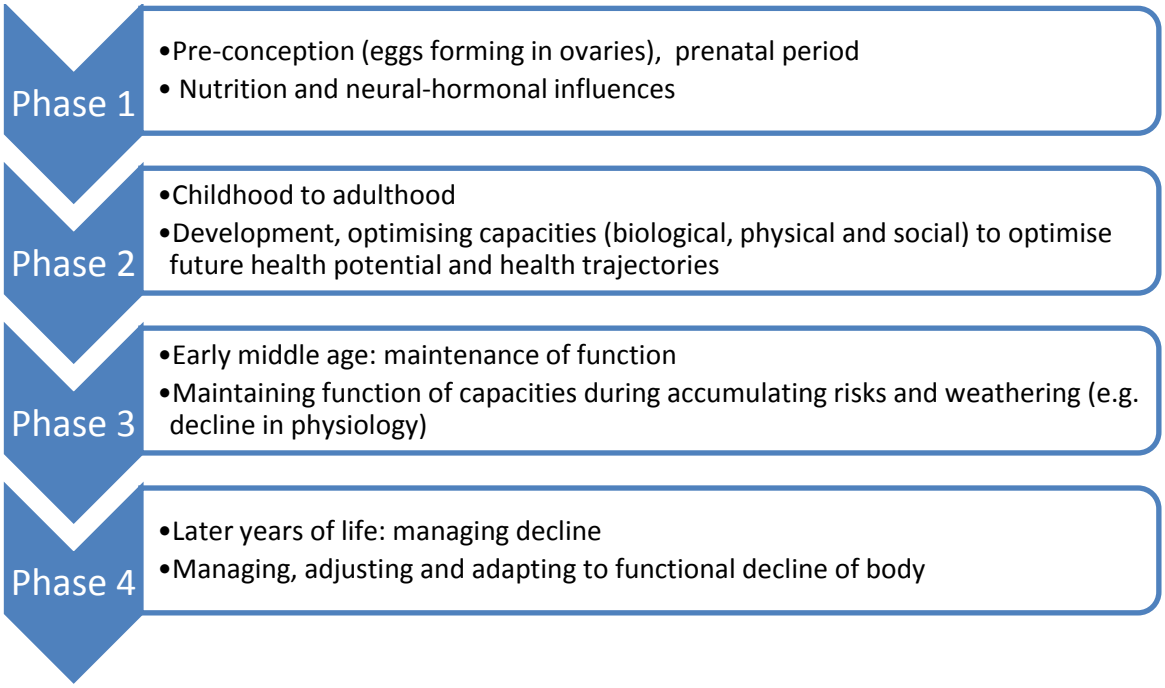

Figure 2: The four functional phases of health during the life cycle (Halfon et al., 2014).

There are many factors that influence the eating behaviour and thus the dietary intake and eventually the nutritional status of adolescents. These factors are depicted in Figure 3 and include environmental systems, social interactions and personal thoughts, beliefs and physical needs. Interventions for changing eating behaviour targeted at adolescents should ideally address all these different levels of influences.

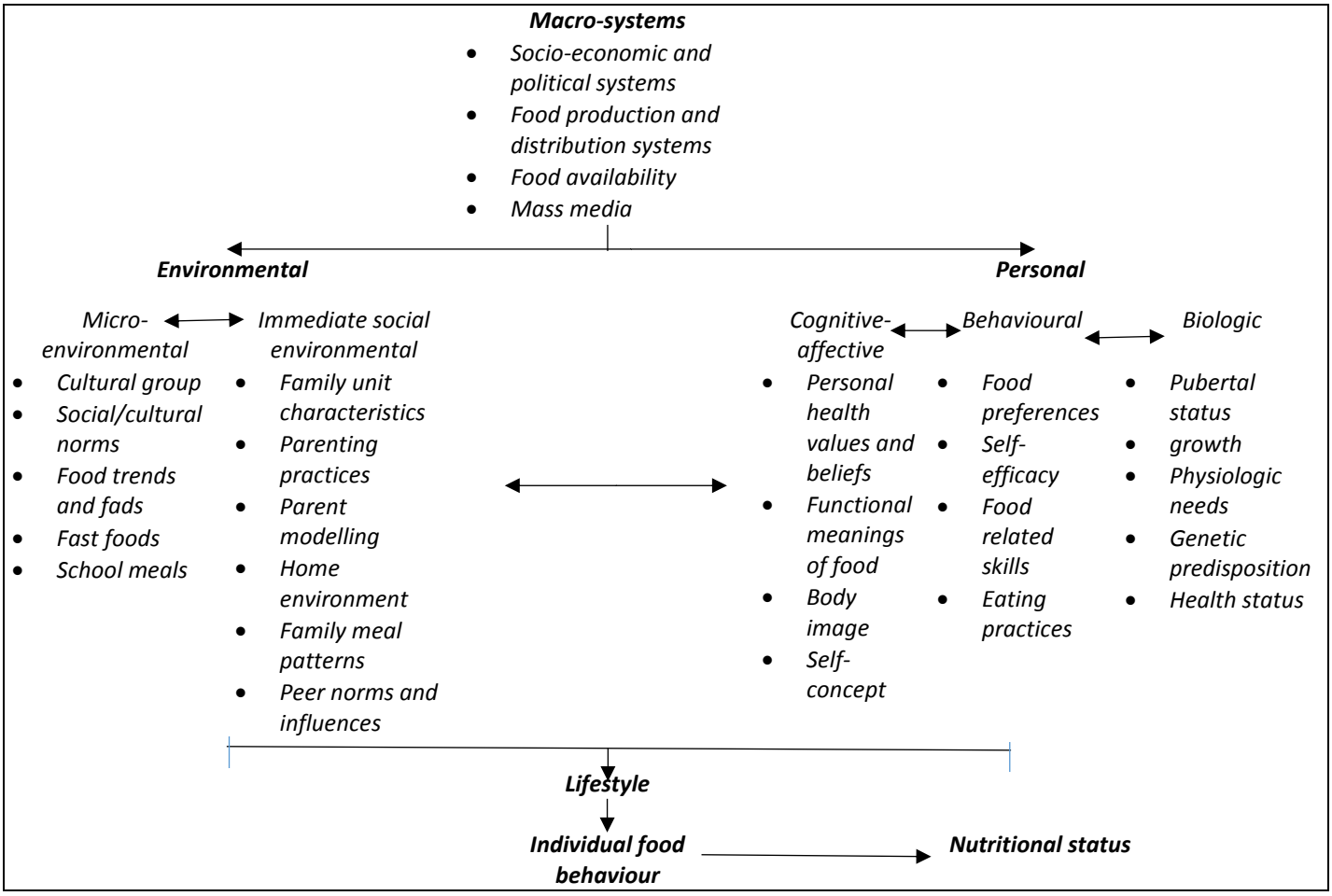

Figure 3: Conceptual model of factors influencing eating behaviour of adolescents (Brown, 2007)

2.2.2 Weight status of adolescents in South Africa

Weight status of adolescents is primarily dependant on energy balance (balance between energy intake and energy expenditure), although the importance of adequacy of micronutrient intake in this regard should not be ignored. Details on energy needs of adolescents are included in Appendix 2.1 and physical activity recommendations for health in Section 3.7.8 of this literature review.

A summary of South African surveys that include data on the weight status of late-adolescents is provided in Table 2. Prevalence of underweight in males ranges from 24.9% (Birth to 20 study) to 14.6% (NYRBS), while prevalence of overweight ranges from 9.7 (SADHS) to 5.8% (SANHANES) and obesity from 4.2% (SANHANES) to 1.8% (SADHS). In females the prevalence of

underweight ranges from 14.1% (Birth to 20 study) to 4.4 (SANHANES), while prevalence of overweight ranges from 25.3% (SANHANES) to 19.7 (SADHS) and obesity from 21.7% (SANHANES) to 5.9% (NYRBS). It is important to bear in mind that when comparing prevalence reported in different surveys that standards and cut-offs applied may not be consistent. Differences in this regard may explain some of the variance that is evident in prevalence estimations from the different surveys (Pradeilles et al., 2015; Shisana et al., 2013; Reddy et al., 2010; SADHS, 2003).

Table 2: Summary of South African studies on the weight status of late-adolescents

Studies on BMI of late-adolescents	***Underweight % BMI<18.5 kg/m²***		***Overweight % BMI 25-29.9 kg/m²***	***Obese% BMI>30.0 kg/m²***
*SADHS (15-24 years) 2016 ****				
Males (n=927)	*15.8*		*8.9*	*2.3*
Females (n=1040)	*5.8*		*24.4*	*15.5*
*SADHS (15-24 years) 2003 ****				
Males (n=1086)	*20.3*		*9.7*	*1.8*
Females (n=1199)	*11.1*		*19.7*	*11.0*
*SANHANES-1 (18-24 years) 2012 ****				
Males (n=486)	*17.9*		*5.8*	*4.2*
Females (n=843)	*4.4*		*25.3*	*21.7*
*NYRBS (>19 year olds) 2008 ****				
Males (n=640)	*14.6**		*8.6***	*2.0***
Females (n=460)	*7.3**		*23.7***	*5.9***
*Birth to 20 (18-19 years) 2009****				
Males (n=974)	*24.9*		*6.1*	*8.3*
Females (n=1045)	*14.1*		*17.9*	*2.2*
Naude et al. ***(12-16 years)***	*Control (n=79)*	*AUD (n=78)*	***Overweight and obese***	
			Control	*AUD*
Males	*11.8**	*9.1**	*17.7***	*18.2***
Females	*4.4**	*4.4**	*26.7***	*37.8***

(NDoH et al., 2017; Pradeilles et al., 2015; Shisana et al., 2013; Naude et al., 2011; Reddy et al., 2010; SADHS, 2003)

**Used underweight for age (WAZ socre< -2 SD)*
***Age dependent BMI cut-offs by Cole used (Cole et al., 2000)*
**** WHO 2000 BMI cut-offs for adults (World Health Organization, 2000)*
Alcohol use disorder (AUD)

The double burden of malnutrition is evident from these surveys, with underweight being a more prominent problem among males and overweight/obesity a more prominent problem among females. Both forms of malnutrition may impact negatively on the future health of

adolescents, with specific reference to non-communicable diseases (NCDs) such as cancer, diabetes, cardiovascular disease, obesity and osteoporosis (WHO, 2002).

2.2.3 Micro-nutrient deficiencies in adolescents in South Africa

Inadequate micronutrient intake increases the risk of specific deficiency signs, symptoms and syndromes as outlined in Section 2.3. Information on the prevalence of diagnosed micronutrient deficiencies in South African adolescents and late-adolescents is also lacking. SAHNANES (2012) data identified vitamin A deficiency as a mild public health problem in South African females of reproductive age, as 13.3% had a deficient Vitamin A level of <0.7 µmol/L (Shisana et al., 2013). Iron status was measured in both males and females who participated in the SANHANES using haemoglobin as an indicator of anaemia and ferritin levels (only measured in females) as indicator of iron stores.

The SANHANES (2012) results showed that 24.2% of 15 to 24 year old females suffered from anaemia (haemoglobin<12g/dL), while the SADHS (2016) study reported a considerably higher prevalence of 33% for the same age category. According to SANHANES (2012) anaemia (haemoglobin<13g/dL) was detected in in 9.3% of 15-24 year old males, while the SADHS (2016) also reported a higher prevalence of 13.3%. Low haemoglobin levels are most likely the result of iron deficiency. It is thus not surprising that 17.1% of the total group of females who participated in SANHANES 2012 were diagnosed with low blood ferritin levels (<15µg/L). Possible contributors to iron deficiency include dietary iron deficiency, heavy menstrual bleeding, and blood losses as a result of gastrointestinal ulceration, acute or chronic infections (HIV, TB or hookworm infections) (Shisana et al., 2013). However, inadequate intake of other micronutrients involved in the formation and maturation of red blood cells such as folate, Vitamin B12 and Vitamin A may also contribute to low haemoglobin levels and the development of anaemia (Gallagher, 2012).

Researchers have found that vitamin D deficiency is highly prevalent in black South African adults with 62% classified as being vitamin D deficient (n=370) with serum [25(OH)D] <50 nmol/L (Martineau et al., 2011). A study on adolescents in the Western Cape found that between 70% to 90% of the adolescents were vitamin D deficient, with those with alcohol use disorders being at higher risk of vitamin D deficiency (Naude et al., 2012).

There are six B vitamins that are of special interest in the South African adolescent group since these vitamins have been found to be deficient in South African adolescents. These vitamins include riboflavin, nicotinic acid, pantothenic acid, pyridoxine, biotin and folic acid (Steyn et al., 2016; MacKeown et al., 2007).

2.3 Dietary requirements of late-adolescents

2.3.1 Introductory perspectives

Dietary requirements, total energy and micro-nutrients, of adolescents are increased as a result of the growth spurt they experience (Stang & Larson, 2016; Brown, 2007). This growth spurt is characterized by increasing blood volume, muscle building, commencement of menses (females) and increased bone development (Stang & Larson, 2016). Pregnancies during early to mid-adolescence pose further nutritional challenges as a result of the combination of increased nutrient needs of the growing mother and the needs of the growing foetus (Stang & Larson, 2016) (refer to section 2.6.5 for more detail).

Energy and nutrient needs may be further affected or increased by risk taking behaviours such as smoking and alcohol and illicit drug use (refer to section 2.6 for more detail), as well as the presence of infectious disease such as HIV/AIDs and tuberculosis (TB) (Stang & Larson, 2016) (refer to section 2.6.5 for more detail). Adequacy of dietary intake during early- and middle-adolescence will impact greatly on the nutritional well-being of the individual in late-adolescence and adulthood.

A summary of the energy and key nutrient requirements of late-adolescent are provided in Appendix 2.1. Further information on relevant key points are discussed in the sections that follow.

2.3.2 Energy and Macro-nutrient requirements and recommendations

According to Stang and Larson (2016) the estimated energy requirements (EER) of adolescents vary greatly as a result of differences in stage of growth, body composition and physical activity levels. Due to these differences, health professionals should not rely solely on the dietary reference intake (DRIs) for energy to estimate the energy requirements of adolescents, but use their professional insights in the mentioned factors for a particular individual

combined with formulas for calculation of a more individualized estimate of energy requirements. The DRIs for micro-nutrients cover the needs of up to 97.5% of the particular population and in the case of adolescents can be used to guide planning of the micro-nutrient intake (Stang & Larson, 2016).

Ranges for the macronutrient composition of the diet as recommended by a number of countries are presented in Table 3. Individualization of proportion of carbohydrate, protein and fat intake according to preferences can be done within the recommended ranges.

Table 3: Macronutrient Recommendations from Selected Regions/Countries
(Naude & Senekal, 2016)

Nutrients	***Nordic countries[2-3]***	***United States of America and Canada[4]***	***Australia and New Zealand[5]***	***Europe[6]***	***World Health Organization[7]***
Carbohydrate *% of TE*	*45 - 60 (population goal 55)*	*45 – 65 130 g minimum (RDA)*	*45 – 65*	*45 - 60*	*55-75*
Fibre *grams per day*	*25 - 35*	*19-50 years: 38 (males); 25 (females)*	*30 (males) 25 (females)*	*25*	*25*
Sugar *% of TE*	*< 10 (refined sugars)*	*< 25 (added sugar)*	*---*	*---*	*<10 (free sugars)*
Total Fat *% of TE*	*25 – 40 (population goal 30)*	*20 – 35*	*20 - 35*	*20 - 35*	*20*-35***
Saturated fat *% of TE*	*< 10*	*As low as possible with nutritionally adequate diet*	*< 8 - 10*	*As low as possible with nutritionally adequate diet*	*< 10*
Trans fat *% of TE*	*As little as possible*				*< 1*
Monounsaturated fat *% of TE*	*10 – 20*	*---*	*---*	*---*	*By difference*
Polyunsaturated fat *% of TE*	*5 – 10*	*---*	*---*	*---*	*6-10*
Omega-3 Polyunsaturated fat (α-linolenic acid) *% of TE*	*At least 0.5*	*0.6 – 1.2*	*0.4/0.5 - 1*	*0.5 (AI)*	*1-2*
Omega-6 Polyunsaturated fat (linoleic acid) *% of TE*	*3% when combined with omega-3 fat*	*5 - 10*	*4/5 - 10*	*4 (AI)*	*5-8*
Protein *% of TE*	*10 – 20*	*10 - 35*	*15 - 25*	*---*	*10-15*

Abbreviations: TE = Total Energy; RDA = Recommended Dietary Allowance; AI = Adequate Intake
**Intake of at least 20% is consistent with good health*
***Acceptable for those who are highly active and consume diets rich in vegetables, legumes, fruits and whole grains, without the risk of unhealthy weight gain*

Specific references for table:

[2] (Becker et al., 2004)
[3](Nordic Council of Ministers, 2014)
[4](Institute of Medicine Food and Nutrition Board, 2002/2005)
[5](Australian National Health and Medical Research Council and the New Zealand Ministry of Health, 2006)
[6](EFSA Panel on Dietetic Products Nutrition and Allergies (NDA, 2010)
[7](WHO/FAO, 2003AO, null 2003)

The most recent WHO report indicates that there is evidence to support a strong recommendation for limiting intake of free sugars (monosaccharides and disaccharides added

to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates) to be less than 10% of total energy intake. It is further indicated that evidence also supports a conditional recommendation for a further reduction of intake to less than 5% of total energy intake (WHO, 2009; Brown, 2007).

Good quality carbohydrate food choices, for example unrefined starches and legumes, are essential to ensure intake of the recommended 16-28g fibre per day for females and 15-34g fibre per day for males. Adequate fibre intake, including both soluble and insoluble fibre, is important for normal bowel function and prevention of chronic diseases such as certain cancers, coronary artery disease and type II diabetes (Brown, 2007).

The dietary goals presented in Table 3 for fat emphasise the restriction of saturated and trans-fatty acids that may contribute to higher levels of low-density lipoprotein (LDL) and as a result an increase in the risk for heart disease (Raymond & Couch, 2016). Emphasis should be placed on the consumption of essential poly-unsaturated fatty acids of the n-3 type (oily fish and plant based sources such as flaxseed, canola, soybean oils and walnuts), and n-6 type (vegetable oils products like, sunflower oil, margarine and fried products), as well as the ratio between these two types of fatty acids (Gallagher, 2012). In late-adolescents these fatty acids and their ratios may affect inflammation, blood clotting, blood pressure, mood and behaviour and cellular signalling, amongst others (Gallagher, 2012). To achieve the recommended intake of omega-3 fatty acids can be challenging, but may be achieved with the intake of consuming oily fish twice per week and/or the mentioned plant sources (Kris-Etherton et al., 2002).

2.3.3 Micro-nutrient requirements

Calcium

Optimal calcium intake is one of the key factors in ensuring adequate bone mineral density at the age of 30 and prevention of osteoporosis later in life, see Table 54 for the RDA/ AI of micronutrient needs of 18-21 year olds (Gallagher, 2012). Other factors that have been shown to impact on achieving optimum bone mineral density include education on the importance of calcium intake, use of calcium supplements, promotion of weight-bearing activity and strength activities, prevention of excessive weight loss, prevention of amenorrhea, reduction/control of consumption of carbonated drinks and salt (sodium), avoidance of high protein diets, and avoidance of alcohol and tobacco products (Schettler & Gustafson, 2004).

Exclusion of dairy from the diet, either as a result of food insecurity or restrictive diets, may result in inadequate calcium intake if good alternative sources such as green leafy vegetables e.g. spinach, fish containing small bones like sardines or calcium containing supplements are not consumed (Gallagher, 2012). Unfortunately, fortified food products containing calcium are not readily available in South Africa. It is important to bear in mind that the bioavailability of vegetable sources of calcium such as spinach, rhubarb and beets may be compromised by oxalic acid and phytates present in the vegetables, reducing their contribution to calcium intake. Diseases that cause malabsorption of fat may also compromise calcium absorption as calcium binds to free fatty acids and is then excreted (Shapses, 2013). Excessive intake of dietary fibre (> 30g per day) and inadequate vitamin D levels may also decrease calcium absorption (Gallagher, 2012).

Iron

The RDA for iron for late-adolescent females is nearly double the recommendation for males (18mg/day vs. 11mg/day) (Trumbo et al., 2001). The main reason for this difference is iron losses that occur as a result of menstruation and lower iron stores in women than in men (Gallagher, 2012). Iron is essential for the transport and metabolism of oxygen within the red blood cells (Gallagher, 2012).

A key point of consideration in iron nutriture is the bioavailability of the iron consumed. Plant sources of iron, for example brown rice, beans and legumes, potato peels and spinach contain non-haem iron, while meat, fish and poultry contain both haem and non-haem iron (Gallagher, 2012). Approximately 15-40% of haem-iron is absorbed but only 1-15% of non-haem iron is absorbed (Hunt, 2003). Factors that may increase iron absorption in general include low iron stores (Hunt, 2003) and increased needs e.g. during pregnancy. Further enhancers of non-haem iron absorption include increased acidity of the gastro intestinal tract and foods that are consumed concurrently e.g. foods containing ascorbic acid (citrus fruit), sugars and sulphur containing amino acids enhance iron absorption (Gallagher, 2012).

Factors that reduce the bio-availability of non-haem iron include foods/drinks high in phytic acid (green leafy vegetables such as spinach), polyphenols/ tannins (tea, coffee and red wine), soy protein, egg, calcium and phosphate salts, as well as antacids (Hunt, 2003). Inadequate

iron intake and bioavailability may be a particular concern in food insecure individuals as animal protein intake may be low as a result of the higher cost of animal proteins; while intake of bioavailable alternative sources of iron may be challenged by the fact that cheap energy dense, LND food choices are commonly made in lower socio-economic settings instead of foods like green leafy vegetables, rice or legumes (Lim et al., 2013; Darmon & Drewnowski, 2008).

Care should be taken to avoid usual intake of iron above the upper tolerable level of 45mg/day (Trumbo et al., 2001), especially in those who are using supplements. High iron intake increases free iron levels that promote increased formation of reactive oxygen species (ROS), which in turn increases the risk of NCDs (Gallagher, 2012). High iron intake also increases the risk for the development of hemochromatosis in genetically susceptible individuals (Crichton, 2013).

Magnesium

Magnesium is a mineral that plays a role in numerous metabolic processes, especially stabilising the structure of adenosine tri-phosphate (ATP), metabolism of food, synthesis of fatty acids and proteins, phosphorylation of glucose in the glycolytic pathway and to transmit messages to cells in response to hormone factors (Gallagher, 2012).

Adequate intake during adolescence and adulthood may reduce the risk of impaired glucose metabolism and potentially the development of diabetes later in life (Hruby et al., 2014). Low magnesium levels may cause neuromuscular disorders, hypertension, cardiac arrhythmias, mitral valve prolapse, atherogenesis, insulin resistance, eclampsia and disordered bone metabolism (Orchard et al., 2014).

Diets that are high in refined and LND foods, such as those included in the typical late-adolescent diet, are usually lower in magnesium because the food sources of magnesium like vegetables, legumes, milk and whole-wheat cereals are not consumed in sufficient amounts (Gallagher, 2012).

Zinc

Zinc is essential for a multitude of functions in the human body. One function of zinc that is of particular interest in the developing adolescent is the role that it plays in growth and sexual maturation (Gallagher, 2012). Further functions include structural, catalytic and regulatory

functions where carbohydrates, lipids, proteins and nucleic acids are involved. Zinc deficiency may lead to delayed sexual maturation, growth failure, hair loss, delayed wound healing, impaired appetite, immune deficiencies, behavioural disturbances and eye lesions or impaired taste (Grider, 2013; Gallagher, 2012).

The best food sources of zinc are oysters, animal-derived foods such as beef and pork, as well as fortified cereals. Although plant-derived foods such as chickpeas, beans, peas and whole grains contain zinc, the bioavailability is not as good as for animal-derived products. Thus, people on vegetarian diets and those from lower socio-economic groups may have a lower zinc status (Lim et al. 2013). Of note is that zinc bioavailability is seriously compromised by the presence of phytates (green leafy vegetables such as spinach) and foods containing copper (beef and oysters), cadmium (possibly in organ meats or root vegetables), folic acid and high levels of iron or calcium (Gallagher, 2012).

Vitamin A

There are three active forms of Vitamin A, retinol, retinal and retinoic acid, that play a role in reproduction (retinol), ensuring night and colour vision (retinal) and supporting growth, as well as cell maturation involving the sperm and embryo (retinoic acid) (Gallagher, 2012; Wardlaw & Hampl, 1999). Mechanisms of action involve amongst others absorption of photons by 11-cis-retinal in photoreceptor cells (rods), which triggers a chain of events to transmit the visual signal to the brain; regulation of gene expression by retinoic acids and involvement in regulation of lymphocyte physiology by retinol (Noy, 2013).

Vitamin A deficiency results in a number of symptoms of which ocular problems and depression of the immune system are the most serious (Noy, 2013). Ocular changes involve initial night blindness and subsequently xeropthalmia that can result in irreversible blindness. Vitamin A deficiency is the primary cause of blindness in children in the world (Noy, 2013). In children vitamin A increases risk for measles and upper respiratory tract infections. Vitamin A deficiency may also result in anaemia, hardening of the mucous membranes and spontaneous abortion (Gallagher, 2012).

Vitamin A in the form of retinol is most abundant in liver, giblets and eggs, while fortified food products such as wheat flour, wheat bread and maize meal also contain vitamin A in South Africa (SAJCN, 2003). Plant material such as dark green or orange vegetables e.g. sweet

potatoes, carrots or spinach and fruits such as mangoes and tomatoes contain beta-carotene that is converted to retinol in vivo (Gallagher, 2012).

B Vitamins

Thiamine, riboflavin, niacin, pantothenic acid and biotin play an important role in the metabolism of carbohydrates and fats in general, while riboflavin and niacin play a specific role in the electron transport chain for the formation of ATP during energy metabolism are; (Gallagher, 2012). Pyridoxine (B6), folate and vitamin B12 all aid the regulation of homocysteine levels which is very important in the prevention of CVD and reduction of inflammation (Morris et al., 2010; Fairfield & Fletcher, 2002).

Visible symptoms of most vitamin B deficiencies involve the mouth, tongue and lips, and include cheilosis (vertical cracking of the lips), angular stomatitis (cracking of the corners of the mouth), glossitis (inflammation of the tongue) and magenta/scarlet red discoloration of the tongue (Gallagher, 2012). Thiamine and niacin deficiencies result in deficiency syndromes that can result in death, known as Beriberi and Pellagra respectively (Wang et al., 2014; Gallagher, 2012).

All the B vitamins are known to play roles in prevention of cardiovascular disease, diabetes, cancer and possibly Alzheimer's disease (Gallagher, 2012). Riboflavin, biotin and folic acid are involved in cancer prevention via protective effects on DNA synthesis within the body. (Choi et al., 2014). Folic acid has been found to be beneficial in prevention of of colorectal cancer, breast cancer and prevention of neural tube defects in babies (Fairfield & Fletcher, 2002). Female adolescents may be especially at risk of having babies with neural tube defects as unplanned pregnancies are more prone to take place during this time (Stang & Larson, 2016).

Low vitamin B-6 status may have causal connections to NCDs and Alzheimer's disease via changes in hormone functions, immune functions and biosynthesis of other metabolites in the body (Morris et al., 2010). Although these outcomes are only evident during later adulthood, poor nutrition during adolescence may contribute to the initiation of these diseases.

B vitamins are widely found in both animal and plant food sources such as organ meats, eggs, chicken, dairy products, and fortified cereals, including maize and bread flour in South Africa

(Gallagher, 2012). Plant sources that are especially high in B vitamins are mushrooms, spinach, broccoli, beans, legumes and whole grains (Gallagher, 2012). Adolescents who consume large amounts of LND foods will not be consuming sufficient amounts of animal or plant products to achieve sufficient levels of the B vitamins, especially those who do not consume fortified cereals as part of their daily intake.

Vitamin C

Vitamin C aids in the synthesis of collagen and other connective tissues and is important as an antioxidant in the body assisting with the immune function and iron absorption through the diet (Litchford, 2016). Vitamin C is also important for the synthesis of nor-epinephrine, epinephrine, serotonin, thyroxine (thyroid hormone), bile acids, steroid hormones and purine bases used for DNA synthesis (Litchford, 2016).

During emotional or physical stress, the body releases increased amounts of ascorbic acid in the urine, which may lead to increased needs of the vitamin during such conditions. Vitamin C is known to contribute to prevention of NCDs via its role as antioxidant, immune modulator and possibly as vasodilator, which may be important in prevention of CVD (Gallagher, 2012).

Vitamin C deficiency may lead to fatigue, rheumatic pains in the legs and muscle atrophy due to the weakness in bone and connective tissues and ultimately scurvy, which presents itself as swollen bleeding gums and skin lesions and eventually results in death (Gallagher, 2012).

Food sources that are high in vitamin C are red peppers, citrus fruit such as oranges, “naartjies” and lemons, strawberries and tomatoes. Green vegetables such as broccoli, Brussel sprouts and kale also contain vitamin C (Gallagher, 2012). Vitamin C is readily lost during the preparation and cooking processes. Research indicates that the Vitamin C content in foods that are pre-prepared (shredded, cut or peeled) long before the consumer finally receives the cooked meal is reduced between 45% and 52% (Gallagher, 2012).

Vitamin D

Vitamin D can be produced in the body when the skin is exposed to the sun but in the absence of sufficient sun exposure dietary intake of the vitamin is essential (Gallagher, 2012). Factors that reduce the penetration of ultraviolet rays from the sun are; (i) amount of melanin in the

skin (dark skinned people), (ii) wearing full-body clothing covering limbs and face, (iii) window glass type, (iv) level of atmospheric pollution and (v) the use of sunscreen, all of which reduce the amount of vitamin D production by the body (Gallagher, 2012; Fairfield & Fletcher, 2002). Food sources of vitamin D are cod liver oil and fatty fish such as salmon, tuna, sardines or mackerel and beef liver and egg yolks (Gallagher, 2012). The only food that is fortified with vitamin D in South Africa is one brand of margarine, while America has vitamin D fortified orange juice, milk and yogurt (Naude, 2016).

Vitamin D deficiency results in compromised mineralization of bone, which results in rickets in children and osteomalacia in adults (Gallagher, 2012). There is also evidence that vitamin D may have a protective effect against becoming susceptible to the tuberculosis virus (Mycobacterium tuberculosis) in both non-HIV positive and HIV-positive adults (Martineau et al., 2011). Review of current research on vitamin D status and depression has revealed that there is substantial evidence of an increased risk for depression in those suffering from vitamin D deficiency (Parker et al., 2017).

Vitamin K

Vitamin K is important in the process of coagulation of blood and is especially important in the female population who experience menses (Stang & Larson, 2016).

New functions of various forms of vitamin K (menaquinone and phylloquinones) are being investigated, including their effects on bone mineralisation and reduction of coronary artery calcification (Gallagher, 2012; Shearer et al., 2012). Research is indicating that many more studies need to be done to estimate the exact EAR for Vitamin K, especially since there is a paucity of information on the actual amount of Vitamin K (menaquinone) produced by bacteria in the gut, how much of this is absorbed and the mechanisms of action of the various forms of vitamin K (Fairfield & Fletcher, 2002). According to (Guarner & Malagelada, 2003) 10 to 50% of vitamin K is produced by bacteria in the gut.

Sources of vitamin K include fruit and vegetables (Walther et al., 2013). Research also indicates that fermented food products, including yogurt, may have substantial benefits in terms of Vitamin K nutriture as it promotes a healthy gut microbiome (Walther et al., 2013). Adolescents who receive anti-biotic medication to prevent or treat acne may be at increased

risk of Vitamin K deficiency as a result of the disruption of the intestinal flora by long term use of antibiotics (Gallagher, 2012).

2.4 Dietary intake and meal patterns of adolescents

International and local research shows that there is good reason for concern about the food choices and meal patterns of adolescents (Temple, 2006; Kant, 2003; Reddy, 2010; Sedibe, 2014). The dietary intake of adolescents has been shown to be characterised by meal skipping and frequent intake of energy dense, low nutrient dense (LND; high in energy but low in nutrients) foods, which may result in excessive energy intake and inadequate intake of micronutrients (Kant, 2003). High sugar and refined carbohydrate intake, which are also specific concerns in adolescent dietary intake, may lead to low fibre, and poor quality fat intake (Reddy et al., 2010; Kant, 2003).

American and South African research indicates that the prevalence of overweight/obesity is increasing and that LND foods may be contributing to this problem (NDoH et al., 2017; Shisana et al., 2013; Reddy et al., 2010; Kant, 2003). Within the South African context, the nutrition transition i.e. changing from a culture of growing food for home consumption to buying food from vendors and eating away from home, especially in the adolescent population may also be contributing to obesity risk (Sedibe et al., 2014a; Sedibe et al., 2014b; Stupar et al., 2012; MacKeown et al., 2007; MacIntyre et al., 2002; National Center for Health Statistics (US), 1994).

On the other hand, adolescents may be at higher risk for inadequate energy, protein and micronutrient intake as a result of restrictive dietary patterns, for instance vegetarian or macrobiotic diets (Stang & Larson, 2016), food-insecurity, living on the streets, using alcohol or illicit substances and chronic infections such as HIV/AIDS and tuberculosis (Stang & Larson, 2016). Presence of infectious disease may further result in increased nutrient needs to recover from the illness. Inadequate iron intake and bioavailability may be a particular concern in food insecure individuals as animal protein intake may be low as a result of the higher cost of animal proteins. Furthermore, the intake of bioavailable alternative sources of iron may be challenged by the fact that cheap energy dense, LND food choices are more commonly available in lower socio-economic settings than nutrient dense food items (Lim et al., 2013; Darmon & Drewnowski, 2008).

According to Brown et al. (2007) inadequate intakes of calcium, iron, magnesium, zinc, vitamin A, pyridoxine (B6), folate and vitamin E are of specific concern in adolescents, while Stang and Larson (2016) emphasise that vitamin D may also be a concern during this phase. The notion that poor food choices may result in inadequate intakes of micronutrients is supported by the inverse relationship that Kant et al. (2003) found between LND food intake by American adolescents and the quantity of micronutrients such as vitamins A, B6, folate, calcium, magnesium, iron and zinc consumed (Kant, 2003).

There is a paucity of information on the energy and nutrient intake of adolescents, especially late-adolescents, in South Africa (Steyn et al., 2016). Data from the birth-to-twenty cohort showed that calcium, iron, zinc, vitamin A, riboflavin, niacin, pantothenic acid and biotin intake of the 10-13 year olds was below 75% of the RDA (MacKeown et, al. 2007). A review by Steyn et al. (2016) of studies on the nutritional intake of South African adolescents published prior to 2015 indicated that adolescents were at risk of consuming insufficient energy (thus macro-nutrients), iron, zinc, vitamin A, niacin, folate and vitamin B6, but not riboflavin or thiamine. Steyn et al. (2016), however, cautioned that under-reporting of food intake as well as the fact that some of the studies did not consider the fortification of maize and bread flour in South Africa, may have resulted in inflated risk estimates. A study undertaken in the Western Cape that involved adolescents with or without alcohol use disorders (AUD), a population very similar to the target population of this research, showed that the consumption of numerous nutrients was below the EAR. For calcium, the proportion below the EAR was 100%, for folate 99%, for magnesium 98%, for vitamin A 80%, for vitamin C 65%, for vitamin E 51%, for thiamine 36% and for zinc 43% (Naude, 2012). Increased intake of LND foods was clearly associated with nutritional deficiencies in this study.

Results from the NHANES III in the USA showed that LND foods contributed 30% to total daily energy intake of American adolescents (Kant, 2003). Further USA based research found that more than 70% of a sample of 4746 adolescents ate fast-foods (food items purchased from a fast food restaurant) at least once a week (French et al., 2001). Data from the South African SANHANES (2012) showed that 31% of the 15-24-year-old group ate out weekly (Shisana et al., 2013). However, when considering these results, it needs to be borne in mind that “eating out” may not necessarily reflect fast food intake or poor food choices. However, it can be argued that fast foods are much more available and affordable for “eating out” when compared to formal dining at restaurants that offer healthy food choices e.g. low fat foods and vegetables.

Data from the YRBS (2008) showed that 40% of Western Cape adolescents ate fast foods or "luxuries"(defined as hamburgers, fried chicken, hotdogs, hot chips, pies, "vetkoek") four or more times per week, while 56% had fizzy drinks/cold drinks Coca-Cola, Fanta, Pepsi) four times per week (Table 4) (Reddy et al., 2010).

Table 4: Energy dense low nutrient dense food choices made by participants in the NYRB 2008 study (% of total group) (Reddy et al., 2010).

Indicator	***South Africa n=9663***	***Western Cape n=1130***
Fast food or 'luxuries' (Ate fast food more than 4 days per week)	*39.2*	*40.2*
Cakes and/or biscuits (Ate 4 or more days per week)	*42.6*	*43.9*
Cold drink frequency (Drank 4 or more days in the week)	*50.3*	*56.2*
School tuck shop (Purchased item(s) at tuck shop one or more days in the previous week)	*44.7*	*54.7*

Further research in Western Cape schools showed that the proportion of learners who regularly purchased the specific items or brought them to school from home was 46% for crisps and candies/chocolate, 33% for sugar containing cold drinks and 26% for potato chips or "slap chips" (Temple et al., 2006). Fruit was regularly brought to school or purchased by only 12% of the learners (Temple et al., 2006). Feeley et al. (2012) reported that the most popular items that adolescents in Cape Town consumed were in order of most preferred: fried chips, sweets, crisps, soft drinks and "vetkoek". Adolescent in this study typically also had a low intake of fruit, vegetables and dairy products, which is associated with a reduction in nutrition quality of the diet (Feeley et al., 2012).

Research in the Western Cape that compared food choices between adolescents with and without alcohol use disorders (AUD) found that poor food choices were prevalent in both groups (Naude, C. E. 2012). High fibre and low fibre foods were eaten approximately twice a day respectively (Naude, Senekal & Carey, 2012) and calcium-rich foods were only eaten approximately once a day. Fruit and vegetable intake was clearly below the recommendation of 5 a day (Wang et al., 2014), as the combined intake was less than 100g per day for both groups. Energy-dense foods were consumed approximately four times a day, unhealthy fats

approximately three times a day and sodium-rich foods approximately 1.5 a times day, and healthy fats were not consumed daily. These poor food choices resulted in the inadequate intake of calcium, magnesium, zinc, vitamin A, C, E and thiamine and folate (Naude, 2012).

A further concern regarding eating habits of adolescents is skipping of meals, especially breakfast. Naude (2012) reported that about one third of adolescents with or without AUD in the study skipped breakfast and snacking was most common during first break (approximately 75%). Approximately two thirds in both groups snacked during second break at school and late afternoon respectively, with about a third in both groups snacking after the evening meal. In line with these findings, results from the Birth-to-twenty study in urban area in South Africa (Soweto) showed that 45% of adolescents skip breakfast, while a further study in the Western Cape indicated that 22% of school going adolescents skip breakfast (Temple et al., 2006). Research indicates that although South African adolescents in the Cape metropole area are aware of the health benefits of consuming breakfast, they still found it difficult to include breakfast into their daily routine due to early traveling times to school (Stupar et al., 2012).

2.5 Barriers to healthy food choices

According to Shisana et al. (2013) "long term health outcomes are determined by factors like lifestyle, diet, nutritional levels and education", yet numerous barriers may prevent the achievement of a healthy lifestyle.

The authors of the 2011 American Academy of Paediatrics policy explain that lower socio-economic status (SES) is related to poorer health status and unmet physical health needs (Committee on Adolescence, 2011), which resonates with the research done by Schönfeldt et al. (2013) who indicated that people with a lower SES cannot afford to eat the variety of foods needed to be healthy (Schönfeldt et al., 2013). Food-coping strategies found in low-income groups as mentioned by Schönfeldt et al. (2013) include skipping of meals, reducing portion sizes, opting for cheaper-ready to eat LND foods (e.g. packets of chips or sweets) and even not eating for a whole day. Research by Sedibe et al. (2014b) in 16-19-year-old females in a rural area of South Africa also mentioned skipping of meals, especially breakfast, as a coping mechanism of food insecurity because it reduces the feeling of hunger during school time.

Food insecurity is not uncommon in the Western Cape. SANHANES-1 (2012) results showed that 25.6% of the sample were at risk of hunger and 16.4% experienced hunger in the past month. Research in rural 16-19-year-old adolescents reported that the most influential barriers to eating healthy fruit and vegetables were poverty and the fear of being labelled as "poor", which prevented them from either buying the fruit and vegetables or bringing home grown foods to school (Sedibe et al., 2014b). The main reason given by adolescents in the Naude (2012) study for not eating fruit was that it was not available at home, supporting the notion that lack of income (food insecurity at home) may be an important contributor to poor food choices in adolescents.

However, lack of purchasing power may not be the only reason for poor food choices and meal patterns in food insecure adolescents. Research done by Widome et al. (2009) on the perceptions of adolescents from food-secure and food-insecure households in the USA found that although both groups understood that healthy eating is beneficial, those who were food-insecure felt that eating healthy food was inconvenient and that such foods did not taste good, resulting in them choosing more fast foods and having breakfast less frequently (Widome et al., 2009). Interestingly, the main reason given by the adolescents in the Naude (2012) study for not eating vegetables was dislike of vegetables, although non-availability in the household was also mentioned.

A further barrier to healthy food choices may be related to the delivery of the national school feeding scheme. Menus for this intervention typically include a protein, starch and vegetable for the lunch meal that is served, with a fruit included on the menu. However, Sedibe et al. (2014b) reported that food served as part of the feeding scheme lunch in a rural area in Mpumalanga, seemed to contain very little vegetables, fruit or protein and reportedly made the students feel ill.

Stupar et al. (2012) investigated barriers to eating healthy foods during lunch break at school within the South African context. Adolescents mentioned the following potential barriers: the lack of availability of healthy foods at home that can be packed for lunch breaks at school, the perception of learners that eating healthy foods would not improve their happiness, the fact that high fat foods tasted better and lastly the perception that one is wealthy when eating purchased fried and other foods rather than brining food from home (Stupar et al., 2012). Stupar et al. (2012) also reported that female South African adolescents felt that being happy

and eating food that was tasty was more important than how much they weighed. It is important to note that some females said they wanted to weigh more because family and friends were of the opinion that if they were 'thin' or at a healthy weight they looked like boys (Stupar et al., 2012).

The female adolescents in the study by Stupar et al. (2012) were also asked what they thought could be done to improve their food choices. They mentioned increased availability of healthy foods at all levels (home, tuck-shops and cafeterias), nutrition education of parents and in schools, guidance of health promotion activities by dietitians and nurses, implementation of government health campaigns via platforms such as television and radio, as well as improvement of the food markets to ensure that healthier food choices are available (Stupar et al., 2012).

In a systematic review by Spronk et al. (2014) on the relationship between nutrition knowledge and dietary intake in adults, the reviewers report that most studies found a weak positive association between nutrition knowledge and some aspect of dietary intake such as fruits and vegetables (Spronk et al., 2014). This information indicates that nutrition knowledge can impact positively on the intake of fruit and vegetables; lack of knowledge may thus be seen as a barrier to healthy eating.

Research done on rural adolescent girls in South Africa by Sedibe et al. (2014b) showed that adolescent girls knew that vegetable and fruit intake would improve their health and that LND foods such as sweets, chips, 'vetkoek' (dumplings) and ice bites were not good for their health. Some of these adolescents also showed insights into the fact that these unhealthy snacks could result in disease such as NCDs (Sedibe et al., 2014a). Another study done on rural male and female adolescents in the Eastern Cape found that their knowledge of nutrition was fair, as most knew that it was important to eat a variety of foods to be heathy, yet their food variety score (FVS) did not emulate this knowledge(Oldewage-Theron et al., 2015) . The authors speculated that the poor food variety score may be linked to the high unemployment rate of their caregivers, indicating that both financial resources as well as nutrition knowledge impact on nutrient intake of adolescents (Oldewage-Theron et al., 2015). The majority of adolescents in the Oldewage-Theron et al. (2015) research in the Eastern Cape stated that fruit and vegetables should be consumed daily (58% males and 73% females), while very few knew that dairy and starchy foods should also be consumed every day (20% males and 14% females).

Although the majority of the adolescents knew that sugar containing foods cause tooth decay, none of them knew that sugar containing beverages such as Coca-Cola or fruit juice could be a cause of tooth decay. The adolescents struggled to identify foods that contained protein as well as identification of healthy portion sizes of fats and oils (Oldewage-Theron et al., 2015).

Research done in the Western Cape schools found that the majority of students could identify healthy and unhealthy foods, however nearly half of the students did not realise that 'Samoosas' (a deep fried savoury snack with filling) and pies were unhealthy food items. Interestingly, the adolescents' knowledge of healthier choices did not improve the quality of foods bought from tuck-shops (Temple & Steyn, 2016).

From the research, it is clear that education on healthy versus poor food choices and the benefits to be gained from healthy choices may not have a substantial effect on actual food choices. Addressing nutrition knowledge in combination with attention given to the barriers mentioned above in a multipronged approach that includes the school, parents, teachers, children seems to be the way to go (Temple & Steyn, 2016; Stupar et al., 2012)

2.6Risk taking behaviours of adolescents

2.6.1 Introductory perspectives

During adolescence, physiological factors such as levels of growth hormones and affect impulse control change in a manner that increases risk taking behaviour (Barbalat et al., 2010; Ernst et al., 2006). The work by Steinberg et al. (2017) in a sample of 5000 adolescents across 11 countries showed that the pattern of sensation seeking and self-regulation was consistent across countries despite considerable differences in parenting and environmental factors between countries. Sensation seeking peaked at the age of 19 and self-regulation improved linearly as age increased. These results support the notion that neurological and hormonal factors impact on impulse control in this age group and that adolescents may not yet have developed the capacity to keep impulsive behaviour in check (Steinberg et al., 2017).

Risk taking behaviours practiced by adolescents include smoking, alcohol use, drug use, disordered eating behaviour and poor food choices (described in section 2.6) (Mould et al., 2011; Reddy et al., 2010; Kant, 2003) and high levels of sedentary behaviour (Pearson & Biddle, 2011). Unprotected sexual activity is also relevant to the risk-taking profile of adolescents not

only because of the dangers of sexually transmitted diseases (STD's) and HIV/ Aids, but also due to the risk of pregnancy and the stress that an unplanned pregnancy may place on the family and individuals involved (Avalos et al., 2010).

2.6.2 Smoking

According to the WHO (2015) report approximately six million people die annually prematurely of smoking associated illnesses. The CDC (2000-2004) report stated that 30% of cancer deaths could be attributed to tobacco smoking, which caused people to suffer with chronic obstructive pulmonary disease (COPD) and early CVD. Not only does tobacco smoking cause premature death by approximately ten years, but it also places a high economic burden on countries due to productivity losses and direct or indirect expenditure caused by smoking related diseases, with the estimates for American monetary burden being 193 billion dollars per year (CDC, 2008).

Research in the EU found that the prevalence of smoking was high in adolescents, with 58% reporting that they started smoking at the age of 14 and 31% adolescents between the ages of 14-17 reporting that they smoked regularly (Wasserman, 2016). The 2014 USA report on smoking prevalence in high school pupils (age range: 16-18 years) indicated that 28% males and 21% females had used some form of tobacco product in the previous month. It is interesting to note that cigarette smoking accounted for only half of the tobacco products used (Singh, 2016).

National studies show that smoking may also be common among South African adolescents, especially among males. According to the 2008 South African youth risk behaviour survey (SAYRBS) 30% of 13-19-year-old adolescents had tried smoking, with 24% more males having tried smoking than females (n=10 053) (Reddy et al., 2010). Results from the SANHANES (2012) showed that 12.8% adolescents and young adults between 15-24 years of age (n = 4239) had "ever smoked", with 55% more males having "ever smoked" than females (Shisana et al., 2013). The SADHS (2016) results on smoking only reported on daily, occasional or non-smoker in the 15-24-year-old age group, with daily smoking reported by 21% males and 3% females in this age group.

A longitudinal study in secondary schools in the Western Cape over a four-year period documented that the prevalence of smoking at the end of the four years was 56% for males.

Learners included in this study were 15-18 years old and the majority identified themselves as being of coloured ethnicity (Carney et al., 2013). According to Flisher et al. (2006) the prevalence of smoking in 15-18 year old females in the Western Cape went down from 21% to 18%, but that it was still much higher than the 5.7% reported for 15-18 year olds for the country as a whole in the WHO international report (WHO 2015). These results are in line with the findings of the SADHS (2016) where it was found that 15-19 year old males and females in the Western Cape had a higher prevalence for currently smoking daily than those in other provinces, and that coloured males and females had a higher prevalence for currently smoking daily than other race groups in the country. The SADHS (2016) results show that adolescents between 15-19 years of age in the Western Cape have a high prevalence for "ever smoked" for males and females (37%; 30% respectively), while the prevalence of those who "currently smoke daily" is only slightly lower for males (33%) but substantially lower for females (17%). Black adolescents smoke significantly less than coloured adolescents, while adolescents with no education or only Grade 5 education are more prone to smoke daily (NDoH et al., 2017). This evidence clearly points to a higher smoking prevalence in the Western Cape than in the rest of the country.

A multitude of factors may contribute to the initiation of and are associated with smoking in adolescents. The saving and empowering young lives in Europe (SEYLE) study found that smoking was significantly associated with migration background, living in single parent households, being inactive/ sedentary, parental smoking and physical fighting behaviour, excessive alcohol intake, illicit drug use, anxiety and previous suicide attempts (Banzer et al., 2015). Research in Dutch adolescents found that various intrapersonal (impulsivity, inhibition, reward seeking and personality) and social risk factors (peer pressure, subjective perceptions of smoking as a normal behaviour and conforming behaviours) are important for prevention of smoking initiation and should be addressed as early as possible, preferably from the age of 12 years (Defoe et al., 2016).

2.6.3 Alcohol use

The WHO 2014 report on "Global status report on alcohol and health" highlighted that globally harmful use of alcohol accounted for 4% of the total number of annual deaths, with this prevalence being more than double for the 15-19 year age group at 9% (WHO, 2014). Alcohol is a dangerous substance that increases the vulnerability of adolescents to various risk taking

behaviours such as sexual activity, interpersonal violence and accidents while under the influence of alcohol (Giancola et al., 2010).

The disinhibition effects of alcohol on regulation of behaviour can be explained using the alcoholic myopia model (AMM) developed in 1990 by Steele and Josephs (Steele & Josephs, 1990). According to the model alcohol restricts the range of internal and external cues that can be perceived and processed, causing increased aggression and reduction in awareness of consequences to oneself and others (Giancola et al., 2010).

Research in the EU indicated that 13% of 14-16-year-old adolescents had used alcohol at the time of the study (Wasserman, 2016). A study conducted among USA adolescents showed that 42% had used alcohol in the past month, with males and females having the same prevalence of use (Talley et al., 2014).

South African studies show that there is good reason for concern about alcohol abuse by adolescents in the country. According to the SAYRBS (2008) nationally 35% of learners between 13-19 years had used alcohol in the past month. Significantly more white (56%) and coloured (49%) learners used alcohol than African black (32%) learners, while more males (40%) than females (30%) used alcohol. SADHS (2016) results show that 20% of 15-24-year-old males and 5.1% females had consumed five or more drinks on one occasion in the past month. Results from the Birth-to-twenty study in an urban area in South Africa (Soweto) found that 66% of late-adolescents had “ever used” alcohol in their lifetime (Ramsoomar et al., 2013), while the SADHS (2016) indicated that 56% of males and 30% of females had ever used alcohol.

Although the results of the SADHS (2016) did not identify Western Cape 15-24 year olds as those with the highest alcohol use in this age group in the country, two studies conducted in the province itself reported very concerning statistics for alcohol use (NDoH et al., 2017). Results from the four-year longitudinal study conducted in schools in the Western Cape where most subjects identified themselves as from coloured ethnicity showed that 65% of the learners had used alcohol over the study period (Carney et al., 2013). Parry et al. (2004) reported that 23% of their sample of arrested adolescents in the Western Cape said that they were under the influence of alcohol at the time of their alleged offence.

As is the case with smoking, a multitude of factors contribute to the initiation of and continuation of drinking alcohol and many are similar to those identified for initiation of smoking (Ramsoomar et al., 2013). A review done on factors associated with alcohol consumption and future alcohol use disorders identified the following risk factors: genetic risk (diminished alcohol sensitivity), neurobiological risk (novelty-seeking/ impulsivity), parental or family beliefs, environment (parental behaviour and accessibility to alcohol), gender roles, personal or emotional dysregulation of behaviour, diminished decision making abilities and depression (Schulte et al., 2009).

Ramsoomar et al (2013) mention the following potential risk factors for alcohol use based on a study in adolescents in South Africa: parents, especially mothers, may not be educated sufficiently on the harmful effect alcohol may have on adolescents and the fact that alcohol may be more accessible in lower SES areas than in other areas, including the possibility that there are more retail stores available in lower SES areas in South Africa.

2.6.4 Illicit substance use

Illicit substance use is a health concern for adolescents because of the myriad of physiological effects that each of the substances may have on the body. The Centre for Behavioural Health Statistics and Quality of Americans (2016) report that adolescents between 18-25 years had a higher frequency of use of any illicit substances in the past month at 22% than younger or older age groups. These statistics were not reported by gender. The most commonly used illicit substance was marijuana, followed by prescription medications, with methamphetamine only being seventh on the list of ten substances (Center for Behavioral Health Statistics and Quality, 2016).

Results of the 2008 SAYRBS indicated that the most commonly used illicit substances were inhalants and over-the-counter drugs at 13% and 14% respectively in the month preceding the study (Reddy et al., 2010). A longitudinal study in schools in the Western Cape over 4 years, where most subjects identified themselves as from coloured ethnicity, found that 32% had tried illicit substances over the course of the study (Carney et al., 2013). A high use of methamphetamine has specifically been reported for adolescents in the Western Cape, with a large multistage study in 30 schools reporting the lifetime use of methamphetamine for males at 13.3% and females at 11.9% (Parry et al., 2011; Plüddemann et al., 2010; Flisher et al., 2006). This is a major concern as side-effects of this drug include increasing metabolism, heart

palpitations, sleeplessness and irritability to adjustment of the cognitive realities experienced by the individual (Sung et al., 2013; Scott et al., 2007; Virmani et al., 2005). The use of illicit substances may further lead to being in conflict with the law and incarceration of the adolescent (Parry et al., 2004).

A review of factors that may increase the risk of illicit substance use in adolescents identified the following factors: aggressive behaviours (bullying, fighting, peer pressure and being involved in gangs), family or parenting factors (parental attachment, violence in the home, substance abuse by parents) and skipping school (Carney et al., 2013). Parental criminal behaviour increased the odds ratio by 17 for drug abuse or dependence among their children, while physical abuse increased the odds for drug dependence of children by nine (Benjet et al., 2013).

2.6.5 Sexual activity, pregnancy and HIV/Aids

Sexual activity in adolescents is a concern for numerous reasons, including sexually transmitted infections (STIs), high rate of HIV infection and unplanned pregnancies. The latter increases the nutritional needs of the pregnant adolescent and also raises socio-economic concerns relating to parenthood at such a young age.

Research in the EU on 11000 adolescents found that 38% of 16 year olds had already engaged in sexual activity at the time of the study (Wasserman, 2016). Adolescents between the ages of 18-24 had a significantly higher prevalence of sexual risk behaviour (44%) than older participants (25%) in the research done in the Western Cape of South Africa (Avalos et al., 2010). The SADHS (2016) research showed that more males than females reported having had intercourse with someone during the past 12 months, with 62% males and 52% females between the age of 15-24 years and 44% males and 38% females between the ages of 15-19 years reporting having had intercourse during the past 12 months.

The SADHS (2016) showed that 28% of South African females have begun child bearing, thus they had either had a child or had been pregnant, at the time of the study. The SADHS (2016) data further showed that females in rural areas, those with only primary school education and those who fell into the second quintile of wealth were more prone to have started childbearing (NDoH et al., 2017). According to the 2008 YRBS 24% of late-adolescent females had been pregnant and 22 % had children. Although the SADHS (2016) showed that the

Western Cape had the lowest prevalence of 15-19-year-old females who had begun child bearing, it could be argued that those who find themselves in the second wealth quintile may have been more prone to this behaviour.

Statistics from the 2008 YRBS of indicate that 55% of all respondents reported to have been treated for STIs and only 30% reported to have used condoms when they were sexually active (Reddy et al., 2010). The SADHS (2016) reported on the HIV testing but not on the actual prevalence of infection. It was found that more females (68%) than males (58%) between the ages of 15-24 had been tested for HIV. A survey done in 2012 in South African to assess HIV prevalence showed that 2.9% of males and 11.4% of females between the ages of 15-24 years were HIV positive. The overall prevalence of 7.1% for the 15-24-year-old age group was significantly lower than the 2008 HIV prevalence of 8.7% (Shisana et al., 2014). SANHANES data showed that African black South Africans had a 7.6 times higher prevalence of HIV than coloured South Africans. There was insufficient data on white and Indian South Africans to compare prevalence of HIV with other race groups.

A variety of personal and environmental factors could contribute to the pattern of sexual activity observed in adolescents and young adults. Avalos et al. (2010) reported that being younger, personal threats, interpersonal problems and alcohol use increased sexual risk behaviour in 18-24 year olds seeking primary health care in Cape Town clinics. Factors such as trading sex for illicit substances, transportation or money; male homosexuality; sexual partners who use injectable drugs; sexual partners who have STIs; having multiple sexual partners and failure to use a condom during intercourse, were deemed to be sexual risk taking behaviours in the research by Avalos et al. (2010). A review by Eaton et al. (2003) of 10 studies done between 1991-1996 on unsafe sexual behaviour of South African youth revealed the following risk factors for engaging in early sexual activity in adolescents: parents who do not explain sexual matters to their children, low access to media in rural areas, lack of recreational facilities, living on the streets and being incarcerated.

Eaton et al. (2003) explained that the factors that perpetuate unsafe sexual behaviour in South African adolescents were found to include inappropriate/incorrect understanding of the process of transmission of HIV, the value of condom use for the prevention of transmission thereof and the inaccurate perception that condoms could be bad for their health Eaton et al. (2003) also mention that some adolescents were under the impression that hormonal

contraception contributed to the prevention of HIV transmission, while less than half of the youth believed that they were at risk of contracting HIV. Eaton et al. (2003) further point out that many heterosexual relationships in South African adolescents were seen to be coercive, violent and male-dominated, where females were bullied. Furthermore, peer pressure seems to influence both males and females to be sexually active to prove their masculinity and maturity (Eaton et al., 2003).

2.6.6 Sedentary behaviour and physical activity

The WHO global recommendation for physical activity (PA) for health specifies that individuals should attain one of the following PA recommendations: do moderate PA more than 150 minutes per week or do vigorous PA for more than 75 minutes per week or achieve 600 metabolic equivalent of task minutes (MET min) per week from the combination of moderate and vigorous PA (WHO, 2010).

Physical activity assessment for comparison across populations and countries has been a major challenge. To address this situation, the WHO developed a PA assessment tool that has been standardised and validated for low-middle income countries, including South Africa (Herrmann et al., 2013; Bull et al., 2009). Application of this questionnaire, the General Physical Activity Questionnaire (GPAQ), allows for the categorisation of PA as vigorous or moderate during work or recreation and as moderate PA during travelling (Armstrong & Bull, 2006). The amount of time spent being sedentary is also determined and the MET min per PA category can be estimated for both vigorous and moderate PA (MET minutes are calculated by multiplying vigorous PA minutes by 8 and moderate PA minutes by 4) (Armstrong & Bull, 2006).

According to the WHO global health observatory (GHO) data, 23% of adults globally were insufficiently active, with 20% males and 27% females not doing sufficient PA. Furthermore, older adults were less active than younger adults and adults in high-income countries were less active than those in low-income countries (WHO, 2015b). The eastern Mediterranean and Americas had the highest prevalence of insufficient PA of 32%, while the prevalence was 21% for Africa (WHO, 2015b).

Statistics from the EU showed that 33% of adolescents aged 14-16 years (n=11000) were not physically active (Wasserman, 2016). South African data shows similar trends for adolescents, with females being more inactive than males. Physical activity data from the 2003 South

African Demographic and Health Study (SADHS) is in the form of MET minutes per day and was obtained using the international physical activity questionnaire (IPAQ) which is aligned with the GPAQ (IPAQ Research Committee, 2005). Results showed that 34% males between the ages of 15-24 years were sufficiently active (≥3000MET min), 30% minimally active (600-2999 MET min) and 36% inactive (≤599 MET min). Eighteen percent of the females in the same age category were sufficiently active, 30% minimally active and 52% inactive (SADHS, 2003). Unfortunately, SANHANES (2012) did not use the GPAQ to investigate PA, but did assess the cardiovascular fitness levels. Sixty five percent of males between 18-24 years of age were found to be fit, 8% had an average level of fitness and 26% were unfit, while 38% females in the same age group were found to be fit, 11% had an average level of fitness and 50% were unfit.

Excessive energy intake combined with low levels of PA may give rise to weight gain, while being overweight or obese are risk factors for NCD development (World Health Organization, 2005). The WHO data indicates that people who were insufficiently active had a 20-30% increase in all-cause mortality when compared to those who did at least 150 minutes of moderate intensity PA per week (WHO, 2015b). Regular PA specifically reduces the risk of heart disease, diabetes, cancer and depression (WHO, 2005). Based on the SANHANES (2012) data it could be argued that young females have a much higher risk profile for developing NCDs because they are less fit than young men. Research in the EU found that frequency of PA was positively correlated with the feeling of well-being while it was also negatively correlated with anxiety and depression. These researchers indicate that PA should be targeted as a possible intervention to promote well-being among adolescents (Wasserman, 2016).

Adolescents living in rural areas in South Africa may be an exception to the typical PA trends reported above. Sedibe et al. (2014a and 2014b) investigated the qualitative aspects of adolescents' PA in rural and urban areas in South Africa and found that adolescents enjoyed doing sports and understood that their health would benefit from doing exercise, with some commenting that they would experience a reduction in illnesses such as the flu as a result of doing PA. However, some adolescents in the urban area said that only fat people who want to lose weight need to do exercise (Sedibe et al., 2014a). Many of the adolescents in rural areas walk long distances to get to-and-from school, which increases their opportunity to do exercise; whereas the urbanised adolescents living in Soweto walked less as they rather used public transport to travel to school (Sedibe et al., 2014a; Sedibe et al., 2014b).

Sedentary behaviour was defined by Armstrong and Bull (2006, p69) as: “sitting or reclining at work, at home, getting to and from places, or with friends including time spent (sitting at a desk, sitting with friends, travelling in car, bus, train, reading, playing cards or watching television), but do not include time spent sleeping”. Being sedentary not only increases the risk of performing inadequate levels of PA, but may also result in particular dietary patterns that may further increase the risk of NCDs. A systematic review done by Pearson and Biddle (2011) showed that there is a clear association between sedentary behaviour and unhealthy dietary intake. Higher energy dense snacks and lower intake of fruit and vegetables were reported across age categories when people were sitting or lying around for long periods of time (Pearson & Biddle, 2011).

Low levels of physical activity in a particular population may be the result of many interacting factors/influences. Barriers to physical activity mentioned by female adolescents in South African studies were poverty, demographic location and lack of infrastructure (Kinsman et al., 2015), internal feelings of what other people might think of them while doing exercise, lack of physical education at school, studies in Grade 12 interfering with physical education activities, feeling unsafe in the community and getting tired quickly (Sedibe et al., 2014a; Sedibe et al., 2014b; Reddy et al., 2010; SADHS, 2003).

2.6.7 Eating disorders, muscle dysmorphia and perception of body weight

According to Solmi et al. (2013) eating disorders (ED) are a set of psychiatric conditions that include anorexia nervosa, bulimia nervosa, binge eating disorders or a combination of symptoms that do not meet the strict criteria of any one of these three disorders, which is referred to as eating disorders not otherwise specified (EDNOS).

Muscle dysmorphia is the pathological preoccupation with masculinity and belief that the body is not muscular enough. These people are obsessive about weightlifting, high protein diets, use of anabolic steroids, while thinking that they are underweight and thin when they are not (Gitau et al., 2014; Pope et al., 1997). Disordered eating, unhealthy weight management practices, poor eating attitude and behaviours (high levels of dietary restraint, disinhibition and perceived hunger), abuse of dietary supplements and body image distortion are proxy indicators of eating disorders and muscle dysmorphia risk and possibly presence of actual

diagnosable disease (Senekal et al., 2001). People with EDNOS have increased odds of reporting mood and anxiety disorders, substance use and suicidality (Solmi et al., 2014).

Research indicates that female adolescents are at high risk of eating disorders such as anorexia or bulimia, while males are more likely to present with muscle dysmorphia (Gitau et al., 2014). Hudson et al. (2007) state that 13% of adolescent females will experience some form of eating disorder by the age of 20, with the median age of onset of eating disorders being between 18-21 years. The lifetime prevalence estimates for anorexia, bulimia and binge eating in the USA for males are 3%, 5% and 2% respectively and for females 9%, 1.5% and 3.5% respectively (Hudson et al., 2007).

In South Africa, there are limited statistics on the prevalence of these disorders, but some insight can be gained from reported proxy indicators. The SANHANES (2012) used accuracy of perception of body size in terms of BMI category as a reflection of whether a person would be likely to adopt healthy lifestyle behaviours such as healthy eating and taking part in physical activity (Shisana et al., 2013). Body dissatisfaction is related to disordered eating in males and females (McCabe & Ricciardelli, 2004). The SANHANES (2012) results show that 37% of the 15-24-year-old coloured and black African males and 39% of the coloured and black African females in this age group in the Western Cape could accurately determine their BMI as either being over- under- or normal weight. However, 34% males and 44% females perceived their weight as being higher than it actually was and 28% males and 16% females perceived their weight as being lower than it actually was (Shisana et al., 2013).

A study done by Cilliers et al. (2006) on white females at a Western Cape university showed that although only 10% of the females were overweight, a third of the females thought they were overweight, with only 15.8% of them being satisfied with their weight. More than half (55.3%) of them tried to lose weight in the preceding two years (Cilliers et al., 2006). According to statistics on adolescents in the USA 61.5% of females and 21.5% of males wanted to lose weight while 6.8% females and 36.3% of males wanted to gain weight (Middleman et al., 1998). These data indicate that males are more prone to wanting to gain weight, while females are more prone to wanting to lose weight. This may indicate that those who overestimate their weight may be aiming for a smaller body ideal and may be dieting unnecessarily (linked to anorexia or bulimia or excessive PA), while those who underestimate their body weight may be aiming for a larger, muscular body size and attempt to gain weight, consuming diets high in

protein, excessive muscle building, supplement use and excessive exercise (linked to muscle dysmorphia) (Gitau et al., 2014).

In research done by Mould et al. (2011) on South African adolescents, black girls between 13 to 15 years of age were found to have a higher prevalence of bulimia than white girls. In the 16 to 18-year-old age group white girls had significantly higher scores for disordered eating attitudes and behaviours than their black counterparts. The researchers concluded that eating behaviours of teenage girls must be addressed more effectively and that differences in the profile of body dissatisfaction and eating disorders between ethnic groups should be considered in these actions (Mould et al., 2011).

In a study that involved black and white South African adolescent males in Johannesburg no significant differences were found between the two groups for body satisfaction (Gitau et al., 2014). Even though there was a higher prevalence of underweight black adolescent males (44%) than underweight white adolescent males (10%), Gitau et al. (2014) found that a third of both groups had a "below average" level of body satisfaction. This indicates that there are different perceptions of body satisfaction within adolescent males depending on their race and culture as seen in the research done by Holmqvist and Frisén (2010).

Body shape and size ideals and satisfaction are influenced by numerous environmental factors including that of modernisation of living environment, standard of living, exposure to western lifestyle ideals, religious affiliation, age, race and culture (Holmqvist & Frisén, 2010). The concept of culture may be described as a group of people who exist within some kind of shared context, take part in similar cultural ideas, have similar lifestyles are exposed to similar advertisements and similar appearance ideals (Heine, 2015). In a review on body dissatisfaction across cultures, Holmqvist and Frisén (2010) found that degree of affluence and exposure to Western lifestyle ideals were prominent factors that influenced body dissatisfaction across cultures.

2.7Mental health of late-adolescents

Key concerns relating to the mental health of adolescents include mood disorders, anxiety disorders, substance use disorders and externalising disorders (Benjet et al., 2010). Research in the European Union (EU) on the prevalence of anxiety and depression in a sample of 11000 14 to 16-year-old adolescents found that 9% were suffering from anxiety, 34% from subthreshold depression, 15% from depression and 44% had suicidal thoughts (Wasserman, 2016). Lifetime

prevalence of deliberate self-injurious behaviours (D-SIB) was 28%, while 4% of the sample reported to have attempted suicide during their lifetime (Wasserman, 2016).

Mental health was assessed in the SANHANES (2012) with the 10 item Kessler psychological questionnaire/ tool. Andrews and Slade (2001) suggest that the score achieved is categorized as follows: likely to be well (<20 score), likely to have a mild mental disorder (20-24 score), likely to have a moderate mental disorder (25-29 score) and likely to have a severe mental disorder (>29 score). The SANHANES (2012) however, using the same cut-off points categorised the ranges as; low distress levels (<20 score), moderate distress levels (20-24 score), high distress (25-29 score) or very high distress levels (>29 score). Twenty percent of the 15-24-year-old males and 26% of females who participated in the SANHANES were found to experience moderate to very-high distress levels, indicating that adolescent females seem to be more distressed than adolescent males. Information on each of the four categories of distress according to the 10-Item Kessler questionnaire was only reported for males and females combined. Proportions for each of the four categories for the 15-24-year-old group was 88% who experience low distress (likely to be well), 8% who experience moderate distress (likely to have a mild mental disorder) and 3 % who experience high distress (likely to have a moderate mental disorder), with 1.1% experiencing very high distress levels (likely to have a severe mental disorder).

Longitudinal research done by Flisher et al. (2006) from 1997 to 2004 on 14-year-old adolescents in the Western Cape showed that suicide attempts increased from 7% to 20.7% for males over the time period, while the prevalence for females was consistent at 17% at both time points. These results on distress levels and suicide attempts in adolescents are good reason for concern in both males and females in this regard (Shisana et al., 2013; Flisher et al., 2006).

A study done in Mexico showed that family pathology (parent mental illness, parent substance abuse, parent criminal behaviour, family violence) and abuse/ neglect (physical abuse, neglect, sexual abuse) were significant risk factors for mood disorders, anxiety disorders, substance use disorders and externalising disorders (intermittent explosive disorder, oppositional-defiant disorder, conduct disorder and attention-deficit/hyperactivity disorder)(Benjet et al., 2010). Follow-up research by Benjet et al. (2013) describes that addiction prevention efforts in youth

should focus on the needs of this age group to deal better with parental dysfunction and physical abuse.

Mental health problems in adolescents may be preventable. For example, the youth awareness of mental health (YAM) intervention reviewed by Wasserman (2016) showed a significant reduction in suicide attempts and reduction in severe depression in the adolescents who took part in the intervention (Wasserman, 2016). Teachers, school staff, professionals and pupils were targeted as part of the intervention that covered six topics, including (1) mental health risks and awareness, (2) self-help advice, (3) stress and crisis management, (4) depression and suicidal thoughts, (5) helping a troubled friend and (6) getting advice and who to contact for these purposes with telephone numbers and e-mail addresses (Wasserman, 2016).

2.8Juvenile delinquency

In America 11 million adolescents younger than 18 years were arrested in 2008, equating to 4% of the population at that time, with a third of those arrested being female (Committee on Adolescence, 2011). National statistics on the number of adolescents arrested in South African is not available. However, research conducted in 2004 on people who were arrested in three South African metropoles, including Cape Town, showed that 47% of individuals arrested in Cape Town were under 25 years of age (similar to Durban and Johannesburg), with 16.5% of the arrestees in Cape Town being female and 56% of them testing positive for various illicit substances. Illicit substance use by arrestees in Durban was similar (50%) to the prevalence in Cape Town, but was found to be lower in Johannesburg (29%) (Parry et al., 2004).

Parry et al. (2004) reported that 23% of the arrested sample in all three metropoles said that they were under the influence of alcohol at the time of the alleged offence. Researchers argue that there is a definite link between crime and drug or alcohol abuse and school non-attendance which should be considered when implementing crime prevention initiatives (Plüddemann et al., 2010; Parry et al., 2004). In a policy statement released by the American Academy of Paediatrics on the health care needs for youth in the juvenile justice system, the authors linked trends in adolescent crime to poverty, educational failure, low SES and lack of family structure such as single parent households and lack of residential stability (Committee on Adolescence, 2011). Hoeve et al., (2012) also reported that there is a link between delinquent behaviour during adolescence and a loss of attachment to parents.

Many studies support the cumulative risks theory applied in the longitudinal survey of Dutch adolescents referred to as the tracking individuals lives (TRIAL) research. This research set out to investigate both protective and cumulative risks for becoming a juvenile delinquent. These risks included personal temperament, family constructs (child's perception of their parents and methods of child rearing) and well-being at school (academic performance and behaviours toward teacher and classmates) to determine cumulative risk of becoming a delinquent (Benjet et al., 2010; van der Laan et al., 2010). Risk taking behaviour and substance abuse may be predictive of the future participation in delinquent behaviour and subsequent incarceration (Carney et al., 2013; Flisher et al., 2006; Parry et al., 2004).

2.9 Correctional services in South Africa

2.9.1 Incarceration statistics

The majority of correctional facilities in South Africa are public, with a few private facilities across the country (Luyt & du Preez, 2013). There are 243 correctional facilities listed that are under the auspices of the Department of Correctional Services (DCS), but only 236 of these were operational at the time of the research. At that point in time, nine of these centres were for women only, 14 centres for juveniles (18 to 21-year-olds) and 129 centres were for men only, and the rest of the centres housed males, females and juveniles in separate facilities in a centre. In 2014/2015 DCS established 15 remand detention facilities that were used solely for the incarceration of inmates who were on remand awaiting trail (DCS, 2015).

According to the web site of the International Centre for Prison Studies (ICPS), South Africa has the 10th highest incarcerated population in the world (ICPS, 2014). The average annual inmate population in South Africa for 2014/2015 was 157 141, which accounts for 0.3% of the total South African population (DCS, 2015; Statistics SA, 2012). At the time of this study, the Judicial Inspectorate for Correctional Services Annual Report (JICSAR) indicated that 36% of the incarcerated population in South Africa comprised of remand detainees (un-sentenced), of whom 43% were juveniles (inmates between 18 to 21 years of age). The juvenile population of remand detainees consists of 98% males and only 2% females (DCS, 2013). Statistics indicate that the number of incarcerated females of all ages in South Africa has increased by 8% since 2010 (DCS, 2015). However, the proportion of female detainees is still at the lower end of the estimated range of 2-9% for incarcerated females in other countries across the world.

Twenty percent of the total number South African inmates are incarcerated in Western Cape correctional facilities. The proportion of un-sentenced male inmates in the province is 8% higher than in the rest of the country, while the female population is similar to the national proportion at 4% (DCS, 2015).

2.9.2 Health services in correctional facilities

The WHO developed a guide for provision of essential health services in correctional facilities stating that health care in correctional institutions is not fully recognised as being part of public health service delivery (Møller et al., 2007). Møller et al. (2007) emphasize that good health care within correctional facilities may contribute to the health of the community by helping those who are usually the most disadvantaged people in society.

International and national laws determine that all inmates have the right to the same medical treatment as those who are not incarcerated (Møller et al., 2007). This is also mentioned in Section 35(2)(e) of the South African Constitution that makes provision for the conditions under which inmates are to be detained, namely: "every prisoner who is detained, including every sentenced prisoner, has a right to conditions of detention that are consistent with human dignity, including at least exercise and the provision, at state expense, of adequate accommodation, nutrition, reading material and medical treatment" (Constitution of the Republic of South Africa, Act 108 of 1996, 1996). The DCS website further states that "Health Care Services in Correctional Centres promote the health of inmates and awaiting trial detainees, identify inmates with health problems, assess their needs and deliver treatment or refer to specialist services as appropriate. It also continues any care that has been started in the community contributing to a seamless service and facilitates after care on release. The majority of the health care services and programs in Correctional Centres are of a primary care nature. However, healthcare delivery in Correctional Centres faces a significant number of challenges not experienced by primary care in the wider community. All inmates are entitled to health care at State expense except for treatment for cosmetic purposes. An inmate may be granted permission to be treated by his or her private medical practitioner or dentist at own cost and risk" (DCS, 2014a).

Many researchers state that correctional facilities provide a platform for the diagnosis and treatment of a number of health conditions, including mental illness, substance abuse,

infectious diseases, undernutrition and NCDs such as diabetes and hypertension, contributing to public health initiatives in the process (Rijo et al., 2016; Dumont et al., 2012; Fazel & Seewald, 2012; Committee on Adolescence, 2011; Fazel & Baillargeon, 2011; Møller et al., 2007). These researchers also recommend the need for more research on the health of inmates in low-to-middle income countries such as South Africa.

Providing health care in correctional facilities is not without its challenges. Research in correctional facilities in Mexico identified a lack of medical personnel, shortage of medications and overcrowding of facilities as serious challenges of health care delivery to the inmates (Silverman-Retana et al., 2015). According to Møller et al. (2007) difficulties in recruiting professionals to work in correctional facilities may contribute to staff shortages. Inequalities in the standard of living among inmates in Zambian correctional facilities were reported by Topp et al. (2016). Topp et al. (2016) mention that coercion is used between inmates and officers to ensure basic necessities for certain inmates, including adequate nutrition and access to health care. Strategies recommended by Topp et al. (2016) to alleviate the unfair treatment of some inmates were to increase human resources within the health services offered in correctional facilities and improve the quality of health services (Topp et al., 2016).

South Africa correctional facilities have also been reported to be plagued by overcrowding, with the Minister of Correctional Services being cited in the Sunday weekly news, City Press, in 2012 that South African correctional facilities were 25% over capacity at the time (City press, 2012). This fact was recently highlighted again in news coverage of a United Nations human rights committee report on the criminal justice system in South Africa (Civil Society Prison Reform Initiative, 2016) and in the public service commission report on service delivery by the DCS. The latter report indicated that there was 65% overcrowding in Pollsmoor medium A (juvenile males) and 126% overcrowding in the female centre (Public service commission, 2016). One of the measures recently put in place by the DCS to address this matter has been to move sentenced inmates to correctional facilities that are further out of the city to make way for remand detainees within the correctional facility in the metropole close to the courts (Petersen, 2017).

From qualitative research done by Sifunda et al. (2006) on the health care services in correctional facilities in Kwa-Zulu Natal, South Africa, it was evident that inmates experienced difficulties in accessing health services due to the complex processes and procedures that are

inherent to the security aspects of a correctional facility. The facility staff complained that inmates feign illnesses to benefit from the inter-facility movement that provides opportunities for smuggling of various prohibited items (Sifunda et al., 2006). It is interesting to note that participants in this research mentioned that treatment they received in the correctional facility for conditions such as tuberculosis was better than care they would have received at community health care level. Inmates were thus positive about the health care they received even though the health care personnel themselves felt that they were understaffed (Sifunda et al., 2006). These results point to the possibility that health care provided in correctional facilities in South Africa is at least at the level of that provided in primary and secondary health care facilities in the country, if not better.

Information on the health care of juveniles is sparse. Research conducted in the USA on health care provided in juvenile detention centres identified key needs specific to juveniles (Perry and Morris, 2014). These authors indicated that juveniles are at increased risk of experiencing negative health outcomes as a result of life stage linked factors that characterize juveniles even prior to incarceration. These factors include low SES, increased risk taking behaviour and psychological instability (Perry & Morris, 2014). Perry and Morris (2014) argue that, as is the case for adults, detention centres offer a unique opportunity to assist juveniles with health problems. They also point out that the community should be made aware of juveniles who have a history of incarceration to assist them with reintegration into society and meet their health needs when released (Perry & Morris, 2014).

2.9.3 Food service delivery in correctional facilities

Overview

The nutritional status of inmates during their time in a correctional facility largely depends on the adequacy of dietary intake, and thus on the amount and quality of food served in the facility. There is a paucity of research on food service delivery in correctional facilities. One study that could be traced compared food service delivery between state hospitals and correctional facilities in England (Johns et al., 2013). Results of the work by Johns et al. (2013) show that inmates were served and consumed greater quantities of food than hospital patients. Johns et al. (2013) further found that hospital patients received their food in a much more deteriorated state, although the food produced at both facilities looked the same when it left the food service unit (FSU). It emerged from observation of the food service delivery processes in both units that the process was better managed in correctional facilities and that

food reached inmates without interruption by medical staff, as was the case in the hospital. Lack of communication and management of smooth food delivery from the FSU to the patient was identified as key problems, with the health status of the patient only affecting food intake minimally (Johns et al., 2013).

The South African Department of Correctional Services (DCS) state the following on their website regarding nutrition of inmates: "The Correctional Services Act 111 of 1998 also prescribes how the provisioning of meals should be managed in the Department. Nutrition, personal and environmental hygiene services are managed as prescribed by international and national legislations, policies, norms and standards." The website continues with the following: "All Inmates and awaiting trial detainees are entitled to three nutritious meals per day including children and babies with their incarcerated mothers. Offenders are also provided with therapeutic diets that are prescribed by a medical doctor based on health reasons. Religious and cultural diets are also provided to those offenders whom eating of certain food items are prohibited by their respective religion or cultures" (DCS, 2014a).

The commitment of the DCS to providing optimal nutrition to inmates is evident from the fact that they developed a ration scale and cycle menu to be used for incarcerated adults, juveniles (18-21 years), young children (2-5 years), babies (0-2 years) and pregnant or breastfeeding females in collaboration with dietitians from the Department of Health (DCS & DoH, 2003). This document also includes a detailed description of all possible therapeutic diets that may be prescribed for various health conditions and considers dietary requirements specified for religious purposes e.g. Halaal and Kosher options and the dietary specifications of Rastafarians (DCS & DoH, 2003). DCS indicate that therapeutic diets should only constitute 10% of the meals served to inmates (DCS, 2015). The rationale for this target has not been published.

Psychological aspects related to eating and food service delivery in correctional facilities

An interesting aspect of the literature on the food served in correctional facilities is that food brings with it the most profound feelings of not being in control and not having a choice in what you eat and when you eat it (Smoyer & Blankenship, 2014; Pete & Crocker, 2011). The psychological aspects of not being in control of the simplest things in life are a daunting reality of incarceration for most people.

The psychological aspect of not having the freedom to choose your food or have it available at all times seems to be detrimental to the psyche of inmates (Smoyer & Blankenship, 2014).

Researchers also indicate that because food is a controlled substance in correctional facilities it perpetuates the practise of using illegal or unwanted processes to gain what is desired, thus inmates who have become used to barter for/deal in illicit substances now barter for /deal in food for gain (Smoyer & Blankenship, 2014). This behaviour is a continuation of the long-standing cycle of theft that characterised the lives of many inmates before incarceration and is then replaced by "skarreling"[1] and bartering within the correctional facility (Smoyer & Blankenship, 2014).

Another psychological factor that may play a role is the environment in which one eats (Smoyer & Blankenship, 2014). From observations by the researcher at Pollsmoor correctional facility, it was evident that dining areas were not available and inmates ate their food in their rooms/ cells and were fortunate if they had a spoon to eat with. According to USA foodservice cafeteria planning guidelines there should be dining areas with seating for maximum 125 people per unit, allocating 1.7 m² per seat (Payne-Palacio & Theis, 2016). There are various security concerns surrounding the dining areas of inmates which should be incorporated into the planning of correctional facility dining areas (Payne-Palacio & Theis, 2016). It is speculated that Pollsmoor correctional facility is not the exception when it comes to the availability of appropriate dining areas.

Formal catering in correctional facilities

Research done in a correctional facility in Papua New Guinea that involved adult males 18 years and older (n=148) who had been incarcerated for a mean number of years of 24 months found that the daily rations consisted of water-crackers and black tea for breakfast, white rice topped with tinned corned beef or tuna for both lunch and supper (Gould et al., 2013). Gould et al. (2013) found that 66% percent of inmates reported having vegetables rarely or never and 91% reported having vegetables less than once a week. However, it needs to be noted that inmates underestimated the amount of protein food served by one third, while estimates of the starch portions served was accurate (Gould et al., 2013).

The only further study that reported on food service delivery in correctional facilities that could be traced involved two Mexican correctional facilities. The proportions of inmates who

[1]The word "skarrel" is an Afrikaans word that is used in Pollsmoor to describe anyone that is trying to barter with food or anything contraband.

reported daily intake of fruit and vegetable ranged from 15 to 25% (Silverman-Retana et al., 2015). This research paper did not specify whether fruit and vegetables were served on a daily basis or not. It could thus be argued that fruit and vegetables are served in these facilities on a daily basis, but that many inmates may be choosing not to eat them. Alternatively, some inmates may be accessing fruits and vegetables through alternative sources and bartering, making it possible for them to eat these foods on a daily basis.

As no information on food service delivery in South African correctional facilities has been published, observational perspectives of the researcher on food service delivery in Pollsmoor, where she held a position in the foodservice units for two years, are outlined below.

The formal catering system at Pollsmoor correctional facility comprises of three large scale foodservice units. All three of these units use the conventional foodservice system i.e. food is cooked from raw products/ingredients and served to inmates ideally using a combination of cafeteria style serving for those eating a normal diet and tray service for those who eat therapeutic or religion specific diets. However, as mentioned above, all inmates in Pollsmoor eat in their cells.

The meals are made up of a warm porridge in the morning; a warm lunch including either chicken, fish, beef or an egg as a protein, “samp” or maize-meal as a starch and two vegetables; and a cold supper containing bread with jam or peanut butter and margarine (see Appendix 2.2 for the cycle menu and ration scale). One of the most important differences between the adult and juvenile ration scales is that juveniles receive a fruit every day and an extra 65g of bread (DCS & DoH, 2003).

To provide more insights in the potential adequacy of energy and nutrient provision to inmates in correctional facilities under the auspices of DCS, a menu that is based on the ration scale of one day of a normal diet for 18-21 year old juvenile males was analysed (Appendix 2.2) using the MRC Food-Finder Software (Medical, 2016).

Adequacy was expressed in terms of percentage of the USA EAR (Estimated Average Requirement) or AI (Adequate Intake) if an EAR was not available (Ross et al., 2011; Trumbo et al., 2002; Trumbo et al., 2001). As the South African DCS ration scale is based on the nutritional needs of males it implies that females would receive the same amount of food as males.

Therefore, the adequacy of the example menu was expressed using the male EAR values, with the exception of iron, which is the only micro-nutrient for which the EAR is higher for females than males. The results of this analysis and comparison with reference values are presented in Table 5 (energy and macronutrients) and Table 6 (micronutrients).

In summary, the total energy content of the one day menu is in line with the estimated energy requirement (EER) for healthy active 19-30-year-old males. Protein and carbohydrate content is above the EAR and the macro-nutrient contribution to total energy intake of protein and fat is in line with dietary goals for healthy eating. However, the carbohydrate contribution to total energy intake is slightly higher than the healthy eating guidelines (Trumbo et al., 2002).

Sugar content may be too high as it is above the goal of 10% of total energy intake (WHO, 2009). The percentage contribution of saturated fats, mono-unsaturated fats (MUFA) and poly-unsaturated fat (PUFA) is in line with the healthy guidelines (Trumbo et al., 2002).The micronutrient content of the menu was above the EAR or AI for most of the micronutrients; the exceptions being calcium, vitamin C, vitamin B5 and B12 (Trumbo et al., 2001).

The low calcium content in the menu may be a concern, as the milk rations remain the same every day as per the ration scale (Table 6). Although the particular one day menu that was analysed did not provide sufficient vitamin C, pantothenic acid or vitamin B12, the variation of menu items on other days of the week may contribute to the sufficient intake of these nutrients. For example, inclusion of red meat, eggs or green leafy vegetables on the menu would increase pantothenic acid and B12, while having a citrus fruit or fruit juice would increase the vitamin C content.

Research in correctional facilities in the USA also found that calcium intake from dairy was below the RDA or AI recommendations for adult males, indicating that development of ration scales for the use of correctional facilities should be done with input from nutrition professionals such as dietitians (Cook et al., 2015). The USA research and research conducted in sub-Saharan Africa and other countries generally point to the fact that fruit and vegetable intake seems to be low in correctional facilities (Cook et al., 2015; Silverman-Retana et al., 2015; Gould et al., 2013).

The information gained from the analysis of an example menu based on the DCS ration scale (DCS 2003) shows that the food served to juveniles has the potential to meet the majority of the nutritional needs of incarcerated juveniles. The nutrition status of those who are well nourished at admission will thus be maintained and the nutritional status of those who are undernourished at admission should improve. The exception is calcium and this aspect in the ration scale may need attention to contribute to long term bone health. However, if the juveniles do not receive the fruit every day or extra ration of bread as specified by the DCS (2003) ration scale, the macro and micro-nutrient intakes may not be adequate for some nutrients.

*Table 5: Energy and macro-nutrient content of a one day menu based on the DCS ration scale for juvenile males** (Medical, 2016; DCS & DoH, 2003).*

Dietary component	***Composition of Ration scale based on Foodfinder analysis[1]***	***EAR OR AI of males (19-30 years old)[2]***	***% EAR OR Comment***
Energy (kJ)[3]	*13049*	*12797 to 12881 (active individuals)[4]*	*101%*
Protein (g)[5]	*85*	*50.2g[5]*	*421%*
% total energy[6]	*11%*	*10-35%*	*Falls within guideline*
Total fat (g)[7]	*93*	*	*NA*
% of total energy	*26.3*	*20-35%*	*Falls within guideline*
Saturated fatty acids (g) % total energy	*21.2* *6.02%*	* <10%*	*Falls within guideline*
MUFA (g) ***% total energy***	*35.6g* *10.1%*	* ≥10%*	*Falls within guideline*
PUFA (g) ***% total energy***	*27.7g* *7.9%*	* ≤10%*	*Falls within guideline*
Cholesterol (mg)	*383*	*	*
Total trans FA (g)	*0*	*	*
Carbohydrate (g)[8]	*455*	*100*	*Achieves EAR*
% total energy	*66.3*	*45-65*	*Higher than guideline*
Total sugar (g)	*94*	*NA*	*NA*
% total energy	*13%*	*4-10[9]*	*Higher than guideline*
Dietary fibre (g)	*54*	*38*	*Higher than guideline*

NA= Not applicable

[1] (Medical, 2016)

[2] (Trumbo et al., 2002)

[3] DRI for energy for healthy active individuals (Trumbo et al., 2002)

*[4] Subtract 10 kcal for each year above age 19. Maximum age for this sample was 21 the calculation then was 12881kJ - (10kcal*4.2 = 42kJ*2years) = 12797kJ*

*[5] Acceptable macronutrient distribution range (AMDR) for protein is set at 10-35% of energy (Trumbo et al., 2002). Calculation: 0.66g/kg/day = 76kg x 0.66g =**50.2g***

[6] (National Center for Health Statistics (US), 1994)

[7] (Trumbo et al., 2002)

[8] (Trumbo et al., 2002)

[9] (WHO, 2009)

**Not determined*

*** Due to the fact that females receive the same amount of food as males, the total macro-and micro-nutrient intake may exceed the nutrient needs of females. Iron is the only micro-nutrient for which the*

EAR for females is higher than the EAR for males. The Foodfinder results indicate that the iron content of the menu does potentially provide the iron EAR of females.

Table 6: Micro-nutrient content of a one day menu based on the DCS ration scale for juvenile males (Medical, 2016; DCS & DoH, 2003)*

Minerals	***Composition of Ration scale based on Foodfinder analysis[1]***	***EAR OR AI of males (19-30 years old)[2]***	***% EAR or AI***
Ca (mg)	*509*	*1000*	***51***
Fe (mg)	*28*	*6(m); 8(f)*	*467;350*
Mg (mg)	*427*	*330*	*129*
Zn (mg)	*27*	*9.4*	*287*
Vit A (RE) µg	*3552*	*625*	*568*
(B1) Thiamine (mg)	*3.8*	*1.0*	*380*
(B2) Riboflavin (mg)	*2.1*	*1.1*	*191*
(B3) Niacin (mg)	*48.0*	*12*	*400*
(B6) Pyridoxine (mg)	*11.0*	*1.1*	*1100*
(B9) Folic acid (µg)	*1023*	*320*	***320***
(B12) Cobalamine (µg)	*1.9*	*2.0*	***95***
(B5) Pantothenate (mg)	*4.5*	*5.0*	***90***
(B7) Biotin (µg)	*58.2*	*30*	*194*
Vit C (mg)	*53*	*75*	***71***
Vit D (µg) [3]	*14.4*	*5*	*288*
Vit E (mg)	*14.0*	*12*	*117*
Vit K (µg) [4]	*216.0*	*120*	*180*

M=Male; F= female

[1] (Medical, 2016)

[2] (Ross et al., 2011; Trumbo et al., 2001)

[3] Most of our Vit D is produced by the skin when exposed to sunlight (Wardlaw & Hampl, 1999)

[4] Ten to 50% of Vit K is also produced by bacteria in the gut (Guarner & Malagelada, 2003; Wardlaw & Hampl, 1999)

** Due to the fact that females receive the same amount of food as males, the total macro-and micro-nutrient intake may exceed the nutrient needs of females. Iron is the only micro-nutrient for which the EAR for females is higher than the EAR for males. The Foodfinder results indicate that the iron content of the menu does potentially provide the iron EAR of females.*

Informal food delivery structures in Pollsmoor

Food provided by visitors

Remand detainees in Pollsmoor are permitted to receive food brought to the correctional facility by their visitors and these foods may include cooked meals in ice-cream tubs or crisps and cool drinks. However, personal communication with DCS staff highlighted that remand detainees do not typically receive food from outside. Gould et al. (2013) reported that inmates in a Papua New Guinea corrections facility were also allowed to receive food from visitors. However, the food had to be consumed in the waiting area before the inmate returned to his/her holding cell. They further did not allow inmates to share food received from visitors with other inmates (Gould et al., 2013).

Gould et al. (2013) reported that foods received from visitors increased the intake of various micro-nutrients that were lacking in the diet of inmates substantially. Data from a 24-hour recall administered on 148 inmates indicated that the additional foods resulted in an increased the proportion of those who met the EAR for particular nutrients with 35% for vitamin A, 11% for riboflavin, 10% for folate, 49% for vitamin C and 10% for potassium (Gould et al., 2013).

Food from tuck-shops in the correctional facility

Each of the juvenile male and female facilities at Pollsmoor has a tuck shop for the use of inmates. These tuck shops open only once a month and are accessible to remand detainees who receive money from their families. A maximum amount of R200 may be spent per month on purchases from the tuckshops (personal communication with DCS staff). Items stocked by the tuckshops include non-perishable items such as biscuits, chips, sweets, mayonnaise, tomato sauce and some canned products such as baked beans. Due to the high energy LND nature of most of the foods provided by the tuck-shop the perpetuation of unhealthy eating may be a point of concern. Food items that are nutrient dense, low in fat and non-perishable e.g. dried fruit, 100% fruit juice and low-fat milk in tetra packs, tinned vegetables such as corn, peas, tomato and onion mix, would be more appropriate options to sell at the tuck-shops for.

Within this context, it is interesting to note that research in correctional facilities in the USA that have tuck-shops found that foods items purchased by inmates at the tuckshops made a considerable contribution to total energy and nutrient intake of the inmates (Hannan-Jones & Capra, 2016).

Trading of food inside the prison

In any correctional facility where the use of money is restricted or forbidden, food becomes an important commodity used for bartering (Smoyer & Blankenship, 2014). Research conducted by Smoyer and Blankenship (2014) found that female inmates kept left-over food in their cells for later use in an attempt to normalise the environment they find themselves in. This is especially true if the foods served are prepacked and easy to remove from the dining hall. Smoyer and Blankenship (2014) state that this behaviour may contribute to achieving a sense of control over when one eats, or makes it possible to use the food as a bartering tool to exchange for other items. Keeping leftover food would be difficult in Pollsmoor as food is served as a cooked meal on plates, however slices of bread and spread may be eaten at intervals that suit them.

Concluding perspectives

The right to food to ensure optimal nutritional status is entrenched in the South African Bill of Human Rights, irrespective of whether you are incarcerated (sentenced and un-sentenced) or not (Constitution of the Republic of South Africa, Act 108 of 1996). Well planned and managed food service delivery is key to meeting this right of inmates.

Appropriate interpretation and implementation of the ration scale using nutrient rich, healthy foods is core to this process. Although the analysis of the example menu based on the ration scale showed that it potentially meets all the nutritional requirements of male and female juveniles, with the exception of calcium, it needs to be borne in mind that inmates with special needs including those with diseases such as HIV/Aids, TB, cancer, diabetes and hypertension, as well as pregnant and lactating females need to receive special consideration in terms of providing addition energy and nutrients or therapeutic diets as prescribed by the medical health professional in the correctional facility.

Inmates should also take responsibility for healthy food choices within the context of types of foods available in the facility, including food served, food brought by visitors and items available at the tuck-shop. The value of nutrition education in the correctional context was illustrated in a small pilot study (n=19) where a nutrition education intervention significantly improved the nutrition practices of inmates when compared to a control group, indicating that nutrition education may be a feasible option for improving food choices in correctional settings (Curd et al., 2013).

2.10 Juveniles within correctional service facilities

2.10.1 Smoking, alcohol use and use of illicit substances by juveniles

Information on smoking, alcohol and illicit drug use for incarcerated juveniles is sparse. Some insights in this regard may be gained from information on the use of the substances by adults. It is important to bear in mind that information on substance use by inmates reported in most research is collected on admission to the correctional facility and pertains to the period prior to incarceration. A review by Fazel et al. (2006) on substance abuse by adult inmates at entry to correctional facilities showed that the prevalence for alcohol abuse ranged from 18-30% for males and 10-24% for females. The prevalence for drug abuse ranged from 10-48% for males and 30-60% for females (Fazel et al., 2006). These results indicate that male and female inmates had a similar prevalence of alcohol abuse, but that female inmates had a much higher prevalence of drug abuse than male inmates. It emerged from research by Gould et al. (2013) in a correctional facility in Papua New Guinea that 71% of inmates in the facility reported that they currently smoked while being incarcerated although smoking was against the rules. Alcohol intake was, however, decreased from 79% before incarceration to 13% during incarceration.

Research in the USA on 39 juvenile correctional facilities indicated that more than 80% juveniles had smoked before entry and that 87% had tried smoking tobacco in their lifetime (Morris et al., 1995). The report of the American academy of paediatrics (AAP) on the intake of alcohol and illicit substances in the juvenile detention population in the USA indicates that adolescents in detention have a much higher prior prevalence of substance abuse than the average adolescent population (Committee on Adolescence, 2011). According to the AAP the use of alcohol is 18% higher and the use of illicit substances 45% higher in juveniles at entry into a correctional facility when compared to the same age group in the general population (Committee on Adolescence, 2011).

If these statistics are extrapolated to adolescents in the Western Cape using the 2010 drug and alcohol use statistics for this group, it could be expected that up to 25% of adolescents in custody at Pollsmoor may be struggling with alcohol addiction and at least 57% have used or are using illicit substances prior to entering the correctional facility (Plüddemann et al., 2010; Plüddermann, Parry & Bhana, 2007).

2.10.2 Nutritional status of incarcerated juveniles

There is a paucity of information on the nutritional status of incarcerated populations in general and specifically of South African juveniles at both admission to correctional facilities, and during their time in the facility. For this reason reference is made to research done on adults where there is no information available for juveniles.

Globally here seems to be a trend for inmates to have a higher prevalence of being underweight, with a lower prevalence of being overweight (BMI>25) than the general population. Research conducted in a correctional facility in Papua New Guinea on adult males who had on average been incarcerated for 24 months, found that 5% of inmates were underweight and 15% overweight (Gould et al., 2013). Thirty percent of adult males (n=146) in an Ethiopian correctional facility were found to be underweight (BMI <18.5kg/m^2) (Fuge & Ayanto, 2016). Silverman-Retana et al. (2015) reported that the obesity prevalence in Mexican correctional facilities was 9.5%, which was lower than the prevalence in the general population.

Dietary intake assessment of the adult male inmates who participated in the Gould et al. (2013) study in Papua New Guinea (using a single 24-hour recall showed that less than 25% of the inmates achieved the EAR for vitamin A, folate, vitamin C, vitamin E, potassium and calcium after being incarcerated for 24 months (Gould et al., 2013). The dietary intake indicators that there may be risk of deficiency of particular nutrients was confirmed with biochemical assessments. Gould et al. (2013) found that more than half of the inmates had biomarker concentrations that were below the recommended cut-offs for retinal, vitamin C and zinc. Almost all of the inmates had plasma folate levels in the deficient range while one third had deficient red blood cell (RBC) folate levels (Gould et al., 2013). Low plasma and RBC folate levels were associated with the length of stay in the facility, with folate status deteriorating as duration of incarceration increased (Gould et al., 2013). Gould et al. 2013 recommended that the diet of inmates should be improved by including more fruit, vegetables and milk powder in the menus served in correctional facilities in Papua New Guinea.

Research on the vitamin D status of inmates in long and short term incarceration in the USA showed that inmates who were incarcerated for longer than a year had 18.7 greater odds of having deficient vitamin D levels (Jacobs & Mullany, 2015). Vitamin D is found in some fortified

foods but sun exposure and the resulting endogenous synthesis of vitamin D is the main source of the vitamin.

No information on the nutritional status of inmates in South Africa could be traced. The only mention of food in relation to correctional facilities in South Africa was made by Sifunda et al. (2006) with respect to the segregation it may cause when an inmate with HIV/Aids is given a high fruit diet or "HIV diet", with this also promoting the use of the "extra" food to barter with.

2.10.3 Non-communicable diseases in juveniles

There is a paucity of information on NCDs in incarcerated populations in general and specifically in South African juveniles. For this reason reference is made to research done on adults where there is no information available for juveniles to provide some insights in the NCD patterns during incarceration.

Non-communicable diseases (NCD) include coronary vascular disease (CVD), cancer, chronic respiratory disease and diabetes (Mendis, 2014). A combination of modifiable risk factors contributes to the likelihood of developing intermediary risk factors for NCDs. The combination of modifiable risk factors including unhealthy diet, physical inactivity, smoking and excessive alcohol intake that takes place during the juvenile's younger years, in combination with the non-modifiable risk factors including age, genetics, gender and race contributes to the development of intermediary risk factors such as obesity, hypertension, hyperglycaemia and hypercholesterolemia and ultimately one or more NCDs during adulthood (Manning et al., 2016).

In a review on, the health of prisoners around the world, the age adjusted prevalence of hypertension was reported to be 30% and diabetes 10% (Fazel & Baillargeon, 2011). Mexican correctional facilities reported a prevalence of 2.5% for hypertension and 1.8% for diabetes in inmates, which is much lower than the averages reported in the review paper by Fazel and Baillargeon (2011) and probably more in line with that of lower-income countries, including South Africa (Bautista-Arredondo et al., 2015). Silverman-Retana et al. (2015) further reported that they found an association between length of incarceration and risk factors for NCDs in inmates incarcerated in Mexican facilities. Results show that BMI and waist circumference measures followed a U-shaped curve as length of stay increased, indicating that inmates lost

weight during the initial period of incarceration, after which they started gaining weight. Blood pressure increased linearly as length of stay increased (Silverman-Retana et al., 2015).

Silverman-Retana et al. (2015) point out that food served to inmates may increase their risk of NCDs since final preparation and distribution of food may be the responsibility of the inmates themselves in some instances, in which case neither salt addition nor standard portion sizes can be regulated. Furthermore, food provided by visitors may also contribute to excessive energy intake and increased risk of obesity. It is also possible that those who need special diets for management of intermediate risk factors of NCDs may not be receiving the special diet, contributing to the risk of NCD development (Silverman-Retana et al., 2015).

When considering the lifetime model of the development of disease (section 2.2.1), specifically NCDs, one would not expect to find a high prevalence of the mentioned intermediate risk factors or diagnosed disease in juvenile populations. However, poor dietary intake, physical inactivity, smoking and excessive alcohol use seem to characterise young adults admitted to correctional facilities. Addressing modifiable risk factors during incarceration may contribute to decreasing the risk of juveniles to development these conditions later in life.

2.10.4 Infectious diseases in juveniles

International data shows that the prevalence of both HIV/AIDS, tuberculosis (TB) and hepatitis B and C are higher among incarcerated populations than in the general population, with incarcerated females having a higher prevalence of HIV infection than incarcerated males (Fazel & Baillargeon, 2011). The profile of infectious disease in females may be linked to a global increase in female sex workers and accordingly, an increase in the number of females being imprisoned (Strathdee et al., 2015). Research also indicates that sex workers have a higher prevalence of illicit substance use, which in turn increases the risk of HIV infection (Strathdee et al., 2015).

A report compiled by the Desmond Tutu HIV foundation indicates that the prevalence of HIV in South African adults in correctional facilities was higher between 2006-2010 at 20-23% than the prevalence in general population of 16% for the same time period (Davies & Karstaedt, 2012; Scheibe et al., 2011). Although not representative of the South African inmate population, a study on inmates in Durban in 2012 found that 43% of inmates under 25 years of age tested positive for HIV, while South African prevalence for the same age category was only

28% (Gow et al., 2012). It is clear from these statistics that juveniles may have a higher prevalence of HIV than adult populations.

The prevalence of hepatitis C was found to be between 23-34% in correctional facilities in the USA (Macalino et al., 2004), while the prevalence of hepatitis B in low-income countries was similar to hepatitis C in the USA, with 25% of inmates in Ghana, 23% in Nigeria and 17% in Brazil being diagnosed with hepatitis B (Fazel & Baillargeon, 2011). A systematic review of research conducted in incarcerated populations in the middle-eastern and North African countries on the prevalence of HIV and hepatitis C infections showed that the prevalence of both HIV and hepatitis C was lower than the statistics for the countries mentioned above (Heijnen et al., 2016). These statistics were reported for the total population of inmates in a particular setting and not by age category – it is speculated that the prevalence in juveniles will be in line with that reported for the total incarcerated populations. Risk factors identified for hepatitis B and C are rife in adolescents and juveniles and include injectable drugs and unprotected sexual activity (Macalino et al., 2004), tattooing while incarcerated and the use of non-sterile razors (Heijnen et al., 2016).

The risk for contracting TB is much higher in low- socio economic areas where people live in close courters, those who live under poor hygiene conditions and people who are underweight (Fuge & Ayanto, 2016; Wood et al., 2010). Smoking and being HIV positive were also found to be associated with a positive TB diagnosis (Telisinghe et al., 2014). Fuge and Ayanto (2016) reported that the prevalence of TB of adult males in a correctional facility in Ethiopia was three times higher than the national prevalence. No South African data on recent TB prevalence in incarcerated populations could be found, however, it is of note that research in a 16-20-year-old population living in townships in the Western Cape showed a 66% prevalence of TB (Wood et al., 2010), while the WHO report estimated that the prevalence of TB in the country was 454000 in 2016, with a 78% treatment success rate in 2014 (WHO, 2016).

Although statistics are not available for all the common infectious diseases for juveniles, it is evident that they may be at increased risk for having these conditions at the time of incarceration Researchers therefore indicate that the time spent in corrections should be used to treat and support both males and females who enter the facilities with any of these diseases (Strathdee et al., 2015).

2.10.5 Mental health of juveniles

In a systematic review and meta-analysis done by Fazel and Seewald (2012) on the prevalence of mental illness in 33 588 inmates from high-income and low-to-middle income countries it was found that one in seven adult inmates suffered from mental illness. Interestingly, the prevalence of both major depression and psychosis was significantly higher in the low-to-middle income countries than higher income countries (Fazel & Seewald, 2012). The prevalence of psychosis in adult male and female inmates in low-to-middle income countries was 5.5% versus 3.5% in high income countries and the prevalence of major depression 22.5% in low-to-middle income versus 10% in high-income countries (Fazel & Seewald, 2012).

Fazel and Seewald (2012) did not find a significant difference in mental illness prevalence between male and female inmates or between remand and sentenced inmates. This indicates that results of research relating to the prevalence of mental illnesses of sentenced inmates may be extrapolated to remand detainees and that psychological status of males may reflect that of females (Fazel & Seewald, 2012). These researchers emphasize that there is a need for more research on the prevalence of mental illness in inmate populations in low-to-middle income countries (Fazel & Seewald, 2012).

Seventy-nine percent of juveniles in detention facilities in Portugal were reported to have disruptive disorder (attention deficit/hyperactivity disorder, oppositional/defiant disorder, and conduct disorder), 39% had substance-related disorders [alcohol dependence/abuse, and substance (non-alcohol) dependence/abuse], 14% had anxiety disorders (panic disorder, agoraphobia, separation anxiety disorder, social phobia, specific phobia, obsessive–compulsive disorder, and post-traumatic stress disorder), while 11% had mood disorders (major depression disorder, major recurrent depression disorder, and bipolar disorders) (Rijo et al., 2016).

Fazel and Baillargeon (2011) report that the prevalence of psychosis and conduct disorders among 10-19-year olds in custody was ten times higher than age matched adolescents in the general community. The prevalence of depression and attention deficit hyperactivity disorder was twice as high in 10-19- year old juveniles in custody, while the prevalence of depression in female juveniles was three times higher than the prevalence in male juveniles and adult females (Fazel & Baillargeon, 2011).

A study conducted in Ghana by Ibrahim et al. (2015) showed that 65.8% of adult male inmates exhibited high to very-high distress levels using the Kessler psychological distress score (K10). Research in Durban, South Africa, found that 55.4% of adult male inmates had an Axis 1 disorder, which includes substance disorders, while 23% had disorders of psychosis, bipolar, depression or anxiety disorders (Naidoo & Mkize, 2012). Naidoo and Mkize (2012) also reported that 46% of inmates were diagnosed with antisocial personality disorder. It is concerning that these researchers found that eight out of nine inmates had a psychotic disorder and that none of the inmates with major depressive disorders had been diagnosed. Naidoo and Mkize (2012) note that ethnicity impacts on the prevalence of suicide attempts in inmates as it was found to be much lower in the black African population than in the Caucasian population. Male versus female statistics were not reported due to the small sample of females (n=8) used in the study by Naidoo and Mkize (2012).

Research highlights the importance of early detection of mental illness in juvenile offenders, which is only possible if appropriate screening tools are implemented and at risk individuals are referred to professionals and standardised assessment procedures are used (Rijo et al., 2016). These procedures may lead to effective interventions and the support that incarcerated juveniles may need in terms of ensuring mental health (Rijo et al., 2016).

2.10.6 Pregnancy prevalence in incarcerated females

According to “the health of prisoners” review women represent 2-9% of the incarcerated population of the world and the proportion of incarcerated females is increasing steadily in many countries (Fazel & Baillargeon, 2011). The prevalence of pregnancy at entry into a correctional facility is 6%-7%, from 1994-2004 in the USA (Maruschak, 2004; Snell, 1994). Statistics on the number of pregnant inmates entering correctional facilities in South Africa could not be traced.

It is interesting to note that, a review of research conducted mostly in the USA indicates that pregnant female inmates have a lower prevalence of stillbirths and low birthweight babies compared to similarly disadvantaged control females, despite the lower quality of prenatal services they may be receiving in correctional facilities (Knight & Plugge, 2005). This could be due to protective factors that may be in place during incarceration including protection from abusive partners, proper shelter and nutrition and the lack of access to alcohol and illicit substances (Knight & Plugge, 2005). However, other studies showed that inmates in the USA

had a greater risk of poor perinatal outcomes than non-incarcerated women (Siefert & Pimlott, 2001). The latter possibility is confirmed by research done in Australia by Walker et al. (2014). These researchers found that pregnancy outcomes were not better in women who were pregnant at the time of incarceration than non-incarcerated women from the same socio-economic backgrounds (Walker et al., 2014).

It is clear that the prevalence and outcomes of pregnancy at incarceration is a very under researched area, especially in low-to -middle income countries (Fazel & Baillargeon, 2011). This is a major concern, especially in the light of the fact that the health and well-being of a young child is also at stake.

2.11 Concluding perspective

Adolescents, including late-adolescents are a nutritionally vulnerable population due to their increased nutritional needs during the growth spurt that they experience. At the same time adolescents are prone to risk taking behaviours such as smoking, alcohol and illicit substance use, risky sexual behaviours, eating disorders and sedentary behaviour as a result of a combination of the physiological changes that are taking place and a range of environmental factors taking place. These risk taking behaviours may contribute directly or indirectly to poor food choices and nutrient deficiencies. Evidence shows that malnutrition in the form of being underweight, overweight and micronutrient deficiencies is a reality in this age group.

Extrapolation of research results on adolescent groups in the general population and adult incarcerated populations indicates that juveniles in detention may be more vulnerable to malnutrition, especially underweight and micronutrient deficiencies, than the general population of the same age. Contributing factors may include increased risk of psychosis, conduct disorders and infectious disease, as well as risk taking behaviours. However, evidence on the actual nutritional status of juveniles is not available, not nationally nor internationally. It is thus not surprising that researchers recommend that more research is needed on the health and nutritional status of juvenile inmate populations, especially in low-to-middle income countries.

Despite the lack of hard evidence on juveniles, globally researchers have been recommending that public health initiatives should be implemented within correctional facilities to improve the health of vulnerable communities. Juszczak and Cooper (2002) specifically emphasize the

need for outreach programs for incarcerated and delinquent male adolescents, however, this should not preclude female inmates from such actions. Numerous researchers and organizations point out that the time an adolescent may spend in a correctional facility could be used to identify health concerns and address them appropriately (Rijo et al., 2016; Committee on Adolescence, 2011; Juszczak & Cooper, 2002). The time could also be used to teach life skills and improve the nutritional education of these adolescents (Curd et al., 2013). In a broader sense, researchers and the WHO state that the community as a whole would benefit if juveniles could receive this kind of support from correctional facilities (Møller et al., 2007).

Chapter 3: Methods

3.1 Study design

The study was a cross-sectional, comparative survey using a questionnaire and anthropometric measurements to describe and compare the nutrition related health status and associated factors in juvenile (18 to 21 year old) male and female remand detainees at entry into Pollsmoor correctional service facilities in the Western Cape.

The objectives stated for this research cover the following:

- To assess the nutrition related health status and associated factors of juvenile male and female remand detainees at entry into correctional facilities in the Western Cape:
- To compare all variables between juvenile male and female remand detainees.
- To determine predictors of BMI, cAMA and MHGS **within** the juvenile male and female remand detainee groups.
- To investigate associations between food choices and meal pattern, availability of healthy foods in the home, food security, risk taking behaviours, knowledge of healthy eating, psychological well-being and physical activity within juvenile male and female detainees.
- To compare the profile of predictors and associated factors **between** the juvenile male and female remand detainees descriptively.

3.2 Study population

3.2.1 Target population

The target population for this research was juvenile male and female remand detainees between the ages of 18 and 21 years at entry into a correctional service centre (Pollsmoor) in the Western Cape.

Seventy-nine percent of incarcerated South Africans, including adolescents, adults, males and females, are black African, which is in line with the proportion of black South Africans in the country (Statistics SA, 2012). The proportion of detainees of coloured in South Africa is 18% (Molebatsi & Lesoana, 2009), which is higher than their population proportion of 9% (Statistics SA, 2012). White and Indian detainees in South Africa account for 3.2% and 0.5% respectively (Molebatsi & Lesoana, 2009), which is lower than their population proportion of 9.6% and 2.5% respectively (Statistics SA, 2012). The Western Cape has a unique population profile in South Africa in that the majority (65%) of the population is of mixed ancestry (Coloured) and only 30% are black African (Statistics SA, 2012).

3.2.2 Sample size

Gaining access to incarcerated populations for research purposes is a major challenge as they are firstly a vulnerable group (see section on ethical considerations for more detail) and secondly, many processes need to be followed to finally be in the position to conduct a face-to-face interview with a volunteer. Therefore, a minimum sample of 50 per gender group was deemed to be feasible for this exploratory research bearing in mind the challenges with accessing subjects and collecting the data, while also providing much needed insights in the nutritional status of the target population. Power calculation for the comparison between genders for the final samples of 67 male and 52 female detainees was conducted using the OpenEpi, Version 2 power calculation option and the mean (SD) BMI for each gender (Table 21) showed a power of 100% with a 95% CI.

3.2.3 Inclusion and exclusion criteria

Juvenile male and female remand detainees who met the following criteria were eligible for participation in this research:

- Was between the ages of 18 to 21 (inclusive)
- Had been newly admitted to Pollsmoor correctional service centre in the Western Cape (presence in facility for less than 21 days).

- Had been found to be mentally fit and able to take part in this research by the appointed remand officer.
- Could understand and converse in English or Afrikaans.

Females who were pregnant at admission were not eligible for participation in this research.

3.2.4 Location of the research

The research was undertaken at Pollsmoor correctional facility as the majority of juvenile remand detainees in the Western Cape were processed primarily within this facility. Details on the centres within Pollsmoor facility from which juvenile detainees were recruited for this research are presented in Table 7.

Table 7: DCS facility management and population size

Area manager	***Head of the centre***	***Name of centre***	***Population***	***Males/ Females***
Mr. Mkabela	*Mrs. Lindiwe Jonas*	*Pollsmoor Female*	*375*	*Females*
	Mrs. Grace Molefe	*Pollsmoor Medium A*	**1111*	*Males*

http://www.dcs.gov.za/AboutUs/COE/centre/centreregion.aspx
**http://pmg-assets.s3-website-eu-west 1.amazonaws.com/docs/1999/minutes/991117correctWCape.htm (DCS; PMG)*

3.3 Recruitment

The recruitment procedure that was followed is as follows (the same procedure was followed at the male and female facilities):

1) The researcher in collaboration with the head of the centre decided on the best days for fieldwork visits, taking into consideration all aspects.
2) The researcher would go to each facility on the days and announce herself at the reception desk.
3) The DCS member on duty at the reception would contact the DCS members at the section who would accompany the researcher to the allocated section.
4) The DCS member in charge at the section would identify all recently admitted on-remand detainees to observe the description of the research being done and to decide whether they were interested in volunteering for the research. A maximum of four detainees were then randomly chosen from those who were willing volunteers.

5) Random selection of the number of detainees to be interviewed was done by using a short rhyme "Eeny, meeny, miny, moe" to ensure that the researcher did not offend volunteers by not selecting them.
6) The detainees who were randomly chosen were then asked to wait while each interview took place individually for the sake of confidentiality.

Box 3.1: Guideline on writing of documents for inmates

Researchers specify that the documentation given to the inmates or guardians should be considered carefully, ensuring the understanding of the wording and the recommendation is to check that the consent and assent forms are written for a reading level of between 3rd to 6th grade (Lane et al., 2012; Quina et al., 2007).

7) Each selected volunteer was then provided with an information sheet and a detailed explanation of the research was provided (Appendix 3.2: Participant information); see guidelines on writing of documentation for inmates in Box 3.1. The volunteer was given the opportunity to ask questions about what was written on the consent form before signing the consent form (Appendix 3.3: Informed Consent form).
8) Once the volunteer had signed the consent form, the assessments were completed in the allocated room. A warden from that facility was present for the duration of the consent process as well as the assessments.

3.4 Measures

3.4.1 Anthropometric and functional measures

Anthropometric and functional measures included weight, height, mid-upper-arm-circumference (MUAC), triceps skinfold and maximal hand-grip strength (MHGS). Remand detainees were requested to remove shoes and any heavy jackets or blankets that they were carrying for these measures. Derived measures included body mass index (BMI) and corrected arm muscle area (cAMA).

3.4.2 Weight

The weight of each remand detainee was measured using an electronic scale that measured to two decimal points e.g. 0.01kg (SECA model 813 manufactured in China). The scale was placed on a flat hard surface and the remand detainee was asked to stand still in the middle of the scale's platform without touching anything, with his/her body weight distributed equally to both feet. The weight measured was repeated until two successive measurements agreed

within 100g (0.1kg); this value was recorded. The accuracy of the scale was checked periodically using standard weights (Lee & Nieman, 2013).

3.4.3 Height

Standing height was taken using a portable stadiometer (SECA model 213, manufactured in Germany). Remand detainees were requested to remove any hats or hair ornaments and to stand with heels together, legs straight, arms to the side, shoulders relaxed and head in the Frankfort horizontal plane. Heels, buttocks, scapulae and back of the head were positioned against the vertical surface of the stadiometer when possible. Remand detainees were asked to inhale deeply and hold the breath and maintain an erect posture during the reading of the measure. The headboard was moved down until it compressed the hair and height was then read to the nearest 0.1cm while the fieldworker kept her eyes level with the indicator of measurement (Lee & Nieman, 2013).

3.4.4 Body Mass Index

Body Mass Index (BMI) was used to evaluate the weight in kilograms of a subject relative to the height in metres squared (Table 8). BMI has a relatively high correlation with body fatness and is convenient to take and has been found to be a reliable indicator of obesity (Garrow & Webster, 1985).

The BMI was calculated as weight divided by height squared; and interpreted using the international classification of adult underweight, overweight and obesity according to the WHO classification table for adults (WHO, 2015a).

Table 8: BMI cut-offs for classification of adult underweight, normal weight, overweight and obesity (WHO, 2015a)

Classification	***BMI kg/m²***
Underweight	*<18.50*
Normal range	*18.50 - 24.99*
Overweight	*≥25.00*
Obese	*≥30.00*

3.4.5 Mid upper arm Circumference (MUAC)

The mid upper arm circumference (MUAC) was measured as follows: The length of the **right** upper arm was measured using a SECA non-stretchable measuring tape, with the elbow bent at a 90-degree angle. The midpoint of the arm was determined and marked along the lateral

side of the arm between the lateral projection of the acromion process of the scapula, and the inferior margin of the olecranon process of the ulna. The arm muscle had to be relaxed when placing the measuring tape around the point that had been marked, with the arm in the elongated position directly next to the body with the palm of the hand facing the thigh. The measurement was recorded to the nearest 0.1cm (Lee & Nieman, 2013).

The **right** arm was used so as to be aligned with the CDC tables (Lee & Nieman, 2013; Fryar et al., 2012; McDowell et al., 2005).The MUAC measurement was interpreted using the CDC percentile charts for males and females aged 18-21 years (Fryar et al., 2012). See (Appendix 4.1) for MUAC percentiles per gender and age group that were used to interpret the data. The MUAC cut-off points that are used to reflect chronic energy deficiency are presented in Table 9.

Table 9: Mid upper arm circumference cut-off points for chronic energy deficiency (CED) (Ferro-Luzzi & James, 1996)

MUAC value (mm)		***Diagnostic category***	***Grade of CED***
Men	***Women***		
<230	*<220*	*Undernourished*	*3*
<200	*<190*	*Severe wasting*	*4*
<170	*<160*	*Extreme wasting*	*5*

3.4.6 Triceps skinfold

The triceps skinfold was taken at the mid-point of the arm as identified for the MUAC measurement. The arm muscle had to be relaxed when the skin-fold calliper (Harpenden calliper manufactured in the United Kingdom) was placed on the point that was marked, with the arm in the elongated position directly next to the body. The skinfold was gripped one centimetre above the point marked and the calliper was then placed on either side of the mark, “pinching” the skinfold. The thumb and index finger maintained pressure throughout each measurement. The dial was read four seconds after the pressure from the fieldworker’s hand was released from the calliper arm. The measure was repeated three times, with a 15 second waiting period between the measures (Lee & Nieman, 2013).The average of the three measurements were taken as the final triceps skinfold measure. Each measure was recorded to the nearest 1mm.

The triceps skinfold was interpreted using the CDC percentile charts (Appendix 4.1) for males and females aged 18-21 (Fryar et al., 2012). No cut-off points for the categorization of body

composition/fatness using triceps or any other single skinfold measurement have been published to date.

3.4.7 Bone free arm muscle area

The bone free arm muscle area (AMA), also referred to as the corrected AMA (cAMA) was derived from the triceps skinfold measure and the MUAC measure using the formula for the cAMA in cm² for males and females (Lee & Nieman, 2013; Heymsfield et al., 1982).

Bone free arm muscle area or corrected arm muscle area (cAMA)

$$\text{cAMA for females} = \frac{[MUAC-(\pi \times TSF)]^2}{4\pi} - 6.5$$

$$\text{cAMA for males} = \frac{[MUAC-(\pi \times TSF)]^2}{4\pi} - 10$$

Note that both MUAC and TSF must be expressed as centimetres in the equation (Heymsfield et al., 1982).

The cAMA was interpreted using the percentiles and cut-off values suggested by Frisancho (1990).

Table 10: Corrected arm muscle area (cm ²) cut-off values and corresponding percentiles for male and female adults between 18-24.9 years of age (Frisancho, 1990)

	Wasted	***Below average***	***Average***	***Above average***	***High muscle***
Percentile cut-off values	*≤ 5th*	*>5th but ≤15*	*>15 but ≤ 85th*	*>85th but ≤ 95th*	*>95th*
Females	*≤ 19.5*	*19.6 to 22.8*	*22.9 to 36.4*	*36.5 to 44.2*	*>44.3*
Males	*≤ 34.2*	*34.3 to 39.5*	*39.7 to 61.7*	*61.8 to 71.9*	*> 72.0*

3.4.8 Maximal hand grip strength test

The maximal hand grip strength (MHGS) test may be a valid indicator of nutritional health status in young adults (Norman et al., 2011) and may predict future bone mineral density in females (Barnekow-Bergkvist et al., 2006; Woodruff & Duffield, 2002). MHGS reflects overall strength and muscle function and is thus indicative of fat-free body mass (Angst et al., 2010; Gallup et al., 2010).

The MHGS was measured by using the Takei Kiki Kogyo (TKK) 5401 GRIP D dynamometer (Operation Manual Takei Scientific instruments co. ltd, manufactured in Japan). A physical and functional assessment was done to assess whether both arms and hands were integrally intact. The remand detainee was then asked to hold the device so that the grip meter indicator faced

outward. The fieldworker turned the dial to adjust the grip width so that the second joint of the pointing finger of the remand detainee made a right angle with the grip handle. The remand detainee was asked to stand upright and lower his/her arm in an elongated position next to the body. Each hand must clasp the grip of the dynamometer with full force individually, keeping the arm still while the measurement is taken.

The measurements were performed twice with the left and right hands alternately. The mean value of the highest values, as calculated by the dynamometer, of the forces of both hands was recorded as the result in kilogram force (kgf). Dodds et al. (2014) developed normative data across the life course for MHGS using the data from 12 studies. For the male and female 20 year olds, Table 11 indicates the MHGS percentiles, mean and standard deviation as given by Dodds et al. (2014).

Table 11: MHGS percentiles for 20-year-old males and females (kgf) (Dodds et al., 2014)

Gender	***Observations***	***10th***	***25th***	***50th***	***75th***	***90th***	***Mean***	***SD***
Male	*354*	*30*	*35*	*40*	*46*	*52*	*41.5*	*7.3*
Female	*463*	*21*	*24*	*28*	*32*	*36*	*28.4*	*5.1*

3.5 Data collection procedures at Pollsmoor Correctional facility

Following approval of the research by the DCS, a representative of the Department of Development and Care (this department oversees the health of DCS inmates) informed the heads of the "Medium A" juvenile male head of centre and the Female centre in Pollsmoor correctional facility that the research project would be taking place under their auspices. Subsequently the primary researcher, who conducted all the fieldwork, presented a short overview of the research at an informal meet-and-greet between researcher and the remand detention wardens from both the male and female centres. The wardens were specifically briefed on the inclusion and exclusion criteria for the identification of eligible subjects. An area that would ensure privacy and confidentiality for the data collection procedures within the context for the need of wardens to oversee the process was also identified at this informal meeting.

3.6 Physical arrangements

A small room was allocated to the researcher in both the male and female juvenile facilities. These rooms were usually used by the wardens as an extra office space or as storage space.

Suitable days and times for conducting fieldwork were agreed on between the researcher and the head of each of the two centres. Factors that were considered in selection of suitable days and times are listed in Box 3.2. Fieldwork at the male centre took place between one and three times a week, but only once a week every two-to-three weeks at the female centre. This discrepancy arose because a greater number of juvenile males are admitted to the correctional facility than juvenile females.

3.6.1 Tools and equipment

The following items were used to complete the assessments and were carried in a large suitcase that could be rolled easily in and out of the correctional facility. A non-stretchable tape measure (SECA), electronic scale with large display (SECA), a skinfold calliper (Harpenden), a portable stadiometer

Box 3.2: Researcher reflections: Engagement with correctional service authorities to facilitate data collection

Discussions with facility heads are key to identification of suitable dates and times for interviews as they are most likely to consider the broader picture of the remand detainees' movements in the facility, as well as the various procedures that need to be considered in setting in place supervised contact time between the detainee and the fieldworker. Section wardens, sisters and other stakeholders need to be included in these meetings. The experience of the primary researcher at Pollsmoor and literature (Lane et al., 2012; Ferszt & Chambers, 2011) show that the following need to be checked/considered when appointments for supervised contact with remand detainees are negotiated:

- Scheduled visiting days for the remand detainees: These days may differ from the dates and times of those scheduled for the sentenced inmates.
- Section warden shifts: It may be helpful to schedule appointments when warden shifts overlap as it would be more feasible for one warden to supervise the data collection session for security purposes and for another warden to attend to the needs of other detainees e.g. accompanying them to clinics.
- Scheduled court dates: Court appearances could affect access to remand detainees.
- Meal times: Wardens need to ensure that everything runs smoothly during meal times as all inmates are out of their cells at that point. Wardens may also be involved in serving meals.
- Inmate lock-up time. Inmates are not available for data collection purposes after lock-up time.
- Target group of inmates: To avoid misunderstandings the target group should be clearly defined to prevent wasting time and resources.
- School holidays (December): Many wardens take leave during this period with a resulting reduction in staff capacity.

Further points to consider/be aware of:

- Ensure that wardens understand the inclusion/exclusion criteria very clearly to ensure that only detainees who meet the criteria are brought from their cells.
- Ensuring that the dress code of fieldworkers is appropriate e.g. no open toe shoes, colour of clothing not similar to that of inmates' uniforms, underwire bra may not be allowed etc. (Ferszt & Chambers, 2011)
- Awareness that security checks of fieldworkers (pat downs) and checking of equipment may take place. These searches may take up time once the fieldworker has entered which may impede on the interview time.
- Awareness of items that may not be brought into the facility for legal and security reasons (mobile phones, stationary, recording equipment etc.)

(SECA), a hand grip strength dynamometer (T.K.K. 5401 Grip D), copies of the consent forms and questionnaire.

3.6.2 Fieldworkers

All the fieldwork was conducted by the researcher (MSc Med in Dietetics candidate) who was trained and standardized to conduct the necessary anthropometric and handgrip strength measures and to conduct the interview survey with the remand detainees.

The fieldwork in this research was characterized by unique challenges that were the direct result of the research setting. Key challenges are summarized in Box 3.3.

3.7 Survey questionnaire

An interviewer based questionnaire was used to assess factors associated with weight status other than body composition. The questionnaire developed by Senekal and de Villiers (2009) approved by Faculty of Health Sciences- Human Research Ethics Committee (FHS-HREC); REF 462/2008 for investigation of weight status and associated factors in adolescents in the Cape Metropole was adapted for this research

Box 3.3: Researcher reflections: Fieldwork challenges

Access to remand detainees:
Gaining access to remand detainees was found to be challenging. This research was specifically true for the female facility. At times the waiting period to be assisted by facility staff to conduct recruitment sessions with new remand detainees was more than an hour. This may have been the result of misunderstandings, tight work schedules or possibly some form of resistance from wardens to the research or the presence of an external person in the facility. Quina et al., 2007 noted the "fear" that staff may have of what outsiders may report (Quina et al., 2007), while (Lučić-Ćatić, 2015; Ferszt & Chambers, 2011) comment on the fact that the extra burden on the staff may not be appreciated.

Identification as researcher
It is very important that staff and inmates in a particular facility are aware of the presence of a researcher. Identification was a major challenge in this research as neither the juvenile nor female facility provided the researcher with any form of identification that distinguished her from the remand detainees. On various occasions, obviously more so in the female centre, remand detainees were under the impression that the researcher was also a detainee. On another occasion, a new warden in a section mistook her for a detainee and nearly bundled her into a cell with a number of other female detainees.

Changing procedures in facilities
Execution of fieldwork can be complicated by changes in regular procedures. For example, in the juvenile male section newly admitted remand detainees were not taken to the clinic for their HIV and TB tests as was the practice in the past. Instead, the sister came the new-admissions area every morning to conduct the tests, using the space that had been allocated to the research for that time period. This situation resulted in a delay of up to two hours in commencement of the research assessments.

Direct research environment and interruption of assessments
The environment within a correctional facility where researchers conduct assessments may prove to be very challenging. Examples from this research include wardens and other inmates constantly walking past and making tea or warming up their food in the allocated research space. Furthermore, there were occasion where other detainees in the vicinity of where the interview was taking place shouted or sang while the interviews were taking place.

Emotional/psychological impact of the environment on the fieldworker
The experience of this researcher as well as available literature on the topic emphasize that the proximity of fieldworkers to inmates, especially for fieldworkers to experience inmates' sense of loss of free movement, may result in profound emotions, sadness and exhaustion. Quina et al., 2007 point out that trauma is inherent in corrections research and that researchers may feel "frightened and disturbed" by the setting and experiences. Arditti et al., (2010) state that "The researcher must on some level share the pains of imprisonment" (Arditti et al., 2010). Actions could include self-reflection pertaining to feelings, emotions, self-exploration, as well as creative ways to externalise pain through poetry, free-writing or journaling Arditti et al., (2010). Researchers should also be made aware of the maximum number of hours that a person should be subjected to the psychological strain of working with "individuals in pain" per week or per month. The pain leaks through to the researcher who then is subjected to secondary victimisation and psychologically painful feelings (Quina et al., 2007). Finally, researchers should go in as a team to allow for debriefing with peers or colleagues. The researcher in this research conducted all the fieldwork on her own and thus had nobody else to talk to and share the extreme feelings and emotions that arose.

(Appendix 3.1). The adapted questionnaire was translated to Afrikaans and both the English and Afrikaans versions were pilot tested.

3.7.1 Socio-demographic and socio-economic information

Socio-demographic and socio-economic information included age, gender, home language (English, Afrikaans, Xhosa, Zulu and other); which race they perceived to belong to (black African, white, coloured, Indian and other); the highest qualification or grade achieved (primary school, Grade 8, grade 9, grade 10, grade 11, grade 12 and post matric qualification; where they were born (Western Cape, Eastern Cape, Gauteng and other). Juveniles were asked; with whom they lived prior to incarceration (parents, family, friends, other) and whether there was a tap and electricity inside the house they lived before incarceration.).

Food security was measured using the following three items from the Hunger scale tool (Ballard et al., 2011) see Table 12.

Table 12: Hunger score questionnaire developed by Ballard et al. 2011

Number	***Question***			***Answer***
Item 1:	*In the last month at home (or where you lived), was there ever no food to eat of any kind in your house because there was not enough money to get food?*			*Y / N*
	If yes, how often did this happen?	*Rarely (1-2 times) (1)*	*Sometimes (3-10 times) (1)*	*Often (> 10 times (2)*
Item 2:	*In the last month at home (or where you lived), did you or any household member/person go to sleep at night hungry because there was not enough food?*			*Y / N*
	If yes, how often did this happen?	*Rarely (1-2 times) (1)*	*Sometimes (3-10 times) (1)*	*Often (> 10 times) (2)*
Item 3:	*In the last month at home (or where you lived), did you or any household member/person go a whole day and night without eating anything because there was not enough food?*			*Y / N*
	If yes, how often did this happen?	*Rarely (1-2 times) (1)*	*Sometimes (3-10 times) (1)*	*Often (> 10 times) (2)*

Response option suggested by Ballard et al. (2011) for these items included “No” (scored 0), “rarely or sometimes” (scored 1) and “Often” (scored 2). The interpretation of scores were based on the following categories suggested by Ballard et al. (2011):

- Score of 0-1: little to no hunger in the household
- Score of 2-3: moderate hunger in the household
- Score of 4-6: severe hunger in the household

The frequency of availability of the following food items in the household (never, sometimes (1/month), often (1/week) and almost always (every day)) in the period before incarceration was asked: Fruit, vegetables, vegetables served during mealtimes, dairy and fruit-juice.

3.7.2 Meal pattern

Meal pattern was assessed in terms of frequency per week the following meals/snacks were consumed: breakfast, 10am snack, lunch, 3pm snack, supper and late night snack.

3.7.3 Dietary intake

Information considered in the decision on the dietary intake methodology is depicted in Table 13.

Table 13: Information considered for finalization of dietary intake methodology

Question	***Answer***
Aim of the dietary intake assessment	*To assess the food choices that late-adolescents made during the month prior to entering a correctional facility.* *To find associations between food choices made and the current anthropometry and MHGS of late-adolescents.*
Type of analysis that researcher would like to do.	*Associations between food choices and food groups with anthropometry, MHGS, physical activity, psychological wellbeing, socio-demographic information, hunger score and drug use.*
What type of data would the researcher need?	*Due to the additional complications of the remand detainee the survey has to be as short as possible.* *Effective and reliable energy intake questionnaires is only possible with three 24 hour food frequency questionnaires. This method is time consuming and costly (Magarey et al., 2009; Field et al., 1998), while the quantified FFQ has been found to under-estimate actual intake (McIntyre et al., 2012). However, non-quantified food frequency questionnaires give valid insights into the typical food choices made during a period of a week, instead of focusing on the intake of one day, which may be assessed to determine the quality of nutrition intake that is consumed on a regular basis (Wong et al., 2012; Cullen et al., 2008).*

Consider the target population of the study	*Remand detainees in Pollsmoor correctional facility. Juveniles who have not completed their schooling. Some cannot read or write.* *The questionnaire should be simple, easy to understand and interviewer based.* *Use of flash cards with foods to keep the remand detainee interested would be beneficial.*
Cost of methodology	*Doing the non-quantified FFQ would be beneficial and reduce the costs to a minimum since there is no need to determine the exact energy and nutrient values using a software program that does nutrient analysis.*

Bearing in mind the answers to the questions asked in Table 13 the researchers decided to make use of the non-quantified FFQ developed by Senekal and de Villiers (2009) which was approved by Faculty of Health Sciences- Human Research Ethics Committee (FHS-HREC); REF 462/2008 for the investigation of weight status and associated factors in adolescents in the Cape Metropole, which was adapted for this research (Appendix 3.1).

The FFQ included 37 items that were categorized in the following eight food groups: protein, dairy, starch, fruit, vegetables, fats and oils, high-fat snacks and high-sugar containing products (Table 14).

Remand detainees were requested to indicate the frequency of intake of each food item during the week preceding their incarceration as either never or number of times for the week and number of times per day. The number of times per day was multiplied by the number of times per week to capture the total number of times per week that each food choice was made.

Table 14: Food groups derived from the indicator food list of the FFQ

Food groups	***Indicator food items on the FFQ in each food group***
Protein foods	*Red meat, chicken not-fried and fried, fish not-fried and fried, 'bokkems', tinned fish, smoked fish, eggs, organ meats, processed meat, legumes*
Dairy group	*Milk, cheese, 'maas', yogurt*
Starch group	*Brown bread, high fibre breakfast cereals, oats; White bread, Rice, 'stywe-pap' or 'slap pap' (maize porridge), pasta, 'samp', potato (mash/ boiled)*

Fruit group	*Apples, banana, oranges, 'naartjies' etc.*
Vegetable group	*Yellow, green, white, mix vegetables, tomatoes*
Fats and oils group	*Margarine, butter, peanut butter, peanuts, oil*
High-fat snacks	*Fried potato chips, 'vet koek', pies, crisps, take-out*
High-sugar products	*Sugar, sweets, chocolate, cakes & biscuits, jam, fruit juice, sugar containing fizzy drinks*

The picture sort method was used to administer the food frequency questionnaire. This method involves the use of a food card for each indicator food item in the FFQ (see Figure 4 for an example). The remand detainee was given the food cards and requested to go through them and identify those that he/she had consumed in the week preceding incarceration. The fieldworker then proceeded to determine the frequency of consumption of these items during the indicated week.

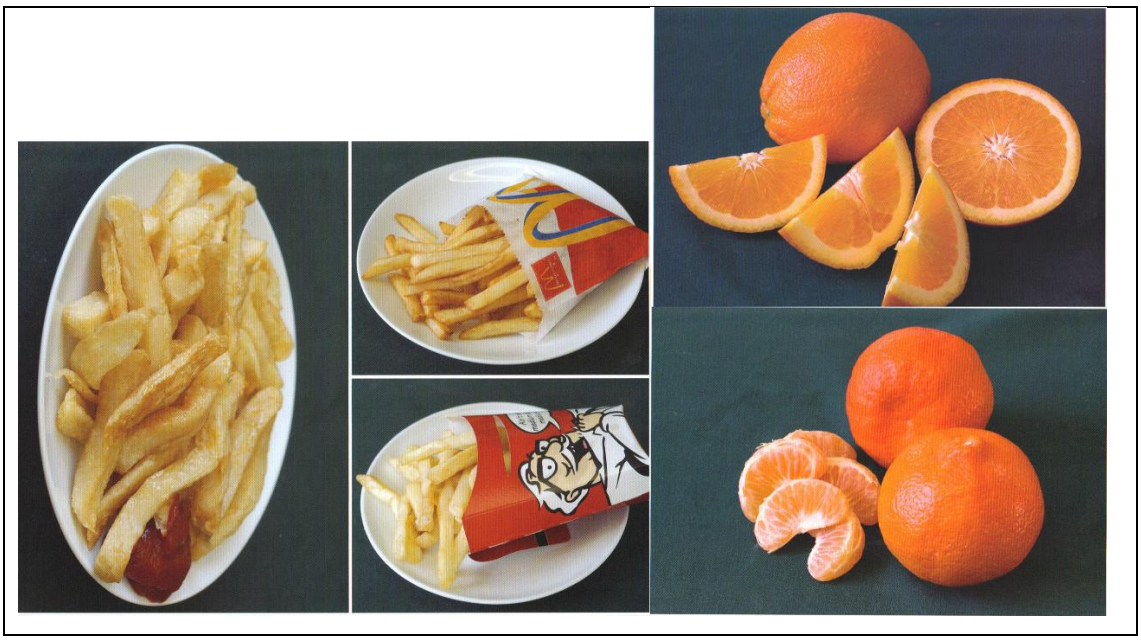

Figure 4: Example of food flash cards used during the FFQ

3.7.4 Understanding of healthy eating

The understanding of healthy eating of remand detainees was measured by asking the following question: "What do you think you must eat for you to be healthy" (the respondent was gently "prompted" as necessary)? Responses mentioned by remand detainees were captured using the guide indicated in Table 15.

Table 15: Guide for capturing responses to the nutrition knowledge question: "What do you think you must eat for you to be healthy"

Food group	***YES*** *Mentioned*	***NO*** *Not mentioned*
Fruit (general or any specific fruit mentioned = YES)		
Vegetables (general or any specific vegetable mentioned = YES)		
Protein (meat, chicken, fish, eggs, dried legumes, peanut butter-anyone/ combination = YES)		
Dairy (milk, yogurt, cheese-anyone/combination = YES)		
Starches (bread, pasta, rice, porridge, cereals etc.-anyone/combination = YES)		
Fats (butter, margarine, oils, cream, lard etc.-anyone/ combination = YES)		
Sugars		
Water		
Anything else that does not fit in the above options		

3.7.5 Risk taking behaviour

Risk taking behaviour questions covered smoking, alcohol and illicit drug use with response options being never, sometimes or every day. Female remand detainees were also asked whether they had any children and if yes, how many.

3.7.6 Perception of body weight and weight loss attempts

Body shape perception was assessed by asking remand detainees whether they perceived themselves as 'too thin', 'just the right weight' or 'too chubby or fat'. They were also asked whether they had tried to lose weight in the last year.

3.7.7 Psychological well-being

Psychological well-being was assessed using the 10-item questionnaire developed by Kessler et al. (2002). This questionnaire is a measure of the distress a person is experiencing by asking

questions about anxiety and depressive symptoms experienced in the last month (Kessler et al., 2002). Each question is rated and added up to provide a total score that can range from 10 to 50. The suggested interpretation of the scores is as follows (Andrews & Slade, 2001):

- Score under 20: likely to be well
- Score from 20-24: likely to have a mild mental disorder
- Score from 25-29: likely to have a moderate mental disorder
- Score from 30 and higher: likely to have a severe mental disorder

For the purposes of this research the SANHANES terminology that refers to levels of distress was adopted rather than likelihood of having a mental disorder, which is what was used to describe the K10 data used in the SANHANES study (Shisana et al., 2013).

- Score under 20: low distress
- Score from 20-24: moderate distress
- Score from 25-29: high distress
- Score from 30 and higher: very high distress

3.7.8 Physical activity and sedentary behaviour

Physical activity (PA) and sedentary levels were determined with the Global Physical Activity Questionnaire version 2 (GPAQv2) developed by the World Health Organisation specifically for developing countries, including South Africa (Armstrong & Bull, 2006). The GPAQv2 focuses on physical activity and sedentary behaviour levels in four domains, namely: activity at work, travel to-and-from places, recreational activities and sedentary behaviour using 18 questions in conjunction with flash cards of typical activities that would fall in each category. Good validity and test-retest reliability coefficients have been reported for the GPAQv2 (Herrmann et al., 2013; Bull et al., 2009).

Variables derived from the QPAQ2 include the following: Metabolic equivalent of task minutes (MET min) per week (Active (≥ 3000); minimally active (600 – 2999); inactive (≤ 599), PA minutes for work, travelling and recreation domains and physical activity average percentage contribution per domain (work, travelling and recreation) per day. Vigorous PA greater than 75 minutes per week (Yes/No); not having done any PA in any one or more of the three domains and the number of sedentary minutes spent per day.

3.8 Statistical Methods/ analysis

Final study sample

A total number of 139 interviews were conducted, but only 119 were included in data analysis. As mentioned in the recruitment section, the research was explained to all detainees in the juvenile holding cells who were assumed to meet the criteria for age group and incarceration period. However, it was evident once the interviews commenced that some of the remand detainees did not meet all inclusion criteria (Table 16). Due to ethical reasons and confidentiality issues, the researcher deemed it to be inappropriate to simply stop the interviews once it was apparent that they were not eligible. As a result twenty remand detainees had to be excluded from the final sample.

Table 16: Reasons for exclusion of remand detainees from the final data set

Reason for exclusion	***Amount***
Pregnant females	*3*
On remand for longer than 3 weeks	*10*
Transferred from secure-care centers (thus had been incarcerated in the period before being admitted to Pollsmoor).	*4*
Older than 21 years of age	*3*
Total	*20*

The statistical software, Statistica 13.2th and SAS were used for data analysis. Three different sets of data analysis were conducted. Firstly, all variables were compared between the genders (Table 17). Secondly, within gender group associations between all variables were investigated (Table 18). Thirdly, regression analyses were conducted to identify predictors of BMI, cAMA and MHGS within each gender group (Table 19). These three indicators of nutritional status were selected as dependant variables as they each reflected a component of nutritional status (body composition) namely body fatness (BMI was highly correlated with triceps skinfold – see Table 30*Table 41*) and lean body mass (cAMA and MHGS).

Table 17: Comparisons conducted between male and female on remand juveniles in Pollsmoor correctional facility for categorical and continuous variables.

Variables	***Response options; subject categorization or unit of measurement***	***Comments***

Categorical variables: Cross-tabulations with gender as grouping variable using Pearson Chi-square test		
Socio-demographic and economic variables		
Race	*African Black, White, Coloured.*	
Lived with whom	*Parents, Family, Friends, Other.*	
Home language	*English, Afrikaans, isiXhosa, isiZulu, other.*	
Education	*Grade 7-8, Grade 9-11, Grade 12 and above Grade 12*	*No respondent indicated above Grade 12*
Place of birth	*Western Cape, Eastern Cape, Johannesburg, Other*	
Weeks on remand	*1-7 days (1 week), 8-14 days (2 weeks) or 15-21 days (3 weeks)*	
Tap inside the house	*yes/no*	
Electricity inside the house	*yes/ no*	
Food insecurity	*rarely(1-2/month), sometimes (3-10/month), often (>10/month)*	*No hunger (0-1), Moderate hunger (2-3), Severe hunger (4-6)*
Availability of healthy food in the home: Vegetables, Vegetables served, Milk and Fruit juice	*Never, sometimes, often, almost always for each item*	*Collapsed as follows* *1= never + sometimes* *2=often* *3= almost always*
Anthropometry and MHGS		
BMI: 4 categories	*Underweight, normal weight, overweight and obese.*	
MUAC percentiles: 3 categories	*<25th, 25th-75th and >75th*	
Triceps percentiles: 3 categories	*<25th, 25th-75th and >75th*	
cAMA: 3 categories	*Wasted, below average, average and above*	
MHGS	*10th, 25th, 50th, 75th and 90th*	
Self-reported health issues *Eating disorders, Diabetes Mellitus types I and II, Hypertension, Hormone imbalance, Current/ recent tuberculosis, Human immunodeficiency virus*	*Yes/ no for each disease*	
Basic nutrition knowledge *Mentioned Fruit, Vegetables Protein, Dairy, Starches, Fats and Water*	*Yes/no for each food group*	*Categories for analysis: Mentioned 0 or 1 or 2 or 3 or >3 groups*
Risk taking behaviour *Smoking, Alcohol use and Illicit substance*	*Never, sometimes, every day for each behaviour*	
Had a baby (females only)	*Yes/ No* *1 or 2 or 3 or 4 children*	
Perception of body weight	*Too thin, just right, and too chubby.*	
Weight loss attempted in previous year	*Yes/ No*	
Anxiety and depression symptoms	*Low (<20), moderate (20-24), high (25-29) and very high (>29).*	

Physical activity behaviour (work & recreation)	*MET min score: active (>3000MET min), minimally active (600-2999 Met min), inactive (<600 Met min)*	
Continuous variables: Normally distributed (Shapiro-Wilk test); Mann-Whitney U-test used for gender comparison		
Age (years), Height (m), MHGS (kgf), Depression and anxiety symptom score		
Continuous variables: Non-normally distributed (Shapiro-Wilk test); Mann-Whitney U-test used for gender comparison		
Sitting/ resting	*Minutes/day*	
Average PA category *Work (vigorous + moderate)* *Travelling (moderate only)* *Recreation (vigorous + moderate)* *Total minutes*	*Minutes/day*	
PA percentage contribution per category per day *Work, Travelling and Recreation*		
Anthropometry *Weight, BMI, MUAC, TSF, cAMA*	*Weight (kg), BMI (kg/m²), MUAC (cm), TSF (mm), cAMA (mm²)*	
Meal pattern *Breakfast, Lunch Supper, 10 am Snacks, 3pm snack, 9pm snacks, total snacks*	*Frequency per week*	
Food choices: *Individual FFQ items (37 items)* *8 Food groups (derived from the 37 items): Protein, Starch, Fruit, Vegetables Fats, High fat snacks and Sugar products*	*Times per day*	

MHGS= Hand grip strength, MUAC= Mid upper arm Circumference, AMA= Arm muscle area, BMI= Body mass index, TSF=Triceps skinfold, Cat=categories

Within gender group associations between categorical variables were investigated using cross-tabulations and the Pearson's Chi Square statistic and correlations between continuous and ranked categorical variables using Pearson's or Spearman's correlation coefficient (Table 18).

Table 18: Within gender group associations between categorical and continuous variables in on remand detainees

Categorical variables		
Anthropometric and MHGS	***Cross-tabulated with (Pearson's Chi Square)***	
BMI (4 categories)	*Race, Language, Birth place, Live with whom Electricity in house, Tap/water in house, Parity (females only)*	

BMI (3 categories): underweight, normal weight, (overweight + obese)	*Perception of body weight #(Kappa statistic, not Pearson's Chi Square))* *Weight loss attempts in previous year*	
MUAC percentiles (3 categories) *Triceps percentiles (3 categories)* *MHGS (3 categories)*	*Race, Language, Birth place, Live with whom* *Perception of weight, Weight loss*	
Socio-demographic	***Cross-tabulated with (Pearson's Chi Square)***	
Lived with whom	*Availability of healthy food, Hunger score, Eat total, Smoking, Illicit substance use, Alcohol use and symptoms of anxiety and depression categories, and school grade,*	
Race	*Smoking, Illicit substance use, Alcohol use and symptoms of anxiety and depression categories*	
Symptoms of anxiety and depression (categories).	*Smoking, Illicit substance use and Alcohol use categories*	
Healthy food availability *Vegetables, Vegetables served* *Milk, Fruit juice*	*Smoking, Illicit substance use, Alcohol use and symptoms of anxiety and depression categories*	
Having had a baby (females only)	*School grade achieved, Hunger score categories, Race, Who live with, Weight loss attempts, body weight perception, BMI (4 categories), Met min/week categories; Smoking, Alcohol use Illicit substance use and symptoms of anxiety and depression categories*	
Agreement between perceived weight and actual BMI category	***Kappa statistic***	
BMI categories (3): underweight, normal weigh, overweight/obese *Perceived weight: too thin, just the right weight and too chubby/fat*	*Interpretation of Kappa statistic: There are no universally accepted interpretation criteria for the kappa coefficient. For the purposes of this research the interpretation criteria published by Landis and Koch (1977) were applied:* *k < 0: no agreement; k = 0–0.20 slight, 0.21–0.40 fair, 0.41–0.60 moderate, 0.61–0.80 substantial, and 0.81–1 almost perfect agreement.*	
Continuous variables	***Spearman correlations matrix with…***	
Correlations matrix done within male and female sample separately ***BMI, cAMA, MHGS***	*Age* *Height* *MHGS* *Total meals per week* *Distress score*	*normally distributed Pearson correlation*
	Food groups (8): *Protein* *Starch* *Fruit* *Vegetables* *Fats*	*non-normally distributed Spearman correlation*

	High fat snacks *Sugar products*	
	PA minutes per day *Work, Travelling, Recreation, Total PA minutes per day* *Days on remand detention* *Education (School grade)* *Breakfast, lunch, supper and snacks* *Individual FFQ items (37 items)* *Parity (how many children)*	

The multiple linear regression analyses were run for each of the three dependent variables, namely BMI, cAMA and MHGS using SAS. Backward elimination was used to find the most appropriate model (Table 19). Multiple linear regression analysis explains the percentage of variability in a dependant variable that may be explained by each independent variable.

Table 19: Regression analysis to identify predictors of BMI, cAMA and MHGS within male and female on remand detainee groups

Dependent numerical variables:	***Independent continuous or ranked variables:***
BMI, cAMA, MHGS	***Socio-demographics:*** *Age, Home language, Ethnicity, Education (School grade), Number of children(females), Days on remand, Food security score, Frequency of availability of vegetables, fruit juice and milk in the household;* ***Anthropometry:*** *Height, weight, BMI, triceps skinfold cAMA MHGS* ***Body weight perception and weight loss attempts.*** ***Meal pattern****: Breakfast, lunch, supper and snacks, total number of meals per week****;*** ***Food choices:*** *Frequency of intake of each of the 37 items on the FFQ, as well as the 8 food groups (Protein****,*** *Starch****,*** *Fruit****,*** *Vegetables****,*** *Fats****,*** *High fat snacks****,*** *Sugar products)* ***Physical activity****: PA minutes per day, minutes doing PA at Work, travelling, and as recreation, total PA minutes per day* ***Risk taking behaviours:*** *Smoking, alcohol use, illicit substance use* ***Psychological well-being:*** *Score for presence of depression and anxiety symptoms*

3.9 Interpretation of clinical significance of statistically significant predictors:

Nutrition related health research investigating differences between treatments (e.g. two weight loss diets), groups (e.g. gender groups) and predictors of a phenotype outcome (e.g. BMI) needs to consider the clinical significance of any statistically significant results. For example, would a significant difference in weight loss of 800g between two dietary treatments over a period be clinically significant; would a significant difference in weight of 800g between

genders be clinically significant; and would a statistically significant prediction of an increase in BMI (dependant variable of 0.5kg/m^2 for each unit increase in a predictor (e.g. energy intake; independent variable) be clinically significant? No international guidelines/criteria for the interpretation of the clinical significance of these statistically significant findings are available. For these reasons an attempt was made to develop and apply such guidelines/criteria for the interpretation of the clinical significance of statistically significant predictors of BMI, cAMA and MHGS.

BMI criteria: To formulate a criterion to reflect on clinical significance for BMI predictor outcomes the BMI percentile categories for adults (Wallace, 1995) were considered. It was evident that a change of 0.9kg/m^2 for both genders can potentially result in changing BMI from being in the normal weight range to being in the underweight range. A predicted change of ≥ 0.9kg/m^2 was thus interpreted as reflecting probable clinical significance.

cAMA criteria: To formulate a criterion to reflect on clinical significance for cAMA predictor outcomes the cAMA percentile categories published by Frisancho (1990) were considered. According to Frisancho (1990) cAMA that falls between the 15th to 85th percentiles could be denoted as "average", while a wasted cAMA would fall below the 5th percentile. The actual value of the 5th percentile in cm^2 was subtracted from the actual value of the 15th percentile in cm^2 for 18-21 year olds in each gender group. A predicted change of ≥ **3.8cm^2** for females and ≥**3.2cm^2** for males were interpreted as reflecting probable clinical significance as this could change the cAMA from being in the average range to being in the wasted (low levels of LBM) range.

MHGS criteria: To formulate a criterion to reflect on clinical significance for MHGS predictor outcomes the MHGS percentile categories published by Dodds et al. (2014) were considered. Percentile values given include the 10th, 25th, 50th, 75th and 90th percentiles. Dodds et al. (2014) do not provide cut-offs for interpretation of MHGS, but similar to the procedure that was followed for BMI and cAMA, the change in actual value for MHGS in kgf between the lowest indicated percentile (10th) and the next percentile (25th) for the 20 year old age group was calculated for each gender to reflect the change criterion that reflects probable clinical significance. A predicted change of ≥ 3kgf for females and ≥5kgf for males were thus interpreted as reflecting probable clinical significance of the predictor.

3.10 Ethical considerations

People in correctional facilities are considered to be a vulnerable population (U.S. Department of Health and Human Services, 1981). The Belmont report refers to five basic categories of harm that may befall a research participant, namely: social, economic, legal, psychological and physical (National Commission for the Protection of Human Subjects of Biome Beha Resea & Ryan, 1978). Current vulnerable groups have been identified as: children, inmates, pregnant women, persons with disabilities, persons living with disease and migrants (U.S. Department of Health and Human Services, 1981). DuBois (2006) states that vulnerable people are those that are unable to protect themselves or when their capacity to protect themselves has been reduced; these people are more susceptible to both intentional and inadvertent harms (DuBois, 2006). Hurst (2008) defines vulnerability in research and healthcare as "An identifiably increased likelihood of incurring additional or greater wrong. In order to identify the vulnerable, as well as the type of protection that they need, this definition requires that we start from the sorts of wrongs likely to occur and from identifiable increments in the likelihood, or to the likely degree, that these wrongs will occur"(Hurst, 2008 p. 191). The national bioethics advisory committee (NBAC) recommend that it should be considered to identify vulnerable people individually in certain circumstances and not necessarily as groups (National Bioethics Advisory Commission, 2001).

The target population for this research was classified as a vulnerable on the basis of being an incarcerated group. All possible measures were thus taken to avoid the occurrence of additional discomfort/disadvantages. Assessments were kept to the minimum and were low-risk and minimally invasive. As the target population was on-remand juvenile detainees between 18 to 21 years of age, they could provide consent for themselves for participation in the research.

Remand detainees were not enrolled into the study until the protocol, information and consent sheets were approved in writing by the FHS-HREC (HREC REF: 409/2014) and before the national department of correctional services' research committee approved the research.

The remand detention official(s) was briefed on the inclusion and exclusion criteria of the study for the identification of eligible subjects. The remand detainees received a short explanation of the research after which they were asked to volunteer if they were interested in taking part. Only those remand detainees who volunteered were given a consent form to read and sign before assessments could proceed (Appendix 3.2). The researcher read the documentation to those who were not able to read it. A DCS staff member identified by the

Correctional centre was present for the duration of the informed consent process as well as the assessments.

Remand detainees had the right to withdraw from the study at any point without being disadvantaged in any way and this was explained to them as part of the consent procedure before the interview commenced. They did not benefit directly from this study, but on completion of assessments they received a "healthy eating guide" developed by the department of health. They were also provided with feedback on their weight status, namely whether they had a healthy weight (normal), or a low (underweight) or too high weight (overweight). The researcher e-mailed the prison number of underweight remand detainees to the sister in charge of the facility's clinic if the detainee in question consented to the e-mail communication when asked by the researcher (Box 3.4). The agreement was for the sister to follow-up on the detainee to ensure that he/she received the necessary attention to address his/her the underweight condition.

Box 3.4: Researcher reflections: Referral of remand detainees for further support

Remand detainees are a difficult group to keep track of due to their sometimes very short stay in the facility. Many detainees are released soon after their intake, which makes it important to act speedily when there is a need that is identified.

- Remand detainees should be screened and assessed comprehensively at intake to refer to health professional within short time-frame. Refer to recommendations section for more detailed screening recommendations.
- The researcher found that e-mail communication worked the best to ensure that those detainees who were identified could be referred to the medical staff of the facility.
- A detainee's "inmate number" was used to refer them to the clinic to prevent confusion with names that may not be given correctly by the detainee.

A summary of reasons for referrals is as follows:

Detainees who were found to be underweight, with severe injuries (e.g. Broken hand), in need of psychological assessment (using K10 screening tool), those who report that they may be pregnant and those detainees who the researcher thought were under the age of 18 were referred.

The interviews were not recorded. The responses of remand detainees were captured by the fieldworker on hard copies of the questionnaire. The interview data was captured in an Excel spreadsheet for analysis in such a manner that it maintained the participants' confidentiality (a code was assigned to each subject for these purposes). The computer and hard copies of the questionnaires were kept under lock and key on the UCT premises. The completed questionnaires will only be destroyed once data analysis and publication of the results are complete to allow for the checking of data entries on the hard copies as necessary.

The study was conducted in accordance with the principles of the 2013 Declaration of Helsinki, Good Clinical Practice (GCP) and the laws of South Africa (World Medical Association (WMA), 2013).

3.11 Institutional approval

The procedure for application for DCS permission for conducting research in correctional facilities is outlined on their website at: http://www.dcs.gov.za/services/Research.aspx.

In short, the following steps need to be executed:

- All research that involves an offender or members of DCS is subject to formal application, review and approval procedures described by the DCS research policy.
- Research applications forms must be completed namely:
    - The Research Application Form (G179)
    - The Agreement form
- These forms must be accompanied by:
    - Certified copies of ID's that should not be older than 3 months
    - Approval letter from the Research Ethics Committee of any South African Academic Institution OR any other recognised Research Ethics Committee in South African e.g. (HSRC and SAMRC)
    - The research instrument/tool (e.g. questionnaire)
    - A comprehensive research proposal
    - Research proposal that will provide the following information for consideration by the Research Ethics Committee:
        - Aim of the research, investigation or inquiry.
        - Purpose, nature and extent of the investigation.
        - The research plan and duration of the investigation.
        - Research designs/method.
        - Interviewing techniques and instruments such as questionnaires, audio tape recorders, video recording, etc.
        - The areas where the research will be conducted.
        - The sample of the research must be provided.
        - Approval of research and proof of registration for that current year with the chosen institution if it is for study purposes.
        - The funders/sponsors involved, if any.
        - The value of research to the Department.
        - The field and level of study in case of research intended for the attainment of qualifications.

- Motivation by lecturer, tutor, supervisor or designated person in the institution or organisation. If the space is insufficient, it may be submitted as an addendum
- Possible ethical issues emanating from the proposed research should be reflected in the research proposal.
- The researcher should indicate whether there is an intention to publish the research findings.
- No digital recording however an audio recording is allowed.

The above stipulated points are additional requirements to be included in the research proposal for consideration by the DCS Research Ethics Committee.

Once the DCS research directorate approved the study, a provincial and a regional contact person were allocated within the Directorate “development and care” sub-facility who provided the researcher with guidance in identifying a suitable contact person within the target facility (Pollsmoor) and acted as the liaison between the researcher and DCS (Appendix 3.4: National DCS approval of research letter). Meetings were subsequently conducted with the on-remand male and female head of centres to establish the research fieldwork plan in the facility.

Chapter 4: Results

4.1 Socio-demographic profile of juvenile male and female remand detainees and comparison between genders

4.1.1 Female profile

The majority of juvenile females were on remand less than eight days when the interview took place (Table 20). These detainees had a median ±SD age of 19.8 ±1.4. The majority identified themselves as belonging to the coloured ethnic group, spoke Afrikaans, were born in the Western Cape and lived with their parent/s prior to incarceration and had a tap with running water and electricity in the house they were living in. Almost a third reported that they experienced moderate to severe hunger in the month prior to incarceration (Table 20).

A very small minority had achieved grade 12 schooling (Table 20). Fifty percent (n=27) of female detainees indicated that they had one or more children, with 84.6% (n=23) having 1 child, 7.7% (n=2) two, 3.9% (n=1) three and 3.9% (n=1) four children (Pearson chi-square test).

None of the female detainees reported having eating disorders, while 11 reported having some form of health problem with one reporting having had gestational diabetes and five reporting having had hypertension during pregnancy. Two reported having had TB and five having HIV/AIDS (Table 20).

4.1.2 Male profile

The majority of male detainees were on remand less than eight days when the interview took place (Table 20). These detainees had a mean ±SD age of 19.6±1.3. The greater majority identified themselves as belonging to the coloured ethnic group, were Afrikaans speaking, were born in the Western Cape and lived with their parent/s prior to incarceration and had a tap with running water and electricity in the house they were living in. Only a very small minority had achieved grade 12 schooling. Forty-three percent experienced moderate to severe hunger in the month before incarceration. Six male detainees reported to have a health problem; one reported having had TB while five reported having HIV/Aids (Table 20).

4.1.3 Male and female comparison

Females had been on remand for a significantly longer time than males before being assessed (Table 20). There was no significant difference in the mean age between male and female detainees (p=0.60 Students t-test). There were also no significant differences between the genders for socio-economic indicators. Although food security was not significantly different between the gender groups and up to two thirds of both genders did not experience hunger in the previous month, there is a trend for males to be more likely to have experienced moderate-to-severe hunger. There was also a trend for female detainees to be more likely to have achieved Gr 9-11 learning than male detainees, who were more likely to have achieved only Gr 7-8 learning. Of note is that TB and HIV/AIDS was prevalent in a small proportion of both genders (Table 20).

Table 20: Socio-demographic profile of juvenile male and female on remand detainees

Characteristic	***Females*** *n=52* *column % (n)*	***Males*** *n=67* *column % (n)*	***p value****
Race			*0.46*
African black	*42.3 (22)*	*31.3 (21)*	
White	*1.9 (1)*	*3.0 (2)*	
Coloured	*55.8 (29)*	*65.7 (44)*	
Home language			*0.16*
English	*13.5 (7)*	*6.0 (4)*	
Afrikaans	*46.2 (24)*	*65.7 (44)*	
isiXhosa	*32.7 (17)*	*23.9 (16)*	
isiZulu	*0*	*1.5 (1)*	
other	*7.7 (4)*	*3.0 (2)*	
Education			*0.17*
Grade 7-8	*32.7 (17)*	*49.3 (33)*	
Grade 9-11	*63.5 (33)*	*46.3 (31)*	
Grade 12	*3.9 (2)*	*4.5 (3)*	
Birth place			*0.69*
Western Cape	*84.6 (44)*	*88.1 (59)*	
Eastern Cape	*3.9 (2)*	*6.0 (4)*	
Johannesburg	*3.9 (2)*	*1.5 (1)*	
Other	*7.7 (4)*	*4.5 (3)*	
With whom live			*0.48*
Parents	*50.0 (26)*	*58.2 (39)*	
Family	*21.2 (11)*	*23.9 (16)*	
Friends	*15.4 (8)*	*12.0 (8)*	
Other	*13.5 (7)*	*6.0 (4)*	
Tap inside house			*0.35*
Yes	*75.0 (39)*	*82.1 (55)*	
Electricity inside house			*0.06*
Yes	*88.5 (46)*	*97.0 (65)*	
Measure of hunger			*0.26*
No hunger (0-1)	*69.2 (36)*	*56.7 (38)*	
Moderate hunger (2-3)	*23.1 (12)*	*26.9 (18)*	
Severe hunger (4-6)	*7.7 (4)*	*16.4 (11)*	
Self-reported health issues (yes)			
Eating disorder	*0*	*0*	*-*
DMI	*2.0 (1)*	*0*	*0.25*
DMII	*0*	*0*	*-*
Hypertension	*9.8 (5)*	*0*	***0.01***
Hormone imbalance	*0*	*0*	***-***
TB	*3.9 (2)*	*1.5 (1)*	*0.41*
HIV/Aids	*9.8 (5)*	*7.5 (5)*	*0.65*
Weeks in facility (on remand)			***0.00***
0-7 days (1 week)	*71.7 (33)*	*98.5 (66)*	
8-14 days (2 weeks)	*26.1 (12)*	*1.5 (1)*	
14-21 days (3 weeks)	*2.2 (1)*	*0 (0)*	

**Pearson chi-square test*

4.2 Anthropometry of juvenile male and female on remand detainees

4.2.1 Female profile

The median (IQR) of BMI for female detainees was in the mid normal range, with the BMI of the majority falling in the normal weight category. However, 15% were underweight, 17.3% overweight and 5.8% obese (Table 21). The majority had a MUAC and triceps skinfold in the 25th to 75th percentiles range for their age group, while the cAMA of the majority could be classified as "average" and the MHGS as above or on the 50th percentile using age appropriate cut-off values.

4.2.2 Male profile

The median (IQR) BMI for male detainees was in the lower normal range with the majority BMI of the majority falling in the normal weight category. Of note is that 17.9% were underweight and that no male detainee was overweight or obese (Table 21). The greater majority had a MUAC and triceps skinfold that fell below the 25th percentile, were categorised as having a cAMA of "below average" or "wasted", and were classified as having a MHGS that fell above the 50h percentile using age appropriate cut-off values.

4.2.3 Male and female comparison

Male detainees were significantly taller (10cm taller) and weighed significantly more (80g) than female detainees yet, male detainees had a significantly lower BMI than females (Table 21). Female detainees were significantly more likely to be overweight or obese and a slightly larger proportion of males were classified as underweight than females.

Females had a significantly greater MUAC and triceps skinfold than males and males were significantly more likely to have a MUAC measurement that fell below the 25th percentile. None of the males had a MUAC above the 75th percentile, while 11.5% of females did. Males were significantly more likely to have a triceps measurement that fell below the 25th percentile, while females were more likely to have a triceps measure above the 75th percentile (Table 21).

Results for cAMA indicated that males had a significantly larger muscle area than females yet, juvenile males were significantly more likely to be classified as having a muscle mass that is "wasted" or "below average" than females (Table 21).

There was no significant difference between the genders for MHGS, but there is a trend for more male detainees to have a MHGS in the 75th percentile range than their female counterparts.

Table 21: Anthropometric measures and MHGS of juvenile male and female on remand detainees

Characteristic	***Females*** *n=52*	***Males*** *n=67*	***p value***
Height: mean ± SD	*1.6 ± 0.07*	*1.7 ± 0.08*	***0.00****
Weight: median (IQR)	*56.2 (49-66.7)*	*57.0 (38.9 – 74.3)*	***0.00*** **
BMI: median (IQR)	*22.5 (19.5- 24.5)*	*19.9 (18.9 – 21.4)*	***0.00*** **
BMI categories[1]: column % (n)			***0.00*** ***
Underweight	*15.4 (8)*	*17.9 (12)*	
Normal weight	*61.5 (32)*	*82.1 (55)*	
Overweight	*17.3 (9)*	*0*	
Obese	*5.8 (3)*	*0*	
MUAC (mm): median (IQR)	*272 (250 – 302)*	*254 (205 – 310)*	***0.02*** *
MUAC percentiles[2]: column % (n)			***0.00*** ***
<25	*23.1 (12)*	*82.1 (55)*	
25th-75th	*65.4 (34)*	*17.9 (12)*	
>75th	*11.5 (6)*	*0*	
Triceps (mm): median (IQR)	*14.6 (11.8 – 21.0)*	*5.9 (3.1 – 20.7)*	***0.00*** *
Triceps percentiles[2]: column % (n)			***0.00*** ***
<25	*32.7 (17)*	*70.2 (47)*	
25th-75th	*50.0 (26)*	*28.4 (19)*	
>75th	*17.3 (9)*	*1.5 (1)*	
cAMA (mm): median (IQR)	*32.0 (17.0-57.2)*	*36.4 (32.1-41.8)*	***0.02*** *
cAMA (cm²):[3] column % (n)			***0.00*** ***
Wasted	*3.9 (2)*	*34.3 (23)*	
Below average	*5.8 (3)*	*32.8 (22)*	
Average	*55.8 (29)*	*32.8 (22)*	
Above average	*19.2 (10)*	*0*	
High muscle mass	*15.4 (8)*	*0*	
MHGS: mean ±SD	*25.4 ± 5.6*	*39.3 ±7.4*	***0.00****
MHGS percentiles(kgf)[4]: column% (n)			*0.32****
10th	*19.2 (10)*	*11.9 (8)*	
25th	*23.1 (12)*	*17.9 (12)*	
50th	*21.2 (11)*	*22.4 (15)*	
75th	*28.9 (15)*	*44.8 (30)*	
90th	*7.7 (4)*	*3.0 (2)*	

Body mass index (BMI); Mid-upper arm circumference (MUAC); Corrected arm muscle area (cAMA); Maximum hand-grip strength (MHGS)

** Students T-test*

*** Mann-Whitney U test*

****Pearson chi-square test*

[1] BMI classification: Underweight (<18.5), Normal weight (18.5-24.99), Overweight (24.99-29.99), Obese (≥30.00).

[2] Appendix 4.1

[3] Wasted (≤ 5th percentile), Below average (>5thto≤15th percentile), Average (>15th to 85th percentile), Above average (>85th to ≤ 95th percentile), High muscle mass (>95th percentile) (Frisancho, 1990)

[4] Females: Weak (<15.25), Normal (15.26-40.74), Strong (>40.74) and Males: Weak (<21.75), Normal (21.76-58.24), Strong (>58.24) Dodds et al. (2014).

4.3 Body weight perceptions and weight loss attempts in juvenile male and female on remand detainees

4.3.1 Female profile

The majority of the female detainees perceived their current weight as "just the right weight" and 1 in 4 had tried to lose weight in the year preceding the study (Table 22).

4.3.2 Male profile

Nearly half of the male detainees thought that they were "too thin" while the other half thought they were "just the right weight". Only 1 in 8 indicated that they had tried to lose weight in the year preceding the study (Table 22).

4.3.3 Male and female comparison

Males were significantly more likely than females to think they are "too thin", while females were more likely to think that they are "too chubby/fat" (Table 22). Although not significantly different, there was a strong trend for females to have been more likely to have attempted weight loss in the year preceding the study.

Table 22 : Perception of body weight and weight loss attempt in the previous year of juvenile male and female on remand detainees

Characteristic	***Females*** *n=52* *column % (n)*	***Males*** *n=67* *column % (n)*	***p value*** *(Pearson chi-square test)*
When you look at yourself now you think you are:			***0.049***
Too thin	*38.5 (20)*	*47.8 (32)*	
Just the right weight	*46.2 (24)*	*49.3 (33)*	
Too chubby/fat	*15.4 (8)*	*3.0 (2)*	
Weight loss attempted in the previous year:			*0.06*
Yes	*25.0 (13)*	*11.9 (8)*	

4.4 Meal pattern and frequency of intake of juvenile male and female on remand detainees

4.4.1 Female profile

Female detainees consumed breakfast, lunch, supper and snacks on a daily basis (Table 23).

4.4.2 Male profile

Male detainees consumed supper and snacks on a daily basis, but breakfast was only consumed four times and lunch five times a week (Table 23).

4.4.3 Male and female comparison

There were no significant differences between male and female detainees for frequency of consumption of any one of the three meals or frequency of intake of individual or all snacks combined (Table 23). However, there was a strong trend for male detainees to eat breakfast less frequently than female detainees.

Table 23: Frequency of consumption of meals and snacks per week by juvenile male and female remand detainees

Characteristic	***Females*** *n=52* *median (IQR)*	***Males*** *n=67* *median (IQR)*	***p value***
Breakfast:	*7.0 (0-7)*	*4.0 (0-7)*	*0.08**
Snack 10am:	*5.0 (0-7)*	*4.0 (0-7)*	*0.25**
Lunch:	*7.0 (0-7)*	*5.0 (0-7)*	*0.26**
Snack 3pm:	*4.5 (0-7)*	*3.0 (0-7)*	*0.28**
Supper:	*7.0 (1-7)*	*7.0 (1-7)*	*0.39**
Snack 9pm:	*0.0 (0-7)*	*0 (0-7)*	*0.86**
Eat snacks total:	*9.5 (0-21)*	*8 (0-21)*	*0.35**

**Mann-Whitney U test (Z-adjusted p-value)*

4.5 Frequency of intake of indicator food items in juvenile male and female on remand detainees

4.5.1 Female profile

The weekly frequency of intake of indicator food items by female detainees in the week before incarceration is depicted in (Table 24). The most frequently consumed items were include sugar (4 times/day), crisps (1 time /day), white bread (1 time/day), sugar-containing beverages (4 times a week), rice/pasta/porridge/samp/potatoes (2 times a week), eggs (2 times a week), milk and milk products (once a week) and apple/pear/banana (once a week) (Table 24).

4.5.2 Male profile

The weekly frequency of intake of specific indicator food items by male detainees in the week before incarceration is depicted in (Table 24). The most frequently consumed items were sugar (2 times/day), crisps (1 time/day), brown bread (1 time a day), white bread (3 times/week), apple/pear/banana (3 times/week), margarine/butter (2 times/week), oranges (once a week) and peanut butter/peanuts (once a week). The median frequency of milk intake was 0 (IQR was 1-7), indicating that milk intake was very infrequent.

4.5.3 Male and female comparison

Female detainees had a significantly higher frequency of intake of eggs, rice/pasta/porridge/samp/potatoes and fat-cakes/doughnuts than male detainees. Males had a significantly higher frequency of intake of apples/bananas/pears and fried potato chips ("slap chips") than females (Table 24).

Table 24: Weekly frequency of intake of indicator food items by juvenile male and female on remand detainees in the week preceding incarceration

Characteristic	***Females*** *n=52*	***Males*** *n=67*	***p value****
	times/week Median (IQR)	*times/week Median (IQR)*	
Red meat like beef, mutton, pork, mincemeat sausage or "boerewors"	*0 (0-2)*	*0 (0-1)*	*0.09*
Organ meats like liver, kidneys, tripe etc.	*0 (0-1)*	*0 (0-1)*	*0.66*
Processed meats like "polony", "viennas" or "Russians" sausages	*0 (0-2)*	*0 (0-1)*	*0.45*
Chicken (not fried)	*0 (0-2)*	*0 (0-1)*	*0.79*
Chicken (fried)	*0 (0-1)*	*0 (0-1)*	*0.27*
Fish: fresh, tinned or smoked or "Bokkems" (not fried)	*0 (0-1)*	*0 (0-1)*	*0.21*
Fish: fried	*0 (0-0)*	*0 (0-0)*	*0.72*
Eggs	*2 (0-7)*	*0 (0-2)*	***0.01***

Characteristic	***Females*** *n=52*	***Males*** *n=67*	***p value****
Milk, sour milk, "maas" or yoghurt (as a drink or in porridge)	*1 (0-7)*	*0 (0-7)*	*0.38*
Cheese	*0 (0-1)*	*0 (0-1)*	*0.71*
Legumes like sugar beans, baked beans or lentils	*0 (0-0)*	*0 (0-1)*	*0.24*
White bread	*7 (0-14)*	*3 (0-14)*	*0.24*
Brown bread	*0 (0-14)*	*7 (0-14)*	*0.08*
Breakfast cereals like All bran, muesli, Weetbix	*0 (0-6)*	*0 (0-4)*	*0.98*
Oats porridge	*0 (0-3)*	*0 (0-1)*	*0.13*
Rice, "stywe-pap" or "slap pap" (maize), pasta, samp, potato (mash/ boiled)	*2 (0-7)*	*0 (0-3)*	***0.01***
Oranges or "naartjies"	*0 (0-2)*	*1 (0-7)*	*0.23*
Apples, bananas, pears	*1 (0-7)*	*3 (0-7)*	***0.04***
Orange or yellow vegetables like sweet potato, pumpkin, butternut, carrots	*0 (0-0)*	*0 (0-0)*	*0.61*
Green vegetables like spinach, peas, beans broccoli	*0 (0-1)*	*0 (0-0)*	*0.87*
Mixed vegetables (fresh, tinned or frozen)	*0 (0-2)*	*0 (0-1)*	*0.87*
Cabbage, cauliflower, lettuce	*0 (0-0)*	*0 (0-0)*	*0.32*
Tomato (raw or cooked)	*0 (0-2)*	*0 (0-2)*	*0.49*
Margarine or butter or lard on bread or in porridge	*0 (0-14)*	*2 (0-14)*	*0.99*
Peanut butter or Peanuts	*0 (0-7)*	*1 (0-6)*	*0.94*
Fried potatoes or slap chips	*0 (0-0)*	*0 (0-1)*	***0.02***
Other fried foods like fat cakes, doughnuts	*0 (0-1)*	*0 (0-0)*	***0.03***
Pies, sausage rolls, samosas	*0 (0-1)*	*0 (0-0)*	*0.14*
Sugar	*21 (1-21)*	*14 (0-21)*	*0.13*
Chocolate	*0 (0-7)*	*0 (0-6)*	*0.94*

Characteristic	***Females*** *n=52*	***Males*** *n=67*	***p value****
Sweets e.g. boiled, lollipops, jelly	*0 (0-28)*	*0 (0-14)*	*0.09*
Cake, biscuits	*0 (0-3)*	*0 (0-1)*	*0.88*
Fruit juice	*0 (0-1)*	*0 (0-0)*	*0.48*
HSB: Fizzy drinks like Coke, Cream Soda (not diet drinks)	*4 (0-14)*	*0 (0-8)*	*0.19*
Crisps like: Lays, Nik-Nacks, papas, pretzels	*7 (0-25)*	*7 (0-21)*	*0.79*
Take outs (KFC, McDonalds)	*0 (0-2)*	*0 (0-0)*	***0.059***
Jam, syrup, honey	*0 (0-6)*	*0 (0-6)*	*0.73*

**Mann-Whitney U test for all variables*

4.6 Frequency of intake of food groups in juvenile male and female on remand detainees

4.6.1 Female profile

The daily frequency of intake of the 8 food groups that were derived from the 37 food items listed in Table 24 by female detainees is presented in Table 25. Items from the high sugar group were the most frequently consumed (6 times/day), followed by starch items (3.3 times/day), high-fat snacks (1.9 times/day), protein foods (1.3/day) and fats and oils (once/day). The following food groups were not consumed on a daily basis: dairy, fruits and vegetables (Table 25).

4.6.2 Male profile

The daily frequency of intake of the 8 food groups that were derived from the 37 food items listed in Table 24 by male detainees is presented in Table 25. Items from the high sugar group were the most frequently consumed (4.6 times/day), followed by starch items (2.4 times/day), high-fat snacks (1.1 times/day), protein foods (once/day) and fats and oils (once/day). The following food groups were not consumed on a daily basis: dairy, fruits and vegetables (Table 25).

4.6.3 Male and female comparison

The only significant difference between male and female detainees for frequency of intake from food groups was for fruit, with males having consumed fruits significantly more frequently than females (Table 25).

Table 25: Daily frequency of intake of food groups by juvenile male and female on remand detainees in the week preceding incarceration

Characteristic	***Females*** *n=52* *times/day* *median (IQR)*	***Males*** *n=67* *times/day* *median (IQR)*	***p value****
Protein foods: *Red meat, chicken not-fried and fried, fish not-fried and fried, "bokkems", tinned fish, smoked fish, eggs, organ meats, processed meat, legumes*	*1.3 (0.6-2.3)*	*1.0 (0.3-1.7)*	*0.10*
Dairy products: *Milk, cheese, "maas", yogurt*	*0.1 (0.0-1.1)*	*0.1 (0.0-2.0)*	*0.47*
Starch foods: *Brown bread, high fibre breakfast cereals, oats; White bread, Rice, "stywe-pap" or "slap pap" (maize porridge), pasta, samp, potato (mash/ boiled)*	*3.3 (2.0-4.1)*	*2.4 (2.0-3.6)*	*0.08*
Fruit group: *Apples, banana, oranges, "naartjies" etc.*	*0.3 (0.0-1.0)*	*0.6 (0.1-2.0)*	***0.04***
Vegetable group: *Yellow, green, white, mix vegetables, tomatoes*	*0.3 (0.0-1.1)*	*0.1 (0.0-1.0)*	*0.40*
Fats and oils: *Margarine, butter, peanut butter, peanuts, oil*	*1.0 (0.0-3.0)*	*1.0 (0.0-2.1)*	*0.53*
High-fat snacks: *Fried potato chips, fat cakes/ "vet koek", pies, crisps, take-out*	*1.9 (0.3-5.0)*	*1.1 (0.4-3.7)*	*0.49*
High-sugar products: *Sugar, sweets, chocolate, cakes & biscuits, jam, fruit juice, sugar containing fizzy drinks*	*6.0 (2.0 -11.9)*	*4.6 (2.0-7.3)*	*0.17*

**Mann-Whitey U test for all variables*

4.7 Availability of healthy foods in the home of juvenile male and female on remand detainees

4.7.1 Female profile

Vegetables were available and were served almost always in the home of the majority of female detainees, while fruit was available often. Just more than half did not have milk

available in the home almost always (Table 26). For the majority of female detainees' fruit juice was available never/sometimes.

4.7.2 Male profile

Vegetables were available and were served almost always in the home of half of the male detainees, while the other half had vegetables often (see Table 26). Slightly more than half reported that fruit was available often, while more than half had milk available in the home almost always. For the majority of male detainee's fruit juice was available in the home never/sometimes.

4.7.3 Male and female comparison

There were no significant differences between the genders for availability of healthy foods in the home. However, there was a trend for vegetables to have been more available in the homes of female than in the homes of male detainees (Table 26).

Table 26: Availability and serving of healthy foods in the home of juvenile male and female on remand detainees

Characteristic	***Females*** *n=52* *column %(n)*	***Males*** *n=67* *column %(n)*	***p value***
Fruit available:			*0.75**
Never/sometimes	*19.2 (10)*	*23.9 (16)*	
Often	*51.9 (27)*	*52.4 (35)*	
Almost always	*28.9 (15)*	*23.9 (16)*	
Vegetables available:			*0.08**
Never/sometimes	*7.7 (4)*	*7.5 (5)*	
Often	*25.0 (13)*	*44.8 (30)*	
Almost always	*67.3 (35)*	*47.8 (32)*	
Vegetables served:			*0.17**
Never/sometimes	*9.6 (5)*	*7.5 (5)*	
Often	*30.8 (16)*	*47.8 (32)*	
Almost always	*59.6 (31)*	*44.8 (30)*	
Milk available:			*0.79**
Never/sometimes	*13.5 (7)*	*10.5 (7)*	
Often	*38.5 (20)*	*35.8 (24)*	
Almost always	*48.12 (25)*	*53.7 (36)*	
Fruit juice available:			*0.65**
Never/sometimes	*46.2 (24)*	*43.3 (29)*	
Often	*32.7 (17)*	*40.3 (27)*	
Almost always	*21.2 (11)*	*16.4 (11)*	

Never (once every two months), Sometimes (once a month), Often (once a week), Almost always (every day of the week)
**Chi-Square test*

4.8 Knowledge of healthy eating in juvenile male and female on remand detainees

4.8.1 Female profile

The food items most commonly mentioned by female detainees as being good for health are in descending order: vegetables, fruits and starchy foods. Only a quarter were able to mention items that covered more than three out of the seven investigated FBDG (Table 27).

4.8.2 Male profile

The food items most commonly mentioned by male detainees as being good for health are in descending order: vegetables, fruits and starchy foods. Only a quarter were able to mention items that covered more than three out of the seven investigated FBDG (Table 27).

4.8.3 Male and female comparison

There were no significant differences between male and female detainees for the type of food groups mentioned or for the number of food groups mentioned when asked; "What do you need to eat to be healthy" (Table 27).

Table 27: Knowledge of healthy eating of juvenile male and female on remand detainees based on responses to the question: "What do you need to eat to be healthy?"

Characteristic	***Females*** *n=52*	***Males*** *n=67*	***p value***
Food groups mentioned:	*Column %(n)*	*Column %(n)*	
Fruit	*66.7 (34)*	*63.2 (43)*	*0.70**
Vegetables	*80.4 (41)*	*86.8 (59)*	*0.35**
Protein (animal and plant proteins)	*35.3 (18)*	*36.8 (25)*	*0.88**
Dairy products	*21.6 (11)*	*16.2 (11)*	*0.45**
Starches and cereals	*39.2 (20)*	*54.4 (37)*	*0.10**
Fats and oils	*13.7 (7)*	*14.7 (10)*	*0.88**
Water	*11.8 (6)*	*19.1 (13)*	*0.28**
Number of food groups mentioned	*Column % (n)*	*Column % (n)*	
Mentioned 0 groups	*5.8 (3)*	*0*	*0.14**
Mentioned 1 groups	*5.8 (3)*	*9.0 (6)*	
Mentioned 2 groups	*28.9 (15)*	*26.9 (18)*	
Mentioned 3 groups	*32.7 (17)*	*38.8 (26)*	
Mentioned more than 3 groups	*26.9 (14)*	*25.38 (17)*	

**Pearson chi-square test*

4.9 Physical activity and sedentary behaviour in juvenile male and female on remand detainees

4.9.1 Female profile

The majority of female detainees achieved an "active" MET score, with the "travelling" PA category (walking and cycling) contributing the most minutes to total physical activity (Table

28). Only 1 in 4 female detainees took part in vigorous PA and the majority did not do any form of PA at work. More than half did not do any form of recreational PA and spent a median of 3 hours per day being sedentary (Table 28).

4.9.2 Male profile

The greater majority of males achieved an "active" MET score category, with both travelling (walking and cycling) and recreational PA contributing to the total PA minutes (Table 28). More than two thirds of the male detainees did vigorous PA and the greater majority of these detainees did more than 75 minutes of vigorous activity per week. Male detainees also spent a median of three hours per day being sedentary.

4.9.3 Male and female comparison

Although the MET minutes score did not differ significantly between the genders and the majority of both genders were categorized as "active"; the amount of vigorous activity (minutes) was significantly higher in male detainees (Table 28). This is also reflected in the higher proportion of males than females who did more than 75 minutes vigorous PA per week. Male detainees also spent significantly more time (minutes) doing recreational PA than female detainees.

Table 28: Physical activity and sedentary time spent in the month preceding incarceration of juvenile male and female on remand detainees

Characteristic	***Females*** *n=52*	***Males*** *n=67*	***p value***
MET min score total/ week (column %(n))			*0.07**
Active (≥ 3000)	*67.3 (35)*	*83.6 (56)*	
Minimally active (600 – 2999)	*25.0 (13)*	*14.9 (10)*	
Inactive (≤ 599)	*7.7 (4)*	*1.5 (1)*	
Average PA minutes per day (median; IQR)			
#Work (vigorous and moderate)	*0.0 (0-0)*	*0.0 (0-6)*	*0.63***
Travelling (moderate only)	*60 (17 – 180)*	*60 (17- 129)*	*0.85***
Recreation (vigorous and moderate)	*0.0 (0 – 51)*	*26 (0 – 77)*	***0.01****
Total (vigorous and moderate)	*106 (51-300)*	*150 (66-325)*	*0.29***
PA average percentage contribution per category per day: (median; IQR)			
#Work	*0 (0-0)*	*0 (0 -12.5)*	*0.77**
Travelling	*83.3 (25 -100)*	*41.1 (20-100)*	***0.02****
Recreation	*0 (0 - 38.5)*	*37.5 (0-75)*	***0.00****
Vigorous PA total >75 minutes per week (work & recreation) (column %(n))	*23.5 (12)*	*68.7 (46)*	***0.00****
Not doing any vigorous activity at all (column %(n))	*70.6 (36)*	*29.9 (20)*	***0.00****
Not doing PA per category (column %(n))			
#Work	*78.4 (40)*	*74.6 (50)*	*0.63**
Travelling	*3.9 (2)*	*10.5(7)*	*0.19**
Recreation	*56.9 (29)*	*32.8 (22)*	***0.00****
Sedentary minutes spent on average per day (median; IQR)	*180 (120 – 240)*	*180 (120 – 240)*	*0.39***

Physical activity (PA); General physical activity questionnaire version 1 (GPAQ-1); Metabolic equivalent of task minutes (MET min)

#Working in the GPAQ does not indicate actual employment in a job, this only indicates hours working "like cleaning a house" but not necessarily for payment.

**Pearson Chi-square*

***Mann-Whitney U test (Z-adjusted p-test)*

4.10 Level of symptoms of depression and anxiety and risk taking behaviour in juvenile male and female on remand detainees

4.10.1 Female profile

Seven out of 10 females experienced moderate to very-high levels of symptoms of depression and anxiety in the month preceding the assessments (Table 29). The majority smoked every day and used alcohol sometimes. A third of the females reported using illicit substances every day.

4.10.2 Male profile

Seven out of 10 males experienced moderate to very-high levels of symptoms of depression and anxiety in the month preceding the assessments (Table 29). The greater majority smoked every day, used alcohol sometimes and a third reported using illicit substances every day.

4.10.3 Male and female comparison

There were no significant differences between the two gender groups for levels of distress, alcohol use and use of illicit substances (Table 29). Male detainees were however significantly more likely to smoke.

Table 29: Symptoms of depression and anxiety in the month preceding incarceration and risk taking behaviour of juvenile male and female on remand detainees

Characteristic	***Females*** *n=52*	***Males*** *n=67*	***p value***
Presence of symptoms of depression and anxiety: column % (n)			
Low (score<20)	*25.5 (13)*	*25.4 (17)*	*0.86**
Moderate (score 20-24)	*15.7 (8)*	*11.9 (8)*	
High (score 25-29)	*19.6 (10)*	*25.4 (17)*	
Very high (score ≥30)	*39.2 (20)*	*37.3 (25)*	
Score for symptoms of depression and anxiety: mean ± SD	*27.5 ± 9.5*	*26.7 ± 7.8*	*0.62***
Smoking category: column %(n)			***0.01****
Never	*23.5 (12)*	*6.0 (4)*	
Sometimes	*11.78 (6)*	*17.9 (12)*	
Every day	*64.7 (33)*	*76.1 (51)*	
Alcohol use: column %(n)			*0.48**
Never	*39.2 (20)*	*46.3 (31)*	
Sometimes	*60.8 (31)*	*52.2 (35)*	
Every day	*0 (0)*	*1.5 (1)*	
Use of illicit substances: column %(n)			*0.69**
Never	*33.3 (17)*	*28.4 (19)*	
Sometimes	*35.3 (18)*	*32.8 (22)*	
Every day	***31.4 (16)***	***38.8 (26)***	

**Chi-square test*
***Student t-test*

4.11 Associations between BMI, cAMA and MHGS and other variables in juvenile female on remand detainees

Please note that only significant associations between BMI, cAMA and MHGS and select variables are presented in Table 30 - 32. The full correlation matrices and cross-tabulations are included in Appendix 4.2.

4.11.1 Significant associations between BMI and other variables

BMI was significantly positively correlated with weight, MUAC, triceps, cAMA and duration of incarceration in the correctional facility before research assessments were done (Table 30). There was also a significant positive association between BMI and the frequency of vegetable consumption and negative correlations with MET minutes per week, smoking and illicit substance use (Table 30).

Females from the coloured ethic group were more likely to be underweight than those from the black African ethnic group, who were more likely to be overweight (Table 31). Females with Afrikaans as home language were more likely to be underweight than those who had Xhosa or English as home language, while females with Xhosa as home language were more likely to be overweight and obese with none of those with Afrikaans as home language being overweight or obese (Table 31).

There were no significant associations between BMI and any of the other variables.

4.11.2 Significant associations between cAMA and other variables

Corrected arm muscle area (cAMA) was significantly positively correlated with weight, BMI, MUAC and MHGS. The frequency of consumption of items from the fruit group was also positively correlated with cAMA (significant) (Table 30).

There were no significant associations between cAMA and any other variables.

4.11.3 Significant associations between MHGS and other variables

Maximum hand-grip strength (MHGS) was positively correlated with height, weight, MUAC and cAMA (Table 30). The score for depression and anxiety symptoms was negatively associated with MHGS and females who had more than two children were more likely to have a MHGS score that was below the 25th percentile than those who had two or fewer children (Table 32).

There were no significant associations between MHGS and any of the other variables.

*Table 30: Significant[1] Spearman correlations between BMI, cAMA and MHGS and other variables in juvenile **female** remand detainees*

Females			
	BMI	*cAMA*	*MHGS*
Height			*r=0.4 p=0.01*
Weight	*r=0.9 p=0.00*	*r=0.6 p=0.000*	*r=0.4 p=0.006*
BMI		*r=0.5 p=0.000*	
MUAC	*r=0.9 p=0.000*	*r=0.7 p=0.000*	*r=0.3 p=0.03*
Triceps	*r=0.8 p=0.000*		
cAMA	*r=0.5 p=0.000*		*r=0.3 p=0.03*
MHGS		*r=0.3 p=0.03*	
Duration in facility	*r=0.3 p=0.02*		
Fruit		*r=0.3 p=0.03*	
Vegetables	*r=0.3 p=0.02*		
MET min/week	*r=-0.3 p=0.03*		
Symptoms of anxiety and depression score			*r=-0.6 p=0.000*
Smoke	*r=-0.5 p=0.000*		
Illicit substances	*r=-0.5 p=0.000*		
Number of children			*r=-0.4 p=0.009*

Body mass index (BMI); Mid upper arm circumference (MUAC); Corrected arm muscle area (cAMA); Maximum hand-grip strength (MHGS)
MET min/ week: Metabolic equivalent of task minutes per week.
[1]Empty cells depict non-significant correlations

*Table 31: Cross tabulation of categorical demographic variables by BMI categories for juvenile **female** on remand detainees (column % (n))*

Variables	***BMI categories***				***p-value****
	Underweight	***Normal weight***	***Over weight***	***Obese***	
Ethnicity African black	*25 (2)*	*28.1 (9)*	*88.9 (8)*	*100 (3)*	***0.01***

White	*0*	*3.1 (1)*	*0*	*0*	
Coloured	*75 (6)*	*68.8 (22)*	*11.1 (1)*	*0*	
Language					***0.035***
English	*12.5 (1)*	*12.5 (4)*	*11.1 (1)*	*33.3 (1)*	
Afrikaans	*62.5 (5)*	*59.4 (19)*	*0*	*0*	
isiXhosa	*25.0 (2)*	*18.8 (6)*	*77.8 (7)*	*66.7 (2)*	
Other	*0*	*9.4 (3)*	*11.1 (1)*	*0*	

**Chi-square test*

*Table 32: Cross-tabulation of number of children by MHGS percentiles in juvenile **female** on remand detainees. (column % (n))*

Parity	***Percentile <25 % (n)***	***50th % (n)***	***>75th % (n)***	***p-value***
				0.00*
None	*0*	*52 (26)*	*0*	
One child	*0*	*44 (22)*	*0*	
Two children	*50 (1)*	*2 (1)*	*0*	
Three children	*0*	*2 (1)*	*0*	
Four children	*50 (1)*	*0*	*0*	

**Chi square test*

*4.12 Predictors of BMI, cAMA and MHGS in juvenile **female** on remand detainees*

Results for significant predictors of BMI, cAMA and MHGS are presented in the text. Reference is made to the probable clinical significance of each statistically significant predictor. Motivations for the decisions regarding the clinical significance of each predictor are presented in Table 33.

4.12.1 Predictors of BMI

Significant predictors of BMI when all other variables remain constant in the regression model include the following:

*<u>Illicit substance use</u>: As illicit substance use increased in frequency by one category from never to sometimes and from sometimes to every day, the average BMI **decreased** by 2.64 kg/m² per category change; (p<0.001). This is a predictor of probable clinical significance (Table 33).*

<u>Availability of fruit juice</u>: As the availability of fruit juice in the home increased in frequency by one category from yearly to monthly; from monthly to weekly and from weekly to daily, the

*average BMI **decreased** by 1.5 kg/m² per category change; (p=0.005). This is a predictor of probable clinical significance (Table 33).*

*Frequency of vegetable consumption: With each unit increase in the number of times vegetables were consumed per week, the average BMI **increased** by 0.32 kg/m²; (p=0.002). This is a predictor of probable clinical significance (Table 33).*

*Frequency of dairy consumption: With each unit increase in the number of times dairy was consumed per week, the average BMI **decreased** by 0.13 kg/m², (p=0.003). This is a predictor of probable clinical significance (Table 33).*

*Frequency of high-fat snacks consumption: With each unit increase in the number of times high-fat snacks were consumed per week, the average BMI **increased** by 0.08 kg/m²; (p=0.009). This is a predictor of probable clinical significance (Table 33).*

*Physical activity behaviour (total MET minutes per week): With each MET minute of increased physical activity (work, travel or recreation activity combined), the average BMI **decreased** by 0.0002 kg/m² per MET minute; (p=0.007). This is a predictor of probable clinical significance (Table 33).*

4.12.2 Predictors of cAMA

Significant predictors of cAMA when all other variables remain constant in the regression model include the following:

*Depression and anxiety score: With each unit increase in the distress score, the average cAMA **decreased** by 0.43cm² per category change; (p=0.001). This is a predictor of probable clinical significance (Table 33).*

Home language: Afrikaans home language speaking females had a lower average cAMA than the English, Zulu or "other language" speaking females, with 10.63cm²; (p=0.009). This is a predictor of probable clinical significance (Table 33).

*Knowledge of healthy eating: With each additional food group that females could mention as being important for health, the average cAMA decreased by 2.90cm² per category; (p=0.005). This predictor is probably **not** of clinical significance (Table 33).*

*Frequency of vegetable consumption: With each unit increase in the number of times vegetables were consumed per week, the average cAMA **increased** by 0.50 kg/m²; (p=0.03). This predictor is probably **not** of clinical significance (Table 33).*

4.12.3 Predictors of MHGS

Significant predictors of MHGS when keeping all other variables remain constant in the regression model include the following:

*Depression and anxiety score: With each unit increase in the depression and anxiety score, the average MHGS **decreased** by 0.4 kgf; (p<0.0001). This is a predictor of probable clinical significance (Table 33).*

Home language: The average MHGS for Afrikaans home language speaking females was 7.4 kgf less than the average MHGS of English, Zulu or "other language" speaking females; (p=0.001). This is a predictor of probable clinical significance (Table 33).

Table 33: Clinical significance of statistically significant predictors of BMI, cAMA and MHGS for juvenile female on remand detainees

Predictors	***Value of predictor per unit***	***Mean ±SD / median (IQR) value for the variable***	***Cut-off criterion for clinical significance****	***Interpretation of clinical significance***
BMI predictors (R^2=0.5)**	*kg/m² (p-value)*			
Availability of fruit juice at home	***-1.5 (0.005)***	*1 (0-2)* *[4 units]*	*≥0.9kg/m²*	*Availability of fruit juice at home is a predictor of probable clinical significance for female detainees since the predictor value is ≥0.9kg/m².*
Frequency of dairy food group intake per week	***-0.13 (0.003)***	*1 (0-8)*		*Dairy intake has to increase by **7 times per week** over and above the median intake of 1 time per week to be ≥0.9kg/m². Thus frequency of intake should reach a minimum of 8 times per week (1.1 times per day) for the predictor to be of clinical significance, which is deemed to be feasible and in line with the FBDG, indicating that frequency of dairy intake is a predictor of probable clinical significance of a lower BMI for female detainees. A review on the effect of dairy on weight and body fat composition showed that the effect of dairy intake was not associated with weight gain and body fat composition (Lanou, 2008), but rather is part of the complex associations between meal patterns and healthy lifestyle including increased fibre intake and reduced dietary fat intake (Liu, 2005).*
Frequency of high fat snack food group intake per week	*0.08 (0.009)*	*13 (2-35)*		*High fat snack intake has to increase by **12 times per week** over and above the median intake of 13 times per week to be ≥ 0.9kg/m². Thus frequency of intake should reach a minimum of 25 times a week (3.5 times a day), which is feasible bearing in mind the median (IQR) for frequency of high fat snack intake per week and the fact that adolescents are known to eat energy dense, high fat snacks regularly (Reddy, 2010; Kant, 2003). Frequency of high fat snack intake is thus a predictor of probable clinical significance of a higher BMI in female detainees.*

Frequency of vegetable food group intake per week	*0.32 (0.002)*	*2 (0-8)*		*Vegetable intake has to increase by **3 times per week** over and above the median of 2 times per week, to be ≥0.9kg/m². Considering the median (IQR) result for frequency of vegetable intake per week, it is deemed possible for female detainees to achieve a frequency of 5 per week (less than 1 times a day), indicating that frequency of vegetable intake is predictor of probable clinical significance of a higher BMI in female detainees.*
Total MET minutes per week	***-0.0002 (0.007)***	*4200 (2160-10480) MET minutes per week*		*MET minutes per week has to increase by **4500 MET minutes per week** over and above the median of 4200 MET minutes per week to be ≥0.9kg/m². Considering the median (IQR) result for MET minutes/week, it is deemed possible for female detainees to do 8700 MET minutes per week (1243 MET minutes per day). 1243MET minutes/day equates to 310 minutes (5 hours) per day of moderate physical activity or 155 minutes (2.5 hours) per day of (vigorous physical activity. This indicates that MET minutes per week is predictor of probable clinical significance of a lower BMI in female detainees.*
Illicit substance use	***-2.64 (<0.001)***	*1 (0-2) [3 units]*		*Illicit substance use is a predictor of probable clinical significance for female detainees since the predictor value is ≥0.9kg/m².*
cAMA predictors (R²=0.4)	*cm² (p-value)*			
Frequency of vegetable food group intake per week	*0.50 (0.03)*	*2 (0-8)*	*3.8cm²*	*Vegetable intake has to increase by **8 times per week** over and above the median of 2 times per week be ≥ 3.8cm²; frequency of intake should thus reach a minimum of **10 times per week** (1 time per day). Considering the median (IQR) for frequency of vegetable intake it is deemed not feasible for female detainees to achieve this intake, indicating that frequency of vegetable intake is probably **not** a clinically significant predictor of a higher cAMA in female detainees.*
Score for symptoms of depression and anxiety	***-0.43 (0.001)***	*27.5 ± 9.5 [maximum score:50]*		*The score for symptoms of depression and anxiety has to increase by **9 units** over and above the mean score of 27.5 to be ≥3.8cm². The score should thus reach 37, which is*

				deemed feasible when considering the mean (SD) score for female detainees as well as the fact that adolescents and detainees are at risk of having poor mental health (Fazel, 2012). Presence of depression and anxiety symptoms is thus a predictor of probable clinical significance r of a lower cAMA in female detainees.
Knowledge of healthy eating	***-2.90 (0.005)***	*3 (2-4) [maximum number: 7]*		*The number of food groups mentioned needs to increase **by 2** over and above the median of 3 mentioned to be ≥ 3.8cm². Considering the median (IQR) for number of groups mentioned this is not deemed feasible, indicating that knowledge of what to eat to be healthy is probably **not** a clinically significant predictor of a higher cAMA in female detainees.*
Afrikaans home language	***-10.63 (0.009)***	*46.2%*		*Having Afrikaans as home language is a predictor of probable clinical significance cAMA in female detainees, since the predictor value is ≥ 3.8cm² .*
MHGS predictors (R²=0.5)	*Kgf (p-value)*			
Score for symptoms of depression and anxiety	***-0.41 (<0.0001)***	*27.5 ± 9.5 [maximum score:50]*	*3kgf*	*The score for symptoms of depression and anxiety has to increase by **8 units** over and above the mean of 27.5 to be ≥ 3kgf. Thus the total score should reach 36, which is deemed feasible when considering the mean (SD) score for female detainees. Presence of depression and anxiety symptoms is thus a predictor of probable clinical significance of a lower MHGS for female detainees.*
Afrikaans home language	***-7.36 (<0.001)***	*46.2%*		*Having Afrikaans as home language is a predictor of probable clinical significance of MHGS for female detainees, since the predictor value is ≥ 3kgf*

Abbreviations: SD=Standard deviation, IQR=Interquartile range, BMI= Body mass index, FBDG= Food based dietary guidelines, MET min= Metabolic equivalent of task minutes, cAMA= corrected arm muscle area, MHGS= Maximum handgrip strength.

**Please refer to section 3.9 for the explanation of how these criteria were developed*

***R^2 indicates what percentage of the variability of a dependant variable can be explained by a particular independent predictor (Petrie & Sabin 2009). R-squared is the statistical measure of how close the data are to the fitted regression line (an assessment of goodness of fit). Even when the R^2 value is low, you can still draw important conclusions about how changes in the predictor values are associated with changes in the response value of those values that are significant. R^2 values are usually low when human behaviours are being explored (Frost, 2013).*

4.13 Associations between variables other than anthropometric measures and MHGS within the **female** on remand detainee group

In this section associations between frequency of consumption of food groups, meal pattern, availability and serving of select food items at home, food security, knowledge of what to eat to be health, symptoms of depression and anxiety, risk taking behaviour and physical activity indicators are presented.

4.13.1 Associations between frequency of consumption of food groups as well as availability of foods in the home and select variables within the **female** on remand detainee group

Food groups X Meal pattern

There was a significant positive correlation between frequency of eating supper and frequency of consumption of items from the high-fat snacks group (Table 34). There was also a significant positive correlation between frequency of eating snacks and frequency of consumption of items from every one of the six food groups listed in Table 34.

There were no significant associations between frequency of intake of any meals or snacks and the frequency of intake of fruits and vegetables. There were also no significant associations between frequency of consumption of breakfast or lunch and any of the food groups within the female group (results not shown in a table).

Table 34: Significant associations between frequency (per week) of consumption of food groups and meal pattern for juvenile female on remand detainees.

Meal pattern	***Quality protein foods***	***Dairy***	***Starch***	***Fats and oils***	***High-fat snacks***	***High-sugar products***
Supper	*r=0,18 p=0,229*	*0,17 p=0,223*	*r=0,20 p=0,171*	*r=0,18 p=0,196*	*r=0,29 p=0,038*	*r=0,26 p=0,067*
Snacks	*r=0,38 p=0,006*	*r=0,35 p=0,011*	*r=0,34 p=0,013*	*r=0,33 p=0,019*	*r=0,44 p=0,001*	*r=0,36 p=0,009*

Food groups X Availability of food in the home

The following significant associations were evident between food group intake and availability of foods in the home. Frequency of consumption of both fruit and vegetables was positively correlated with having fruit in the home and serving vegetables during meal times, while

vegetable consumption was positively correlated with having vegetables and fruit juice in the home. Frequency of consumption of quality protein was positively correlated with having vegetables available and vegetables being served at meal times. Dairy intake was positively correlated with availability of dairy and fruit juice in the home (Table 35).

There were no significant associations between starches, fats and oils, high-fat snacks and high-sugar product intake and any of the variables on the availability of foods in the home (results not shown in a table).

There were no significant associations between food security measured by the hunger score and the frequency of consumption of items from any of the food groups (results not shown in a table).

Table 35: Significant associations between frequency (per week) of consumption of items from food groups and availability of food in the home for juvenile female on remand detainees

Availability of healthy foods in the home	***Quality protein foods***	***Dairy***	***Fruit***	***Vegetables***
Fruit at home	*r=0,21 p=0,141*	*r=0,21 p=0,134*	*r=0,31 p=0,029*	*r=0,42 p=0,002*
Vegetables in the home	*r=0,36 p=0,010*	*r=0,24 p=0,084*	*r=0,27 p=0,051*	*r=0,33 p=0,019*
Vegetables served at meal times	*r=0,31 p=0,028*	*r=0,26 p=0,064*	*r=0,30 p=0,035*	*r=0,36 p=0,009*
Milk in the home	*r=0,13 p=0,350*	*r=0,29 p=0,043*	*r=0,14 p=0,313*	*r=0,26 p=0,071*
Fruit juice in the home	*r=0,15 p=0,287*	*r=0,37 p=0,007*	*r=0,18 p=0,219*	*r=0,45 p=0,001*

Food groups X Knowledge of healthy eating

There was a significant positive correlation between nutrition knowledge and frequency of consumption from items from the high-fat snack group (r=0.33, Spearman p=0.017). There were no significant associations between nutrition knowledge and frequency of consumption from any of the other food groups (results not shown in a table).

Food groups X Risk taking behaviour and depression and anxiety symptoms

There were significant negative correlations between frequency of alcohol intake and frequency of intake of items from the dairy, fats and oils group and high-sugar products groups (Table 36).

There was a significant negative correlation between frequency of illicit substance use and frequency of consumption of items from the vegetable group (Table 36).

There were no further associations between alcohol and illicit substance use and frequency of consumption of any of the other food groups. There were also no associations between frequency of smoking or depression and anxiety symptoms and frequency of consumption from any of the food groups (results not shown in a table).

Table 36: Significant associations between frequency (per week) consumption of items from food groups and risk taking behaviours for female on remand detainees

Variables	***Quality protein foods***	***Dairy***	***Vegetables***	***Fats and oils***	***High sugar products***
Alcohol	*r=-0,12 p=0,404*	*r=-0,31 p=0,026*	*r=-0,10 p=0,475*	*r=-0,41 p=0,003*	*r=-0,30 p=0,032*
Illicit substance use	*r=-0,23 p=0,102*	*r=-0,07 p=0,646*	*r=-0,36 p=0,009*	*r=0,26 p=0,064*	*r=0,13 p=0,375*

Food groups X Physical activity

There were significant positive correlations between time spent being sedentary (minutes per week) and frequency of consumption of items from the quality protein, starch and fruit groups (Table 37). The amount of sport done (minutes per week) was significantly positively correlated with frequency of consumption of items from the fruit and high-sugar product groups.

There were no further significant associations between physical activity variables and frequency of consumption of items from the food groups.

Table 37: Significant associations between frequency (per week) consumption of items from food groups and physical activity and sedentary time for female on remand detainees

Physical activity	***Quality protein foods***	***Starch***	***Fruit***	***High sugar products***
Sedentary minutes per week	*r=0,37 p=0,008*	*r=0,32 p=0,023*	*r=0,28 p=0,048*	*r=0,08 p=0,566*
Sport minutes per week	*r=0.19 p=0.184*	*r=0.04 p=0.802*	*r=0.33 p=0.020*	*r=0.43 p=0.002*

4.13.2 Further associations between physical activity and select variables within the female on remand detainee group

Risk taking behaviour X Depression and anxiety symptoms

There were significant positive correlations between frequency of smoking and travel time (minutes per week) (r=0.34, Spearman p-value=0.015) and total MET minutes per week (r=0.3, Spearman p-value=0.034). There were also significant positive correlations between frequency of illicit substance use and travel time (minutes per week) (r=0.32, Spearman p-value=0.021) and total MET minutes per week (r=0.29, Spearman p-value=0.04). Frequency of alcohol intake was not associated with these two variables.

Risk taking behaviour X Physical activity

There were no significant associations between risk taking behaviours (smoking, alcohol or illicit substance use) and the other PA related variables, including sedentary minutes per week, vigorous activity, moderate and vigorous activity, work minutes or recreation minutes per week (results not shown).

Symptoms of depression and anxiety score X Physical activity

There were no significant associations between symptoms of depression and anxiety score and any of the PA variables (results not shown).

4.13.3 Further associations not covered in previous sections within the juvenile female on remand detainee group

Depression and anxiety score X Length of stay in facility

The longer females had been in the correctional facility the lower the score for depression and anxiety symptoms were (r=-0.34, Spearman p-value=0.013).

Food security X Risk taking behaviours

There were significant negative correlations between illicit substance use and the availability of vegetables in the home (r=-0.36, Spearman p-value=0.009), vegetables being served during meal times (r=-0.42, Spearman p-value=0.002) and fruit juice in the home (r=-0.30, Spearman p-value=0.032).

There were no significant associations between healthy food availability in the home depression and anxiety symptoms, smoking or alcohol use, nor were there further significant

associations between risk taking factors of smoking, alcohol and illicit substance use and level of distress (results not shown).

Availability of food in the home X Food insecurity and illicit substances

There were, however, significant negative correlations between the availability of vegetables, fruit and dairy in the house and hunger score (Table 38).

There were no further significant associations between depression and anxiety symptoms, smoking or alcohol use with the availability of healthy foods in the home.

Table 38: Significant associations between availability of food in the home and hunger score and illicit substance use for female on remand detainees

Variables	***Fruit at home***	***Vegetables at home***	***Veg served during meal times***	***Milk at home***	***Fruit juice at home***
Hunger score	*r=-0,28 p=0,042*	*r=-0,46 p=0,001*	*r=-0,44 p=0,001*	*r=-0,56 p<0,001*	*r=-0,06 p=0,651*
Illicit substance use	*r=-0,26 p=0,069*	*r=-0,36 p=0,009*	*r=-0,42 p=0,002*	*r=-0,16 p=-0,30*	*r=0,266 p=0,032*

*4.13.4 Associations between select **categorical variables** within the **female** on remand detainee group*

Pregnancy X Other lifestyle variables

There was a significant positive correlation for age and the number of children that female detainees have (r=0.4, Spearman p-value=0.003).

Female detainees who had given birth to one or more children were more likely to have achieved a higher school grade than those who had no children. Results for this cross-tabulation are as follows [grade: %(n)]: Given birth: Grade 7-8: 19% (5); Grades 9-11: 74% (20) and Grade 12: 7.4% (2). Not given birth: Grade 7-8: 48% (12); Grade 9-11: 52% (13); Grade 12: none (Pearson Chi Square test p-value: 0.04).

There were no further significant associations between having given birth and socio-demographic, dietary, physical activity, depression and anxiety symptoms and risk taking behaviours (results not shown).

Ethnic group X Home language and risk taking behaviours

Females from the coloured ethnic group were significantly more likely to have Afrikaans as their home language, while those from the black African ethnic group were significantly more likely to speak isiXhosa (Table 39).

Female detainees from the coloured ethnic group were significantly more likely to smoke daily than those from the black African group, who are more likely to have never smoked (Table 39).

Female detainees from the black African ethnic group were significantly less likely to use illicit substances, while those from the coloured ethnic group were more likely to use illicit substances every day (Table 39).

Table 39 : Cross-tabulation of home language, smoking, alcohol and illicit substance use by ethnic group within the female on remand detainee group

Characteristic	***Ethnic group***			***p-value****
	African black column % (n)	***White column % (n)***	***Coloured column % (n)***	
Home language				**p<0.0001**
English	*4.6 (1)*	*0*	*20.7 (6)*	
Afrikaans	*0*	*100 (1)*	*79.3 (23)*	
isiXhosa	*77.3 (17)*	*0*	*0*	
isiZulu	*18.2 (4)*	*0*	*0*	
Smoking				***p=0.002***
Never	*52 (11)*	*0*	*4 (1)*	
Sometimes	*10 (2)*	*0*	*14 (4)*	
Every day	*38 (8)*	*100 (1)*	*83 (24)*	
Alcohol use				*p=0.23*
Never	*28.6 (6)*	*100 (1)*	*44.8 (13)*	
Sometimes	*71.4 (15)*	*0*	*55.2 (16)*	
Every day	*0*	*0*	*0*	
Illicit substances				***P<0.001***
Never	*71 (15)*	*0*	*7 (2)*	
Sometimes	*19 (4)*	*100 (1)*	*45 (13)*	
Every day	*10 (2)*	*0*	*48 (14)*	

** Pearson chi-square test*

4.13.5 Agreement between weight classification according to BMI and perceived weight within the female on remand detainee group

Based on the interpretation criteria published by Landis and Koch (1977) the k-value of 0.01 indicates a slight level of agreement between perceived weight and actual weight classification according to BMI categories (Table 40).

Approximately half of the underweight female detainees perceived themselves to be “too thin”, while a third thought they were “just the right weight”, only one underweight female detainee thought that she was “too chubby” (Table 40).

Approximately half of the normal weight female detainees perceived their weight to be “just the right weight”, a third thought they were “too thin” and a fifth of thought they were “too chubby”.

Approximately half of the overweight female detainees thought they were “too thin”, while half of them thought they were “just right.” Only one overweight female detainee perceived herself to be “too chubby”.

Table 40: Agreement between weight classification according to BMI and perceived weight in female on remand detainees (Column % (n))

Characteristic	***BMI categories***			***p-value***
	Underweight	***Normal weight***	***Overweight & obese***	
Females total	*15.4 (8)*	*61.5 (32)*	*23.1 (12)*	*0.06**
Too thin Females	*50 (4)*	*34.4 (11)*	*41.7 (5)*	
Just the right weight Females	*37.5 (3)*	*46.9 (15)*	*50.0 (6)*	
Too chubby/fat Females	*12.5 (1)*	*18.8 (6)*	*8.3 (1)*	

**Kappa statistic: Value= 0.01 indicating slight agreement*
k < 0: no agreement; k = 0–0.20 slight, 0.21–0.40 fair, 0.41–0.60 moderate, 0.61–0.80 substantial, and 0.81–1 almost perfect agreement (Landis & Koch, 1977)

4.14 Associations between BMI, cAMA and MHGS and other variables in juvenile male on remand detainees

Please note that only significant associations between BMI, cAMA and MHGS and select variables are presented in Table 41. The full correlation matrices and cross-tabulations are included in Appendix 4.2.

4.14.1 Significant associations between BMI and other variables

BMI was significantly positively correlated with height, weight, MUAC, triceps skinfold, cAMA and MHGS (Table 41). There was also a significant positive association between BMI and the availability of fruit-juice in the home.

There were no significant associations between BMI and any of the other variables (*Table 42*).

4.14.2 Significant associations between cAMA and other variables

cAMA was positively correlated with height, weight, BMI, MUAC and MHGS (Table 41). The number of sedentary minutes per day was negatively associated with cAMA. Males originating from the Western Cape were more likely to have a wasted or below average muscle mass than those born in the Eastern Cape and other provinces (Table 43). Males who were classified as having an "average" muscle mass according to the cAMA cut-off values were more likely to have attempted weight loss than those classified as having a below average or wasted muscle mass (Table 43).

There were no significant associations between cAMA and any other variables.

4.14.3 Significant associations between MHGS and other variables

MHGS was positively correlated with height, weight, BMI, MUAC, triceps skinfold and cAMA (*Table 41*). The grade achieved at school was positively associated with MHGS, while hunger score was negatively associated with MHGS.

There were no significant associations between MHGS and any other variables.

*Table 41: Significant[1] Spearman correlations between BMI, cAMA and MHGS and other variables in juvenile **male** on remand detainees*

Males			
	BMI	*cAMA*	*MHGS*
Height	*r=0.3* *p=0.05*	*r=0.5* *p=0.000*	*r=0.7* *p=0.000*
Weight	*r=0.8* *p=0.000*	*r=0.8* *p=0.000*	*r=0.7* *p=0.000*
BMI		*r=0.7* *p=0.000*	*r=0.4* *p=0.001*
MUAC	*r=0.8* *p=0.000*	*r=0.9* *p=0.00*	*r=0.5* *p=0.000*
Triceps	*r=0.5* *p=0.000*		*r=0.3* *p=0.008*
cAMA	*r=0.7* *p=0.000*		*r=0.5* *p=0.000*
MHGS	*r=0.4* *p=0.001*	*r=0.5* *p=0.000*	
Grade completed			*r=0.4* *p=0.001*
Hunger score			*r=-0.3* *p=0.008*
Lunch			*r=0.3* *p=0.03*
Availability of fruit-juice	*r=0.3* *p=0.03*		
Sedentary min/day		*r=-0.3* *p=0.04*	

Body mass index (BMI); Mid upper arm circumference (MUAC); Corrected arm muscle area (cAMA); Maximum hand-grip strength (MHGS); MET min/ week: Metabolic equivalent of task minutes per week.
[1]Empty cells depict non-significant correlations.

Table 42: Cross tabulation of categorical demographic variables by BMI categories for juvenile male on remand detainees (column % (n))

Variables	***BMI categories***		***p-value****
	Underweight	***Normal weight***	
Ethnicity			*0.34*
African black	*16.7 (2)*	*34.6 (19)*	
White	*0*	*3.6 (2)*	
Coloured	*83.3 (10)*	*61.8 (34)*	
Language			*0.64*
English	*0*	*7.3 (4)*	
Afrikaans	*83.3 (10)*	*61.8 (34)*	
isiXhosa	*16.7 (2)*	*25.5 (14)*	
Other	*0*	*3.6 (1)*	

**Chi-square test*

Table 43: Cross tabulation of categorical demographic and weight loss variables by cAMA percentile categories for juvenile male on remand detainees (column % (n))

Variables	***Wasted & below average muscle mass***	***Average muscle mass***	***Above average and high muscle mass***	***p-value****
Birth place				***0.01***
Cape town	*95.5 (43)*	*72.7 (16)*	*0*	
Eastern Cape	*2.2 (1)*	*13.6 (3)*	*0*	
Gauteng	*2.2 (1)*	*0*	*0*	
Other	*0*	*13.6 (3)*	*0*	
Weight loss in last year				***0.04***
Yes	*17.8 (8)*	*100.0 (22)*	*0*	
No	*82.2 (37)*	*0*	*0*	

**Pearson chi-square test done for all the variables.*

4.15 Predictors of BMI, cAMA and MHGS in juvenile male on remand detainees

Results for significant predictors of BMI, cAMA and MHGS are presented in the text. Reference is made to the probable clinical significance of each statistically significant predictor. Motivations for the decisions regarding the clinical significance of each predictor are presented in Table 44.

4.15.1 Predictors of BMI

Significant predictors of BMI when all other variables remain constant in the regression model include the following:

Availability of fruit juice: As the availability of fruit juice in the home increased by one category from yearly to monthly, from monthly to weekly and from weekly to daily, the average BMI ***increased*** *by 0.5 kg/m² per category change; (p=0.004). This predictor is* ***not*** *a probable clinical significant predictor (Table 44).*

Home language: Afrikaans home language speaking males had a lower average BMI than the English, Zulu or "other language" speaking males, with 1.11 kg/m²; (p=0.01). This is a predictor of probable clinical significance (Table 44).

*Sedentary behaviour: With each extra minute spent being sedentary per week the average BMI **decreased** by 0.0004 kg/m²; (p=0.03). This predictor is **not** a probable clinical significant predictor (Table 44).*

4.15.2 Predictors of cAMA

Significant predictors of cAMA when all other variables remain constant in the regression model include the following:

Home language: Afrikaans home language speaking males had a lower average cAMA than the English, Zulu or "other language" speaking males, with 8.0 cm ²; (p=0.005). This is a predictor of probable clinical significance (Table 44).

*Snacking between meals: With each unit increase in the number of times snack were consumed in between meals per week, the average cAMA **increased** by 0.3cm²;(p=0.04). This is a predictor of probable clinical significance (Table 44).*

*Frequency of starch consumption: With each unit increase in the number of times starch foods were consumed per week the average cAMA **decreased** by 0.3cm²; (p=0.04). This predictor is **not** a probable clinical significant predictor (Table 44).*

*Frequency of fats and oil consumption: With each unit increase in the number of times fats and oils were consumed per week the average cAMA **increased** by 0.2cm²; (p=0.009). This predictor is **not** a probable clinical significant predictor (Table 44).*

*Sedentary behaviour: With each extra minute spent being sedentary per week the average cAMA **decreased** by 0.002 cm²; (p=0.01). This predictor is **not** a probable clinical significant predictor (Table 44).*

4.15.3 Predictors of MHGS

Significant predictors of MHGS when all other variables remain constant in the regression model include the following:

Home language: Afrikaans home language speaking males had a lower average MHGS than the English, Zulu or "other language" speaking males, with 8.0 kgf; (p=0.003). This is a predictor of probable clinical significance (Table 44).

Home language: isiXhosa home language speaking males had a lower average MHGS than the English, Zulu or "other language" speaking males, with 8.0 kgf; (p=0.007). This is a predictor of probable clinical significance (Table 44).

*Hunger score: With each unit increase in hunger score during the previous month, the average MHGS **decreased** by 2.0 kgf; (p<0.0001). This is a predictor of probable clinical significance (Table 44).*

*School grade: With each school grade achieved the average MHGS **increased** by 1.6 kgf; (p=0.005). This predictor is **not** a probable clinical significant predictor (Table 44).*

*Knowledge of healthy eating: With each additional food group that males could mention as being needed for health, the average MHGS **increased** by 1.4 kgf per category; (p=0.04). This predictor is **not** a probable clinical significant predictor (Table 44).*

*Frequency of protein consumption: With each unit increase in the number of times quality protein foods were consumed per week the average MHGS **decreased** by 0.3kgf; (p=0.04). This predictor is **not** a probable clinical significant predictor (Table 44).*

*Frequency of fats and oils consumption: With each unit increase in the number of times fats and oil foods were consumed per week the average MHGS **increased** by 0.2kgf; (p=0.02). This predictor is **not** a probable clinical significant predictor (Table 44).*

*Availability of milk in the home: As the availability of milk in the home increased by one category from yearly to monthly, from monthly to weekly and from weekly to daily, the average MHGS **decreased** by 1.7 kgf per category; (p=0.05). This predictor is **not** a probable clinical significant predictor (Table 44).*

*Table 44: Clinical significance of statistically significant predictors of BMI, cAMA and MHGS for juvenile **male** on remand detainees*

Predictors	***Value of predictor per unit***	***Mean ±SD / median (IQR) value for the variable***	***Cut-off criterion for clinically significance****	***Interpretation of clinically significancen***
BMI predictors (R^2=0.2)	*kg/m² (p-value)*			
Availability of fruit juice at home	*0.52 (0.004)*	*1 (0-2) [maximum units: 4 units]*	*0.9kg/m²*	*Availability of fruit juice has to increase by **2 units,** over and above the median of 1 unit, to be ≥ 0.9kg/m²; availability should thus reach a minimum of **3 units.** Considering the median (IQR), for availability of fruit juice, it is deemed not feasible for male detainees to achieve this availability, indicating that the availability of fruit juice is probably **not** a clinically significant predictor of a higher BMI in male detainees**.***
Minutes being sedentary per week	***-0.0004 (0.03)***	*1260 (840-1680) minutes/week*		*Sedentary minutes per week has to increase by 2250, over and above the median of 1260 minutes per week, to be ≥ 0.9kg/m². Considering the median (IQR)minutes per week it is deemed not possible to achieve a frequency of 3510 sedentary minutes per week (501 minutes per day=8 hours per day) Thus this predictor is probably **not a** clinically significant predictor of a lower BMI in male detainees.*
Afrikaans home language	***-1.11 (0.01)***	*65.7%*		*Having Afrikaans as home language is a predictor of probable clinical significance of BMI in male detainees, since the predictor value is ≥ 0.9kg/m².*
cAMA predictors (R^2=0.3)	*cm² (p-value)*			
Minutes being sedentary per week	***-0.002 (0.01)***	*1260 (840-1680) minutes/week*	*3.2cm²*	*Sedentary minutes per week has to increase by 1600, over and above the median of 1260 minutes per week to be ≥ 3.2cm². Considering the median (IQR) it is deemed not possible to achieve a frequency of 2860 sedentary minutes per week (408 minutes per day=7 hours per day)., indicating that sedentary minutes per week is probably **not** a clinically significant predictor of a lower cAMA in male detainees.*

Afrikaans home language	***-7.95 (0.005)***	*65.7%*		*Having Afrikaans as home language is a predictor of probable clinical significance of cAMA in male detainees, since the predictor value is ≥ 3.2cm².*
Frequency of snacking between meals per week	*0.28 (0.04)*	*8 (0-21)*		*Frequency of snacking between meals has to increase by **12 times per week**, over and above the median of 8 times per week, to be ≥ 3.2cm². Considering the median (IQR) it is deemed possible for males to snack between meals **20 times per week** (3 times per day). Snacking between meals is thus probably a clinically significant predictor of cAMA in male detainees.*
Frequency of starch food group intake per week	***-0.25 (0.04)***	*17 (14-25)*		*Frequency of starch food intake has to increase by **13 times per week**, over and above the median of 17 times per week, to be ≥ 3.2cm². Considering the median (IQR) it is **not** deemed possible for males to achieve an intake of starchy foods of **30 times per week** (4 times per day), indicating that frequency of starch food intake is probably **not** a clinically significant predictor of cAMA in male detainees.*
Frequency of fats and oils food group intake per week	*0.21 (0.009)*	*7 (0-15)*		*Frequency of fats and oil intake has to increase by **16 times per week**, over and above the median of 7 times per week, to be ≥ 3.2cm². Considering the median (IQR) it is **not** deemed possible for males to achieve an intake of fats and oils of **23 times per week** (3 times per day), indicating that frequency of fat and oil intake is probably **not** a clinically significant predictor of cAMA in male detainees.*
MHGS predictors (R^2=0.6)	***Kgf** (p-value)*			
Availability of milk in the home	***-1.67 (0.05)***	*3 (2-3) [Maximum units: 4 units]*	*5kgf*	*Availability of milk in the home has to increase by **3 units,** over and above the median of 3 units, to be ≥ 5kgf. Considering the median (IQR) it is deemed **not** possible for males to achieve an increase of **6 units**, indicating that availability of milk in the home is probably **not** a clinically significant predictor of a higher MHGS in male detainees.*
Afrikaans home language	***-7.99 (0.003)***	*65.7%*		*Having Afrikaans as home language is a predictor of probable clinical significance of MHGS in male detainees, since the predictor value is ≥ 5 kgf.*

isiXhosa home language	***-7.95 (0.007)***	*23.9%*		*Having isiXhosa as home language is predictor of probable clinical significance of MHGS in male detainees, since the predictor value is ≥ 5 kgf.*
Frequency of fats and oils food group intake per week	*0.17 (0.02)*	*7 (0-15)*		*Frequency of fat and oil intake has to increase by **30 times per week**, over and above the median of 7 times per week, to be ≥ 5kgf. Considering the median (IQR) it is deemed **not** possible to achieve an intake of **37 times per week** (5 times per day), indicating that frequency of fat and oil intake is probably **not** a clinically significant predictor of a higher MHGS in male detainees.*
Frequency of protein food group intake per week	***-0.25 (0.04)***	*7 (2-12)*		*Frequency of protein food intake has to increase by **20 times per week**, over and above the median of 7 times per week, to be ≥ 5kgf. Considering the median (IQR) it is deemed **not** possible for males to achieve **27 times per week** (4 times per day), indicating that frequency of protein food intake is probably **not** a clinically significant predictor of a higher MHGS in male detainees.*
School grade achieved	*1.60 (0.005)*	*Grade 9 [Maximum units: 8 units]*		*School grade has to increase by **four grades** to be ≥ 5kgf. Considering that MHGS increases as a matter of courseas the adolescent matures up to the age of 35 years when the maximum strength of males is reached, school grade achieved is probably **not** a clinically significant predictor of a higher MHGS in male detainees.*
Hunger score	***-2.01 (<0.0001)***	*0 (0-3) [Maximum units: 6 units]*		*The hunger score has to increase by **3 units**, over and above the median of 0 units, to be ≥ 5kgf. Considering the median (IQR) it is deemed possible for males to achieve a minimum of 3 units, indicating that hunger score is probably a clinically significant predictor of a higher MHGS in male detainees.*
Knowledge of healthy eating	*1.43 (0.04)*	*3 (2-4) [7 units]*		*The knowledge of healthy eating score has to increase by **4 units,** over and above the median of 3 units, to be ≥ 5kgf. Considering the median (IQR) it is **not** deemed possible for males to achieve a minimum of 7 units, indicating that knowledge of healthy eating score is probably **not** a clinically significant predictor of a higher MHGS in male detainees.*

Abbreviations: SD=Standard deviation, IQR=Interquartile range, BMI= Body mass index, FBDG= Food based dietary guidelines, MET min= Metabolic equivalent of task minutes, cAMA= corrected arm muscle area, MHGS= Maximum handgrip strength.

**Please refer to section 3.9 for the explanation of how these criteria were developed*

***R^2 indicates what percentage of the variability of a dependant variable can be explained by a particular independent predictor (Petrie & Sabin, 2009) R-squared is the statistical measure of how close the data are to the fitted regression line (an assessment of goodness of fit). Even when the R^2 value is low, you can still draw important conclusions about how changes in the predictor values are associated with changes in the response value of those values that are significant. R^2 values are usually low when human behaviours are being explored (Frost, 2013).*

4.16 Associations between variables other than anthropometric measures and MHGS within the **male** on remand detainee group

In this section associations between frequency of consumption of food groups, meal pattern, availability and serving of select food items at home, food security, knowledge of what to eat to be health, symptoms of depression and anxiety, risk taking behaviour and physical activity indicators are presented.

4.16.1 Associations between frequency of consumption of food groups as well as availability of foods in the home and select variables within the male remand detainee group

Food groups X Meal pattern

There was a significant positive correlation between breakfast intake and frequency of consumption of items from the dairy products and fruit groups (Table 45). Furthermore, there was a significant positive correlation between frequency of lunch intake and frequency of consumption of quality protein foods. There was also a significant positive correlation between frequency of supper intake and frequency of intake of quality protein foods, dairy products and the fats and oils food group. The frequency of snack consumption was significantly positively correlated with frequency of consumption of all the food groups shown in (Table 45), except for quality protein foods.

There were no significant associations between meal pattern and the frequency of intake of vegetables.

Table 45: Significant associations between frequency (per week) of consumption of food groups and meal pattern for juvenile male on remand detainees

Meal pattern	*Quality Protein foods*	*Dairy*	*Starch*	*Fruit*	*Fats and oils*	*High-fat snacks*	*High sugar products*
Breakfast	*r=0,19 p=0,125*	*r=0,38 p=0,001*	*r=0,08 p=0,544*	*r=0,27 p=0,025*	*r=0,12 p=0,331*	*r=-0,17 p=0,178*	*r=0,11 p=0,373*
Lunch	*r=0,26 p=0,033*	*r=0,02 p=0,896*	*r=-0,10 p=0,437*	*r=0,18 p=0,141*	*r=0,13 p=0,284*	*r=0,07 p=0,596*	*r=0,21 p=0,084*
Supper	*r=0,24 p=0,046*	*r=0,39 p=0,001*	*r=0,12 p=0,327*	*r=0,17 p=0,183*	*r=0,26 p=0,034*	*r=0,11 p=0,370*	*r=0,14 p=0,252*
Snacks	*r=0,05 p=0,720*	*r=0,25 p=0,044*	*r=,27 p=0,025*	*r=0,40 p=0,001*	*r=0,33 p=0,007*	*r=0,41 p=0,001*	*r=0,35 p=0,004*

Food groups X Availability of food in the home

The following significant associations were evident between food group intake and availability of foods in the home: frequency of consumption of proteins, dairy products, fruit, vegetables and fats and oils were all positively correlated with having fruit in the home (

Table *46*).

Frequency of consumption of quality protein, dairy products and vegetables were all positively correlated with having vegetables in the home and serving of vegetables during meal times.

Frequency of consumption of fruit, vegetables and fats and oils were positively associated with the availability of fruit juice in the home (
Table *46*).

There were no significant associations between the availability of foods in the home and the starch and high-fat snacks or high-sugar containing groups (results not shown in table).

Table 46: Significant associations between frequency (per week) of consumption of items from food groups and availability of food in the home for juvenile male on remand detainees

Availability of healthy food in the home:	***Protein foods***	***Dairy***	***Starch***	***Fruit***	***Vegetables***	***Fats and oils***
Fruit in the home	*r=0,37 p=0,002*	*r=0,38 p=0,002*	*r=0,24 p=0,053*	*r=0,29 p=0,017*	*r=0,24 p=0,047*	*r=0,32 p=0,008*
Vegetables in the home	*r=0,24 p=0,046*	*r=0,30 p=0,013*	*r=0,08 p=0,546*	*r=0,21 p=0,089*	*r=0,27 p=0,028*	*r=0,20 p=0,099*
Vegetables served at meal times	*r=0,25 p=0,038*	*r=0,34 p=0,006*	*r=0,10 p=0,419*	*r=0,24 p=0,050*	*r=0,33 p=0,006*	*r=0,23 p=0,057*
Milk in the home	*r=0,28 p=0,021*	*r=0,37 p=0,002*	*r=0,11 p=0,389*	*r=0,18 p=0,140*	*r=0,25 p=0,039*	*r=0,22 p=0,077*
Fruit juice in the home	*r=0,23 p=0,066*	*r=0,21 p=0,086*	*r=0,16 p=0,188*	*r=0,41 p=0,001*	*r=0,28 p=0,020*	*r=0,24 p=0,047*

Food groups X Food insecurity

The hunger score was significantly negatively correlated with frequency of consumption of items from the quality protein, dairy, starch, vegetables and fats and oils food groups (*Table 47*). There were no significant associations between hunger score and the high-fat snacks and high-sugar containing food groups.

There were no significant associations between the score for symptoms of depression and anxiety and any of the food groups (results not shown in table).

Table 47: Significant associations between availability of food in the home and hunger score for juvenile male on remand detainees.

Availability of healthy food in the home:	***Protein foods***	***Dairy***	***Starch***	***Fruit***	***Vegetables***	***Fats and oils***
Hunger score	*r=-0,28 p=0,022*	*r=-0,37 p=0,002*	*r=-0,28 p=0,021*	*r=-0,14 p=0,259*	*r=-0,29 p=0,016*	*r=-0,33 p=0,006*

Food groups X Nutrition knowledge

There were significant positive correlations between the score for knowledge of what to eat to be healthy and the quality protein (r=0.26, Spearman p-value=0.035) and vegetable (r=0.33, Spearman p-value=0.007) food groups.

There were no further significant associations between knowledge of what to eat to be healthy g and any of the other food groups.

Food groups X Risk taking behaviours

There were significant negative correlations between frequency of smoking and frequency of consumption of items from the vegetable food group (r=-0.30, Spearman p-value=0.013) and a significant positive correlation between frequency of smoking and the frequency of intake of high sugar containing products (r=0.25, Spearman p-value=0.046).

There was also a significant positive correlation between frequency of illicit substance use and frequency of intake of high-sugar containing products (r=0.35, Spearman p-value=0.004).

There were no significant associations between frequency of alcohol intake and frequency of intake of any of the food groups. There were also no associations between the score for symptoms of depression and anxiety and frequency of consumption of any of the food groups (results not shown in a table).

Food groups X Physical activity

There was a significant negative correlation between the amount of time spent travelling (minutes per day) and the frequency of consumption of the dairy food group (r=-0.03, Spearman p-value=0.02).

There were no further significant associations between physical activity variables and frequency of intake from the food groups.

4.16.2 Further association between physical activity and select variables within the male on remand detainee group

Physical activity X Risk taking behaviour

There was a significant negative correlation between smoking and amount (minutes per week) of vigorous physical activity (r=-0.29, Spearman p-value=0.017) and the amount (minutes per week) of combined moderate and vigorous physical activity (r=-0.28, Spearman p-value=0.024).

There was a significant negative correlation between frequency of use of illicit substances and time spent being sedentary (minutes per week) (r=-0.27, Spearman p-value=0.029).

There were no further significant associations between risk taking behaviours and any of the other physical activity variables.

Physical activity X Food insecurity

There was a significant negative correlation between the hunger score and the amount of time spent being sedentary (minutes per week) (r=-0.29, Spearman p-value=0.018).

4.16.3 Further associations not covered in previous sections within the juvenile male on remand detainee group

Risk taking behaviour X Healthy food availability

There was a significant negative correlation between the frequency of alcohol use and the availability of fruit juice in the home (r=-0.3, Spearman p-value=0.03). There was also a significant positive correlation between illicit substance use and the availability of fruit in the home (r=0.2, Spearman p-value=0.047).

There were no significant associations between risk taking behaviours and the availability of vegetables or milk in the home. There were also no significant associations between availability of healthy foods in the home and the score for symptoms of depression and anxiety as well as the frequency of smoking.

Depression and anxiety symptoms X and use of illicit substances

There was a significant positive correlation between the frequency illicit substance use and the score for symptoms of depression and anxiety (r=0.39, Spearman p-value=0.001).

Availability of healthy food in the home X Food insecurity

There was a significant negative correlation between all heathy food availability variables and the hunger score (Table 48).

Table 48: Significant associations between availability of healthy foods in the home and hunger score of male remand detainees

Food security	***Fruit at home***	***Vegetables at home***	***Vegetables served at home***	***Milk at home***	***Fruit juice at home***
Hunger score	*r=-0,32 p=0,009*	*r=-0,37 p=0,002*	*r=-0,43 p<0,001*	*r=-0,45 p<0,001*	*r=-0,32 p=0,008*

*4.16.4 Associations between select categorical variables within the **male** on remand detainee group*

Ethnic group X Home language and risk taking behaviours

Males from the coloured ethnic group were significantly more likely to have Afrikaans as their home language, while those from the black African ethnic group were significantly more likely to have isiXhosa as home language (*Table 49*).

Male detainees from the coloured ethnic group were significantly more likely to smoke every day than those from the black African ethnic group. There were no significant associations between ethnic groups and alcohol and illicit substance use.

Table 49: Cross-tabulation of home language, smoking, alcohol, and illicit substance use by ethnic group within the male on remand detainee group (column % (n))

Variables	***Ethnic group***			***p-value***
	Black African	***White***	***Coloured***	
Language				***p<0.0001***
English	*4.8 (1)*	*0*	*6.8 (3)*	
Afrikaans	*9.5 (2)*	*100 (2)*	*90.9 (40)*	
isiXhosa	*71.4 (15)*	*0*	*2.3 (1)*	
isiZulu	*4.8 (1)*	*0*	*0*	
Other	*9.5 (2)*	*0*	*0*	

Smoke				***p=0.04***
Never	*19 (4)*	*0*	*0*	
Sometimes	*19 (4)*	*0*	*18 (8)*	
Every day	*62 (13)*	*100 (2)*	*82 (36)*	
Alcohol use				*p=0.35*
Never	*42.9 (9)*	*0*	*50.0 (22)*	
Sometimes	*52.4 (11)*	*100 (2)*	*50.0 (22)*	
Every day	*4.8 (1)*	*0*	*0*	
Illicit substance				*p=0.32*
Never	*38.1 (8)*	*0*	*25.0 (11)*	
Sometimes	*33.3 (7)*	*0*	*34.1 (15)*	
Every day	*28.6 (6)*	*100 (2)*	*40.9 (18)*	

** Pearson -chi square test*

4.16.5 Agreement between weight classification according to BMI and perceived weight within male on remand detainee group

The Kappa statistic could not be executed as none of the male detainees were overweight/obese, although some perceived that they were overweight/obese. Approximately half of the underweight male detainees perceived themselves to be "too thin" while a third thought they were "just the right weight" and one male thought he was "too chubby" (Table 50).

More than half of the normal weight male detainees perceived their weight to be "just the right weight", while less than half thought they were "too thin", and only one thought he was "too chubby".

Table 50: Agreement between weight classification according to BMI and perceived weight (column %(n))

Characteristic	***BMI classification***			***p-value****
	Underweight	***Normal weight***	***Overweight & obese***	
Too thin	*58.3 (7)*	*45.5 (25)*	*0*	*NA*
Just the right weight	*33.3 (4)*	*52.7 (29)*	*0*	
Too chubby/fat	*8.3 (1)*	*1.8 (1)*	*0*	

**Kappa statistic*

Chapter 5: Discussion

The question of malnutrition is complex, and even more so when considering the double burden of disease as found in South African populations. As is evident from the socio-ecological approach to the causality of malnutrition and the development of suitable interventions (McLeroy et al., 2003), many levels of influence need to be considered when investigating malnutrition and the causes thereof in a particular population, in this research the on remand juvenile detainees.

Factors to consider in this process include intra-individual influences such as gender, risk taking behaviour, nutrition knowledge, pregnancies and so forth. Inter-individual influences that include peer pressure, relationships with figures of authority e.g. parents, teachers. Institutional influences such as rules and regulations at schools relating to smoking, drug use, items sold at tuckshops and nutrition education components in the school syllabus. Community based influences, especially factors such as the reigning culture of gangsterism in this population (Mncube & Madikizela-Madiya, 2014; Van Wyk & Theron, 2005), crime and sexual promiscuity, as well as easy access to alcohol and drugs. Finally policy level influences that control components such as school syllabi, school feeding programmes and a number of economic factors that may affect the food security and health of individuals hailing from a low socio-economic area in the Western Cape. Numerous researchers support the contention that multiple factors should be assessed to identify the possible predictors of nutrition status in a multi-pronged assessment of the sample being assessed (Hargreaves et al., 2013; Must et al., 2009). This discussion presents the nutrition related risk profile and possible predictors of female on remand detainees first. The profile of male on remand detainees is then discussed referring to differences found between the genders as appropriate.

Female on remand detainees

The sociodemographic profile of the on remand juvenile females shows that coloured and black African females were almost equally represented, with only one having been white. In line with national statistics on languages spoken by the different race groups in South Africa (Stats, 2012), coloured female detainees were significantly more likely to report Afrikaans as their home language (78.4% vs 0%), while black Africans were significantly more likely to report Xhosa as their home language (0% vs 80%). The majority of the sample had completed grades 9-11, were almost 20 years old, were born in the Western Cape, were living with their

parent(s) and had electricity and running water in their home at the time of the study. One in two female detainees reported having a child.

The anthropometric results for female detainees reflect a double burden of malnutrition, with 15% having been underweight, 17.3% overweight and 5.8% obese at the time of the study. It is important to note that underweight was more prevalent in the current study than was reported for the same age group of females in the general population in the SADHS (11.1%) (NDoH et al., 2017) and SANHANES (4.4%) (Shisana et al., 2013) and 10.6% in 17-19 year old females in the Birth-to-Twenty (BTT) cohort in Soweto, South Africa (Pradeilles et al., 2015). On the other hand, although still a concern, overweight and obesity were less prevalent in our sample of female detainees than reported for the same age group in SADHS (19.7% and 11.0% respectively) (NDoH et al., 2017) and SANHANES (25.3% and 21.7% respectively) (Shisana et al., 2013)and BTT (17.9% and 8.3%) (Pradeilles et al., 2015). The malnutrition profile of these on remand detainees is in line with global statistics for incarcerated populations in general that show a higher burden of undernutrition and a lower burden of obesity than in the general population (Fuge & Ayanto, 2016; Silverman-Retana et al., 2015; Gow et al., 2012).

Further discussion of the malnutrition profile of the female on remand detainees firstly focuses on the undernutrition problems and predictors thereof, followed by perspectives on the problem of overweight and obesity.

Anthropometric measures conducted to assess body composition indicate that fat stores in the female detainees may have been more compromised than lean body mass (LBM), as 1 in 3 had a triceps skinfold below the 25th percentile and only 1 in 10 had a cAMA indicative of muscle wasting. However, the fact that the MHGS test, which is a reflection of overall health and muscle strength (Angst et al., 2010; Gallup et al., 2010), showed that 1 in 5 may have had compromised LBM stores, may indicate that low LBM may also be a concern, especially as these two independent indicators of LBM were significantly correlated. Research done by Vaz et al. (1996) indicated that MHGS distinguishes between people who are acutely underweight from those who suffer with chronic undernutrition, with those who have a low MHGS being chronically undernourished (Vaz et al., 1996). Research further indicates that MHGS is a more sensitive marker of nutrition deprivation than BMI because muscle function responds more readily to nutrition deprivation than the weight of a person (Norman et al., 2011). Lower MHGS has also been linked to a higher risk of fractures in children (Clark et al., 2011).

Underweight was significantly more prevalent among coloured on remand female detainees who had Afrikaans as home language than the other race groups and those who had either

English or Xhosa as home language. When the races were compared within the underweight juvenile female subgroup, 75% were found to be coloured and 25% black African, while none of the white detainees were underweight. Bearing these results in mind it needs to be noted that the majority of coloured people in the country speak Afrikaans (74%) (Stats, 2012). Female detainees who were coloured and had Afrikaans as home language were also more likely to have a triceps skinfold that fell below the 25th percentile than their black African and Xhosa speaking counterparts. Furthermore, having Afrikaans as home language was found to be a predictor of probable clinical significance of both a lower MGHS and a lower cAMA. These results point to the possibility that coloured Afrikaans speaking on remand female detainees entering a correctional facility in the Western Cape may have a higher risk of being chronically undernourished than their black African, English or Xhosa home language counterparts. This is not in line with data reported for the general population, as the prevalence of undernutrition has been shown to be similar between the coloured and black African race groups in national surveys. The NYRBS (2008) and SANHANES (2012) reported that the prevalence of underweight was 2.9% and 4.9% respectively in coloured and 2.3% and 3.6% respectively in black African females between the age of 15-19 years and in adults (Shisana et al., 2013; Reddy et al., 2010). However, Pradeilles et al. (2015) also found in the BTT cohort that 17-19 year old coloured females had higher odds of thinness compared with their black African counterparts.

Underweight is the result of energy and micronutrient intake below requirements, which in turn can be caused by a wide range of factors when considered within the context of the socio-ecological approach to health. Insufficient food intake in the form of low-nutrient dense (LND) foods combined with increased energy expenditure due to chronic illness or excessive physical activity, could contribute to a negative energy balance and as a consequence inadequate growth and weight gain. Further potential predictors of a lower BMI and reduced LBM that were investigated in this research include weight loss attempts, food insecurity, pregnancy, level of distress, smoking, alcohol use, illicit substance use, infectious disease and high physical activity levels.

Although total energy and nutrient intake was not determined in this study, the frequency of intake of nutrient dense and LND food items in the week prior to incarceration was determined using a non-quantified FFQ. This type of questionnaire has been shown to provide valid insights into the typical food choices and quality during a particular time period (Wong et al., 2012; Cullen et al., 2008). When considering the results on the food choices of on remand female detainees there is reason for concern about the quality thereof. The total daily frequency of intake of nutrient dense foods was approximately five (protein foods, dairy,

starch, fruit and vegetables), while the total daily frequency of intake of high-energy LND foods was nine (fats and oils, high-fat snacks and high-sugar containing products). The six most frequently consumed foods in descending order were table sugar, crisps, white bread, fizzy drinks that contain sugar, non-fibre containing starches (e.g. white rice, pasta, mealie pap) and then eggs. It is thus evident that the four most frequently chosen foods are all high-energy LND foods, which may have contributed to nutrition related problems experienced by the female on remand detainees.

According to Darmon and Drewnowski, (2008) it is a worldwide phenomenon for people with a lower socio-economic status to consume LND foods more often. Although poverty has been identified as a primary barrier to healthy eating in adolescents (Schönfeldt et al., 2013; Stupar et al., 2012; Darmon & Drewnowski, 2008; Pedro et al., 2008), consumption of LND foods instead of healthy foods may not only be the result of non-availability of the latter. Research in the USA and South Africa showed that food-insecure adolescents felt that healthy eating was inconvenient and that healthy foods did not taste good (Sedibe et al., 2014; Schönfeldt et al., 2013; Widome et al., 2009). A further factor to consider is nutrition knowledge, with theory stating that good nutrition knowledge should contribute to, or result in healthy food choices and meal patterns (Spronk et al., 2014; Curd et al., 2013). The results of this research show that the majority of on remand female detainees could only mention three or fewer out of the seven food groups (including water) that are essential for health, reflecting poor nutrition knowledge. However, the expected association between being able to mention more food groups, thus better nutrition knowledge, and a higher frequency of intake of healthier foods, was not evident. On the contrary, better knowledge of what to eat to be healthy was associated with more frequent intake of unhealthy food items such as high-fat snacks. It is thus not surprising that a better knowledge of what to eat to be healthy emerged as a statistical, but probably not clinical significant predictor of a lower lean body mass.

When considering food choices made by on remand female detainees from the nutrient dense food groups, it is evident that a major concern is that fruit and vegetables were not consumed on a daily basis in the week prior to incarceration. The food based dietary guidelines (FBDG) specify having “plenty” of fruit and vegetables every day (Vorster et al., 2013a), while a systematic review of 16 countries worldwide found that having at least five fruits and vegetables a day is optimal for health (Wang et al., 2014). It is thus not surprising that more regular consumption of vegetables prior to incarceration was found to be a predictor of probable clinical significance of a higher BMI, as well as a predictor of statistical, but probably not clinical significant higher cAMA. This indicates that vegetable intake may have contributed

to the maintenance of a healthy body weight in these detainees. Although frequency of vegetable intake was positively associated with the availability of vegetables in the household, it can be argued that the low intake was not exclusively the result of unavailability of vegetables in the household, as the majority of detainees indicated that vegetables were available and served in their homes almost always. Low fruit and vegetable intake is not unique to this population, as numerous researchers have reported inadequate fruit and vegetable intakes in different South African populations (Steyn et al., 2016; Shisana et al., 2013; Reddy et al., 2010; Schneider et al., 2007; Steyn et al., 2006).

A further concern is that items from the dairy group were also not consumed on a daily basis by female detainees. They would thus not have been able to meet the FBDG recommendation of consuming 400-500ml low-fat milk per day to contribute to calcium needs (Vorster et al., 2013b). This low intake of dairy was also not necessarily the result of unavailability of milk in the home, as the majority of detainees indicated that milk was often or always available in their homes. Low intake of dairy is also not unique to female on remand detainees. Vorster et al. (2013b) reviewed available South African data on dairy consumption of adults and concluded that the intake was well below the recommendation, while non-dairy creamers and milk powders were commonly used. Contrary to what could be expected, a higher frequency of intake of items from the dairy group was found to be a predictor of probable clinical significance of a lower BMI. As dairy intake was very low (median of only once a week), this result should be interpreted with caution, bearing in mind that dairy intake per se does not lower the BMI, but rather that a dairy intake may be part of the healthy lifestyle (increased fibre foods, reduced high fat foods and healthy meal pattern) of an individual who aims to maintain a healthy weight (Lanou & Barnard, 2008; Liu et al., 2005).

Intake of quality proteins was low at approximately one time a day, while the FBDG specifies that a minimum of two servings of quality protein should be consumed per day: two to three servings of fish per week, four servings of eggs per week and one serving of meat/poultry per day (Schonfeldt & Hall, 2013). Schonfeldt et al. (2013) reported that the per capita intake of animal meat, fish, poultry and eggs combined in South Africa was approximately two servings of 95g per day in 2010/2011, indicating that the intake of the female detainees was approximately one serving below the national average. Frequency of intake of potential sources of essential fatty acids including margarine, fried foods (possible source of sunflower oil and thus omega-6 fatty acids) and fish (fresh, fried or canned; possible sources of omege-3 fatty acids) was also low.

Recommendations to meet requirements specify consumption of two portions of oily fish per week (Kris-Etherton et al., 2002), while plant based sources such as flaxseed, canola, soybean oils and walnuts may also contribute. However, the majority of these good sources of omega-3 fatty acids may not be financially accessible to lower socio-economic groups. Tinned pilchards, a good affordable source of omega-3 fatty acids, had hardly been consumed by the female on remand detainees.

When considering the particular nutrient contributions of the various food groups included in the FBDG, it is well documented that fruits and vegetables are important sources of vitamins C and A, while fruits and vegetables and whole grains provide numerous other antioxidants and dietary fibre that are important for health (Gallagher, 2012). Green leafy vegetables, dairy products, whole grains, animal proteins and fish are good sources of B vitamins, as well as a number of minerals including iron, calcium, magnesium, phosphorus, zinc and copper, while oily fish (salmon and mackerel) also provides omega -3 fatty acids as mentioned (Stang & Larson, 2016; Schonfeldt & Hall, 2013).

The potential risk for nutrient deficiencies in the on remand female detainees alluded to in the preceding paragraphs are in line with reports that adolescents are at risk of inadequate intake of fibre, vitamin A, C, E, various B vitamins, magnesium, iron, zinc and calcium (MacKeown et al., 2007; Dixon et al., 2001). Deficiencies in these nutrients may increase susceptibility to a compromised immune system and increased susceptibility to infection (Rodríguez et al., 2011), poor wound healing, oxidative stress (increased levels of free radicals), problems with eyesight, skin abnormalities and chronic fatigue (Litchford, 2016), impaired cognitive development resulting in lower school achievement and reduced economic productivity in adulthood (Dewey & Begum, 2011) and ultimately increased risk for development of NCDs such as hypertension, hyperlipidaemia and diabetes (Seligman et al., 2010; Sawaya et al., 2003) and osteoporosis (Matsuzaki et al., 2015) later in life.

Contrary to results from a number of international and South African studies who found that skipping meals was common among adolescents (Temple & Steyn, 2016; Naude, 2012; Naude, 2012; Stupar et al., 2012), this was not true for female detainees; who were found to consume breakfast, lunch and supper regularly (six to seven days per week) prior to incarceration. It would therefore seem that this particular aspect of dietary intake was not problematic in the group of female detainees who participated in this research.

When considering the possible causes of inadequate energy intake and low body weight in adolescents, weight loss attempts and eating disorders need to be considered (Gitau et al.,

2014). One of the underweight female detainees indicated that she thought she was 'too fat/chubby'. As this participant was underweight, it is possible that her responses reflected eating disorder pathology. However, overall the study results show that eating disorders may not be a major concern in female detainees at entry into Pollsmoor.

Food insecurity is a common cause of inadequate food intake, chronic hunger and being underweight or undernourished in lower socio-economic communities (Bocquier et al., 2015; Gupta et al., 2015; Miller et al., 2014; Psaki et al., 2012; Faye et al., 2011). This is illustrated within the South African context by the work of Pradeilles et al. (2015) who confirmed that being in the lowest tertile of the household wealth index was a significant predictor of thinness in 17-19 year old females. Food insecurity may be the result of poor food availability, access to food (financially or other reasons) or utilisation (dietary quality, variety and sanitary conditions) or a combination of these factors (Barrett, 2010). Although food security was not found to be an independent predictor of BMI, cAMA or MHGS in the female detainees, it is concerning that 30.8% of the sample reported to have experienced either moderate or (23.1%) severe (7.7%) hunger in the month prior to incarceration. This finding is supported by other research done in South Africa where a similar prevalence was found for food-insecurity indicators such as "at risk of hunger" and "experiencing hunger" in national samples. Data from the Community Childhood Hunger Identification Project (CCHIP) as reported in the SANHANES (2012) indicated that 26% of males and females in the Western Cape were at risk of hunger and 16% experienced hunger (Shisana et al., 2013).

The possibility that food insecurity may have contributed to the undernutrition found in the female detainees, is reflected in the fact that an increase in the hunger score was significantly correlated with a decrease in the frequency of availability of fruit, vegetables and milk in the home, as well as a decrease in the frequency of vegetables served at meal times. The reduced availability of these food items in the home may, in turn, have affected the food choices of female detainees. This possibility is supported by the fact that 1) more frequent availability of fruit in the home correlated with more frequent intake of fruits and vegetables respectively; 2) more frequent availability of vegetables in the home was correlated with more frequent intake of protein foods and vegetables respectively; 3) more frequent serving of vegetables during meal times correlated with more frequent intake of protein foods, fruits and vegetables respectively; and 4) more frequent availability of milk in the home correlated with more frequent intake of items from the dairy group.

Although having had one or more babies did not emerge as a predictor of BMI, cAMA or MHGS, it is plausible that prior pregnancies in our sample of female detainees may have contributed to inadequate dietary intake and increased the risk of undernutrition. More than half (51.9%) of the female detainees had had one or more children prior to incarceration, which is much higher than the prevalence of 22% reported for non-incarcerated late-adolescents (Reddy et al., 2010). When considering these results, it is important to bear in mind that many of the pregnancies might have taken place during the female detainees' adolescent years. Research done in the Western Cape confirms this possibility, as they found that 45% of women in Pollsmoor and Worcester prisons in the Western Cape had had their first child between the ages of 16 and 20 (Artz, Hoffman-Wanderer & Moult, 2012). It is well documented that pregnancy increases energy and micronutrient needs, which for adolescent females, are added to the increased needs required for optimal growth and development during this vulnerable life phase (Stang & Larson, 2016). Research further indicates that adolescent females who fall pregnant before the age of 15 are at higher risk for complications such as abnormal weight gain, anaemia due to the increased blood volumes and pregnancy-induced hypertension, especially in cases where calcium intake is below 50% of the RDA (Lenders et al., 2000).

It has been reported world-wide that juveniles in detention are characterized by a higher prevalence of mental disorders than the general population of the same age (Gonçalves et al., 2016; Committee on Adolescence, 2011). Research shows that such disorders are most common during the first two months of incarceration, thereafter it is reduced as a result of development of coping mechanisms, visitation by family members and participation in programmes run by the correctional service facility (Monahan et al., 2011; Brown & Ireland, 2006). The on remand female detainees who participated in this research were very likely to have experienced mental disorders in the month prior to incarceration, with 19.6% having experienced high and 39.2% very high levels of symptoms of depression and anxiety. The Kessler et al. (2002) questionnaire (K10) that was used in this research screens for mental illness based on questions about anxiety and depressive symptoms during the past month; for participants in this research the past month reflected the month prior to being arrested, including the incarceration process and the initial period in the facility. Being in conflict with the law, being arrested and being incarcerated for an indefinite period has been reported to cause anxiety and mental distress and increase the risk for self-harm, especially among remand detainees (Gonçalves et al., 2016; Shaw et al., 2004).

The anxiety and depressive symptoms experienced by female detainees in this study may have contributed to the underweight and compromised cAMA and MHGS (LBM) that was evident. Results show that a higher K10 score was found to be a predictor of probable clinical significance of a lower cAMA and a lower MHGS. Likewise, Rodríguez-García et al. (2015) found an inverse relationship between the muscle strength of children and anxiety, while (Keller-Ross et al., 2014) found that post-traumatic stress disorder (PTSD) in adults caused greater fatigability and loss of steadiness during handgrip strength tests. The association between distress and reduced LBM may be explained by a primary reduction in energy and/or protein intake.

Mental health disorders such as stress, anxiety and depression could result in secondary reduction of intake via increased release of cortisol (Dietz et al., 2013), which in turn increases protein catabolism, lipolysis and gluconeogenesis within the body. As a result, glucose stored in the liver is depleted, muscle tissue is catabolised for gluconeogenesis, fat is oxidized for energy and ketone body synthesis takes place. The resulting loss in appetite may cause decreased food intake and weight loss, especially if physical activity levels are elevated concomitantly (Anthony & McNurlan, 2013). It needs to be borne in mind that the effect of anxiety and depressive symptoms on food intake during the period before incarceration may also have been compounded by the presence of food insecurity.

As a result of the fact that female detainees were recruited between one day and three weeks (median of six days) after admission to Pollsmoor, it was possible to detect an improvement in their mental health with increased duration of incarceration, in line with the findings of Gonçalves et al. (2016) and Shaw et al. (2004). Interestingly, the BMI was also found to increase as the duration of incarceration in the facility increased. Ultimately female detainees may have experienced the correctional facility as a more secure environment in terms of food availability and the prohibition of illicit substances, resulting in less anxiety and depressive symptoms, improved dietary intake and weight gain during the first month on remand detention.

Further factors that may have contributed to decreased dietary intake and increased metabolic energy expenditure, and as a consequence the prevalence of underweight, are substance abuse, alcohol intake and smoking (Scott et al., 2007). Methamphetamine for example affects the sympathetic branch of the autonomic nervous system and may result in hypertension, tachycardia, hyperthermia, increased breathing rate and increased physical activity, with concomitant sleeplessness (Scott et al., 2007). It is furthermore well documented that nicotine

from smoking mediates various metabolic processes that cumulate in reduced appetite and reduced food intake (Tweed et al., 2012; Jo et al., 2002). It can thus be argued that the combination of daily illicit substance use, alcohol use and smoking may contribute to inadequate energy intake and being underweight. The results of the current study support this possibility for illicit substance use and to some extent smoking, but not for alcohol use.

Illicit substances were used daily by 1 in 3 juvenile females and was found to be a predictor of probable clinical significance of a lower BMI. BMI decreased with 2.6kg/m^2 in those who sometimes use illicit substances, compared to those who never use such substances, and decreased with a further 2.6kg/m^2 in those who use illicit substances every day**.** Of note is that coloured females who were most likely to be underweight in the sample of female detainees, were significantly more likely to use illicit substances daily (48% used daily, 45% sometimes and 7% did not use) than black African females (10% used daily, 19% sometimes and 71% did not use). Although the current study did not investigate the type of illicit substances used, it is plausible that methamphetamine was being used as it is one of the most commonly used illicit substances in the Western Cape (Plüddermann, Parry & Bhana, 2007).

Smoking (2 in3 of the on remand female detainees smoked daily) was not found to be a significant predictor of BMI in female detainees, but there was a significant negative correlation between smoking and BMI, indicating that there is a possibility that smoking may have contributed to inadequate dietary intake and a lower BMI. Eighty-three percent of the coloured females in the sample reported that they smoked every day, while only 38% of the black African female detainees reported that they smoked every day and more than half of them reported that they did not smoke at all. The use of illicit substances and smoking was higher in the current study than reported by Naude et al. (2011) for a group of coloured binge drinking and non-drinking adolescents (mean age 15) that hail from the catchment area of Pollsmoor correctional facility. The more pronounced risk taking behaviour profile in the current sample of on remand female detainees could possibly be linked to an increased exposure over time to illicit substances in environments of high emotional distress (Pradeilles et al., 2015; Ramsoomar et al., 2013; Committee on Adolescence, 2011; Fazel et al., 2006; Delisle, 2005).

It needs to be noted that smoking, alcohol use and illicit substance use have been reported to be common in incarcerated populations in general, and specifically in juveniles, as a result of their inclination to increased risk taking behaviour (Feeley et al., 2012; Avalos et al., 2010; Plüddemann et al., 2010; Reddy et al., 2010; Plüddermann, Parry & Bhana, 2007). According to

the American academy of paediatrics the use of alcohol and illicit substances is usually 18% and 45% higher respectively in juveniles than the general community of the same age (Committee on Adolescence, 2011). Smoking and illicit substance use prior to admission into a correctional facility may thus contribute to a juvenile having a compromised nutritional status at admission (Scott et al., 2007; Jo et al., 2002). This is a serious consideration when planning for the nutritional rehabilitation of underweight juvenile females subsequent to incarceration.

Chronic infectious diseases have been documented to affect energy and micronutrient needs (Kerkhoff et al., 2016) and may have contributed to the undernutrition documented in this research. International data shows that the prevalence of both HIV/AIDS, TB and Hepatitis B and C are higher among incarcerated populations around the world with females having a higher prevalence of HIV infection than males (Fazel & Baillargeon, 2011). Approximately 14% of the female detainees in this research self-reported that they had TB (1) or HIV (4), which may have been an underestimation as a result of the self-reported nature of the data or unawareness of infection status. Due to the constraints inherent to conducting research on juveniles and their particular vulnerability, HIV and hepatitis B or C status was not confirmed biochemically.

The HIV, TB and hepatitis prevalence reported for similar age-groups in other South African settings confirms the possibility that infection results from this study may be an underestimation. A study on inmates conducted in Durban in 2012 found that 43% of the under 25 years olds tested positive for HIV, while the prevalence in the general female South African population for the same age category was only 28% (Gow et al., 2012). The prevalence of TB may be much higher in low-socio economic areas and correctional facilities where people live in close proximity to each other and do not necessarily have access to appropriate hygiene resources, while space and ventilation may also be limited. This is illustrated by the TB prevalence of 67% found in a 20-year-old population living in a low socio-economic area in the Western Cape by Wood et al. (2010) and the contention by Fuge and Ayanto (2016) that inmates have a three times higher risk of contracting TB when compared to the general population.

According to (Kerkhoff et al., 2016) infectious diseases increase the risk for iron deficiency and anaemia. Adolescents, especially female adolescents, are at risk of iron deficiency due to increased deposition of LBM, increased red blood cell volume and the onset of menses (Stang & Larson, 2016). SANHANES (2012) data showed that anaemia (haemoglobin<12g/dL) was present in 24.2% of 15 to 24-year-old females and that 17.1% of these females had low blood

ferritin levels (<15µg/L). It is thus highly possible that approximately a quarter of the sample of female detainees in this study entered the facility with anaemia, especially bearing in mind the presence of infectious disease, the high rate of pregnancy and the fact that intake of items from the quality protein food group, that are generally the best sources of iron in the diet, was below the FBDG recommendation (NDoH et al., 2017; Phatlhane et al., 2016; Stang & Larson, 2016; Shisana et al., 2013; Gow et al., 2012; Wood et al., 2010).

Excessive physical activity can exacerbate the effect of inadequate energy intake and contribute to the development of undernutrition (underweight). Adolescent populations, including South Africans, typically do not meet the recommended levels of physical activity. Data from SADHS (2003) showed that 52% of females aged 15-24 were inactive and only 18% were classified as being sufficiently active (SADHS, 2003). However, the profile of physical activity of the female detainees in this study point to high levels of physical activity in the region of 740 minutes of moderate and vigorous activity combined per week in the month prior to being arrested. This is much higher than the recommended 150 minutes of moderate physical activity per week or 75 minutes of vigorous physical activity per week as specified by the WHO for optimal health (WHO, 2010). The majority (67%) of the on remand female detainees were classified as 'active' (MET minute score of >3000 per week), with most physical activity involving walking or cycling to places, some time spent doing sport during recreational/leisure time and no time spent doing moderate or vigorous-intensity activities as part of work. The possibility that the high levels of physical activity may have contributed to a negative energy balance and underweight in the female detainees is confirmed by the finding that increased physical activity expressed in MET minutes done per week was found to be a predictor of probable clinical significance of a lower BMI.

An interesting finding is that time spent walking or cycling to places was positively correlated with frequency of illicit substance use and smoking. As mentioned above, use of illicit substances such as methamphetamine may result in increased levels of physical activity and problems with sleeping (Scott et al., 2007). It is thus plausible that illicit substance use may have contributed to the high levels of physical activity documented in this research, especially in the coloured female detainees, and may have contributed to development of undernutrition via stimulation of excessive physical activity.

As alluded to earlier in the discussion of the nutritional problems experienced by female remand detainees, they are characterized not only by undernutrition, but also by overweight and obesity. The very strong positive correlation found between BMI and triceps skinfold in

the on remand female detainees indicates that a higher BMI in the overweight/obese range may have been the result of increased fat stores rather than increased LBM, especially because there was no association between MHGS, an independent indicator of LBM, with the triceps skinfold nor the BMI. Overweight and obesity arise as a result of a positive energy balance over a period of time, with both excessive energy intake and low levels of physical activity contributing to the situation (Stang & Larson, 2016).

While female detainees who were coloured and had Afrikaans as home language were significantly more likely to be underweight, those who were black African and had Xhosa as home language were more likely to be overweight or obese (90% of the overweight and 100% of the obese female detainees were black African). This result must be seen in the context of the fact that cultural norms for especially black African women lean towards accepting a larger body size in the overweight-obese range as the norm (Kruger et al., 2006; Kruger et al., 2005; Puoane et al., 2002). The possibility that cultural norms may have been a factor in the trend for the black African female detainees to be mostly overweight or obese is supported by the finding that only one overweight/obese juvenile female correctly perceived herself to be overweight/obese, while 41.7% perceived themselves as being too thin and 50% as having a normal weight. The fact that a quarter of the overweight/obese female detainees indicated that they had tried to lose weight in the preceding year reflects that a wish to weigh less was present in some, even though the majority perceived themselves to be too thin or having a normal weight. Bearing in mind the potential link between smoking, illicit substance use and weight loss, the much lower frequency of smoking and illicit substance use by black African female detainees may have contributed to their maintenance of a higher BMI despite experiencing many challenging circumstances that could have contributed to weight loss and underweight.

In line with the generally accepted notion that high-energy LND foods contribute to the development of overweight and obesity (Kant, 2003), results show that a higher frequency of intake of high-fat snacks was a predictor of probable clinical significance of a higher BMI. Snacking typically took place during the mid-morning and mid-afternoon, while late-night snacking was not common. Snacking as such may be recommended as part of a healthy eating pattern within the context of choosing healthy snack options (Widome et al., 2009; Pedro et al., 2008). In this research frequency of snacking was positively correlated with both nutrient dense items (protein, dairy) and high-energy LND items (fats & oils, high-fat snacks and high-sugar containing foods). These high-energy LND food choices are typical of the urban South African adolescent diet (Shisana et al., 2013; Feeley et al., 2012; Reddy et al., 2010) and have

been linked to an increased risk of becoming overweight and obese (Kranz et al., 2008; Langevin et al., 2007).

Male on remand detainees

The sociodemographic profile for on remand male detainees shows that the majority of the sample was coloured and the mean age was approximately 20 years. In line with the profile of the female detainees, coloured male detainees were significantly more likely to have Afrikaans as home language (92%), while black African male detainees were significantly more likely to have Xhosa as home language (75%). The majority were born in the Western Cape and they lived with their parents, and had electricity and running water in their home at the time of the study. There was a non-significant trend for male on remand detainees to have been more likely to have only completed grades 7 or 8 level schooling (49%), while the majority of females (63.5%) had completed grades 9-11. Only three male and two female detainees had completed grade 12.

The anthropometric results for male on remand detainees reflect that undernutrition at entry into the correctional facility is a concern, as 18% of these detainees were underweight, while none were overweight or obese. Of note is that the SADHS (2016) reported a prevalence of overweight and obesity of 8.3% and 2.3% respectively for 18-24 year old males and the BTT study reported 6.1% and 2.2% respectively for 17-19 year old males (Pradeilles et al., 2015). The proportion of underweight male detainees was slightly higher than that found for the female detainees, and also higher than the 15.8% reported for 18-24 year old males in the SADHS (2016), but lower than the 22% reported in the BTT study for 17-19 year old males. The seriousness of the problem of undernutrition among male detainees is emphasized by the fact that 4 out of 5 of them had a MUAC below the 25th percentile (vs 1 in 5 females). MUAC is typically used for nutritional screening and to determine eligibility for nutrition support among adults, especially pregnant women and people living with HIV and/or tuberculosis (Goossens et al., 2012; Duggan, 2010). As was the case for the female detainees, the nutritional status profile of male on remand detainees in Pollsmoor prison was in line with global statistics that point to the fact that incarcerated populations are usually characterized by a higher prevalence of underweight and lower prevalence of overweight or obesity (Silverman-Retana et al., 2015; Gould et al., 2013; Fazel & Baillargeon, 2011).

Although more than half of the underweight male on remand detainees correctly identified themselves as being underweight, it is a concern that 41% perceived themselves to be normal weight and one even perceived himself to be overweight/obese. These detainees may not be aware of their underweight status, contributing to maintenance of their poor nutritional status. A possible explanation for this finding is that many of their peers may also have been underweight, with the norm for a normal body weight thus being in the underweight range (Holmqvist & Frisén, 2010). Normal weight male detainees in this study were most likely to correctly perceive themselves to be normal weight (53%), although the majority of the remaining normal weight detainees felt that they were underweight. This finding may reflect a wish for a "larger" physique in line with male body ideals for adolescent and adult males that focus on a muscular V-shaped body shape, characterized by well-developed shoulders and abdominal musculature and narrow hips (Gitau et al., 2014; Holmqvist & Frisén, 2010; McCabe & Ricciardelli, 2004).

Despite some indications that body-image distortions may have been present among male detainees, it was less prominent than among female detainees. In contrast, SANHANES (2012) found no difference in the proportion of 15-24 year old males and females whose perception of their weight was in agreement with their actual weight classification (37% and 38% respectively).

Anthropometric measures conducted to assess body composition indicate that both body fat stores and LBM levels may have been compromised in the male detainees. Triceps skinfold results showed that the majority of the sample had a value below the 25th percentile, indicating decreased fat stores. Results for cAMA, an indicator of LBM, showed that 34% of the males were in a wasted condition. The MHGS of 2 in 5 of the male detainees was below the 25th percentile, a further reflection of not only a compromised LBM, but also chronic undernutrition (Angst et al., 2010; Gallup et al., 2010; Vaz et al., 1996).

In line with findings for female detainees, underweight male detainees were mostly coloured (83.3%), with the remaining 16.7% being black African. Furthermore, having Afrikaans as home language was found to be a predictor of probable clinical significance of a lower BMI, cAMA and MHGS. Having Xhosa as home language was found to be a predictor of probable clinical significance of a lower MHGS only. These results point to the possibility that coloured Afrikaans speaking juvenile males entering a correctional facility in the Western Cape may have a higher risk of being underweight and chronically undernourished than detainees of other race and language groups. This possibility is supported by the finding reported by

Pradellies et al. (2015) that 17-19 year old coloured males in the BTT cohort had higher odds of thinness compared with their black African counterparts.

Results on the food choices of male detainees in the week prior to incarceration revealed that nutrient dense foods (quality protein, diary, starch, fruit and vegetables) were chosen less frequently than LND foods (fats and oils, high-fat snacks and high-sugar containing items) (four vs six times a day). The six most frequently consumed foods in descending order were table sugar, crisps, brown bread, white bread, fruit (apples, bananas) and oils. When considering these results it is evident that the profile of food choices is similar to that described for females detainees, with fruit and vegetable, dairy and quality protein intake not meeting the FBDG recommendations (Wang et al., 2014; Schonfeldt & Hall, 2013; Vorster et al., 2013a). Although male detainees had a significantly higher frequency of intake of fruits per day than female detainees, it was still not consumed on a daily basis and thus not adequate.

Naude (2012) also found that the fruit and vegetable intake of male and female adolescents with and without alcohol use disorders (AUDs) in the Western Cape was insufficient. The six most commonly consumed foods reported by Naude (2012) for these adolescents included four LNDs: sugar, white bread, carbonated beverages and savoury snacks (crisps). Naude (2012) further reported a prevalence for inadequate intake (<EAR) of greater than 50% for folate, vitamin C, vitamin A, vitamin E, calcium and phosphorus. These inadequate intakes clearly reflect low intake of green leafy vegetables, yellow and red fruit and vegetables, diary and plant oils. Bearing in mind the similarities of food choices between the on remand detainees and the adolescents in the Naude (2012) study, it is plausible that similar micronutrient deficiency risks could have been prevalent in the male and female detainees who participated in this research.

Food choice predictors of BMI and LBM (cAMA and MHGS) differed between male and female on remand detainees. Predictors found for females included frequency of intake of items from the vegetable, high-fat snacks and dairy groups, while significant predictors for males included frequency of intake of items from the starch group (increased frequency of intake reduced cAMA), fats and oils group (increased frequency of intake increased cAMA and MHGS) and quality protein group (increased frequency of intake decreased MHGS). However, none of these food choice predictors met the requirements stated in this research for probable clinical significance. Starches (carbohydrate), although less energy dense than fats (Ireton-Jones, 2012), are important energy sources, especially in lower socio-economic communities (Darmon & Drewnowski, 2015). The finding that lower starch intake possibly predicted

improved LBM may reflect replacement of starch with more energy dense fat and oil items. The same may be true for the finding that a lower intake of quality protein was associated with a higher MHGS. The finding that increased frequency of intake of items from the fats and oils group possibly predicted improved LBM and MHGS supports this possibility; however, this effect may be at the cost of adequate quality protein and micronutrient intake. These findings emphasise the importance of consumption of a variety of foods in recommended amounts to ensure optimal weight and health (Vorster et al., 2013a).

Although not significantly different, there was a trend for male detainees to skip breakfast and lunch more frequently prior to incarceration than female detainees. The potential negative effects of skipping breakfast and lunch on quality food choices in male detainees is evident from the fact that a decrease in frequency of breakfast consumption was significantly correlated with a lower frequency of intake of items from the dairy and fruit groups. Furthermore, lower frequency of lunch consumption was correlated with lower frequency of intake of items from the protein group. Research shows that skipping meals, reducing portion sizes and opting for LND foods are often employed as mechanisms to cope with food insecurity in developing countries, including South Africa (Gupta et al., 2015; Schönfeldt et al., 2013).

The significant positive correlations found between frequency of snack consumption and frequency of intake of items from the dairy, fruit, starch, fats and oils, high fat snacks and high sugar groups indicate that snacks consumed by male detainees included both nutrient dense and high energy LND foods. Snacks could thus have contributed to both energy and essential micronutrients towards meeting energy and micronutrient needs. This possibility is confirmed by the finding that increased snacking between meals was found to be a predictor of probable clinical significance of a higher cAMA.

The nutrition knowledge of male detainees also seemed to be poor, with the majority only being able to mention three groups or fewer of the seven food groups that are essential for health. Contrary to the finding that better understanding of what to eat to be healthy predicted a poorer nutritional status (cAMA) in female detainees, knowledge of healthy eating was found to be a statistical, but probably not clinical significant predictor of an increased MHGS in male detainees. Despite the potential lack of clinical significance, it is encouraging to note that nutrition knowledge may affect LBM positively and lower the risk for chronic undernutrition in male detainees. This possibility is supported by the significant positive association found between knowledge of healthy eating and frequency of intake of nutrient dense foods such as vegetables and quality proteins in male on remand detainees. It is thus

possible that nutrition education may be an intervention option for the improvement of the nutritional status of juvenile males (Spronk et al., 2014; Curd et al., 2013). School grade achieved was also found to be a statistical, but probably not clinical significant predictor of MHGS, supporting the possibility that increased knowledge and education level may be a protective factor in male detainees. However, the association between school grade and MHGS needs to be considered within the context of the fact that schooling level is linked to age, and that MHGS increases with age up to the age of 35 (Dodds et al., 2014).

Moderate or severe food insecurity (based on the hunger score) in the month prior to incarceration was found to be more prevalent among male than female detainees (43.3% vs 30.8%), although this difference was not significant. When comparing the prevalence of severe food insecurity in the male on remand detainees in this study (23%) to statistics generated in the General Household Survey (GSH) of 2015 conducted for the City of Cape Town, it is evident that "severely inadequate access to food" was less prevalent in the general population at 13% (Stats SA, 2017). As mentioned in the discussion of the female detainees, data derived from the community childhood hunger project questionnaire (CCHIP) as reported in the SANHANES (2012) also showed a lower prevalence of hunger of 16% (Shisana et al., 2013). Of note is that questionnaires/tools used to determine food insecurity varied across the mentioned studies and comparisons of findings should thus be done with caution.

While food insecurity was not found to be a predictor of any of the nutritional status indicators for female detainees, a higher hunger score was found to be a predictor of probable clinical significance of a lower MHGS; thus possibly reflecting compromised LMB and the presence of chronic undernutrition in the male detainees (Vaz et al., 1996). Factors contributing to increased risk of chronic undernutrition in low income households include a decrease in dietary diversity, specifically the servings of dairy and vegetables, in an attempt to reduce the expenditure on foods (Schönfeldt et al., 2013; Committee on Adolescence, 2001; Dixon et al., 2001). Further results involving the male detainees that support a possible role for food insecurity in the development of undernutrition in male detainees prior to incarceration include the following: 1) the availability of fruit juice in the home was found to be a significant predictor of a higher BMI although this predictor was probably not of clinical significance, 2) there was a significant negative correlation between the hunger score and the frequency of intake of items from all eight the food groups investigated, and 3) an increase in the hunger score was correlated with a decrease in the availability of fruit, fruit juice, vegetables and milk at home and a decreased frequency of vegetables served during meals at home. The reduced availability of the mentioned food items in the home may, in turn, have affected the food

choices of male detainees, as less frequent availability of the items was correlated with lower frequency of intake from especially the diary and vegetable groups, and to a lesser extent quality protein and fruit groups. The fact that more than half of both male and female detainees resided with their parents prior to incarceration confirms the importance of food security in the home environment in preventing undernutrition. Research also shows that support of family members may further contribute to improved nutritional outcomes in children (Bocquier et al., 2015; Coleman-Jensen et al., 2014; Charlton & Rose, 2002).

The profile of mental health risk experienced by male detainees was similar to the profile documented for females, with 25% of the male detainees having experienced high and 37.3% very high levels of anxiety and depressive symptoms in the month prior to admission. As can be expected, the prevalence of these indicators of mental disorders were more common in male detainees than in the general population, with only 20% of the general male population of the same age having been reported to have experienced any level of mental distress (Shisana et al., 2013). As mentioned earlier in this discussion, events leading up to arrest, the arrest procedures as such and the first two months in detention may contribute to the development or exacerbation of mental health risks in juveniles (Gonçalves et al., 2016; Brown & Ireland, 2006; Shaw et al., 2004). Naidoo and Mkize (2012) reported that 23% of male inmates in Durban, South Africa exhibited one or more psychiatric disorders, including psychosis, bipolar, depression, anxiety and antisocial personality disorders during incarceration. Similarly, in a review on mental illness experienced by inmates world-wide, Fazel and Seewald (2012) documented that the prevalence of psychosis in inmates in low-to-middle income countries was 5.5%, while the prevalence of major depression was 22.5%.

However, in contrast to female detainees for whom increased depressive and anxiety symptoms was found to be a predictor of comprised LBM, mental health risks experienced by male detainees did not seem to influence their nutritional status. One possible explanation for this finding is that the rate of PTSD among incarcerated juvenile females has been reported to be higher than that found among incarcerated male juveniles (Kerig et al., 2009; Cauffman et al., 1998). Kerig et al. (2009) found that 45% of newly admitted juvenile females met the criteria for full PTSD, and 21% met the criteria for partial PTSD, while only 26% of males met the criteria for full PTSD and 21% met the criteria for partial PTSD. Female juveniles who suffer from PTSD have also been reported to exhibit higher levels of distress and lower levels of self-restraint than those who do not have PTSD. The most traumatic event experienced by female detainees was sexual abuse, while male detainees experienced both community violence and the injury/death of a loved one as most traumatic (Kerig et al. 2009).

The profile for use of illicit substances and smoking for male detainees is a specific concern; they were significantly more likely to smoke every day than female detainees (76.1% vs 64.7%). Male detainees also tended to be more likely to use illicit substances every day (38.8% vs 31.4%), while the profile of alcohol use by male detainees was similar to that of females. Only a few male detainees used alcohol on a daily basis, just over half had used alcohol sometimes and the balance indicated that they had not used alcohol. Smoking among remand male detainees was 46% higher than the prevalence found for males of the same age group in the general population, while alcohol use was found to be 17% higher (NDoH et al., 2017). Use of illicit substances by male detainees was 27% higher than the prevalence reported for male adolescents in the Western Cape (Parry et al., 2011).

The strong positive correlation between frequency of smoking and use of illicit substances supports the notion of clustering of risk taking behaviours as indicated by Kaczynski et al. (2008) and van der Laan et al. (2010). Clustering of risk taking behaviours in the sample of male detainees who participated in this study is further illustrated by the positive associations found between frequency of smoking and poorer lifestyle behaviours, including lower levels of physical activity, lower frequency of intake of healthy foods and more frequent intake of unhealthy foods (foods high in sugar). Likewise, increased frequency of illicit substance use was also associated with poor food choices.

Coloured male detainees, like their female counterparts, were more likely to smoke and use illicit substances than their white or black African counterparts, with the possible consequence of an increased risk of negative nutritional outcomes. As mentioned earlier in this discussion, illicit substance use and smoking could result in increased energy needs as a result of increased physical or metabolic activity on the one hand (Scott et al., 2007; Jo et al., 2002), and/or reduced dietary intake on the other hand (Tweed et al., 2012). However, use of illicit substances may have played a lesser role in affecting nutritional outcomes in male than in female detainees, as unlike results for the female detainees, use of such substances was not associated with any of the indicators of nutritional status investigated in this study in male detainees.

An interesting, but not unexpected, finding in the male group of detainees is the positive association between the presence of mental health risks in the month preceding the survey and the frequency of use of illicit substances. Research on the mental health of late-adolescents indicates that substance use disorders and mental disorders in the form of externalising disorders (measures of aggression, hostility, impulsivity and violence directed

towards self and others) (Gorodetsky et al., 2016)are key concerns in this age category (Topp et al., 2016; Silverman-Retana et al., 2015; Perry & Morris, 2014; Benjet et al., 2013; Dumont et al., 2012; Fazel & Baillargeon, 2011; Møller et al., 2007; Sifunda et al., 2006). The results of this research point to the possibility that more frequent use of using illicit substances may result in increased levels of depressive symptoms or visa-versa. Support for this possibility comes from the research by Segal et al. (1982) that suggested that drug use may be a means of coping with stress, as well as a means of altering consciousness in detained juveniles suggested. However, Riggs et al. (1995) reported that despite the finding that depressed 13-19 year old delinquents had more substance dependence diagnoses than the general 13-19 year old population, the depression did not appear to be related to substance intoxication, as a four week period of abstinence did not alleviate the depression problem.

The proportion of male detainees who reported to have AIDS was low at five (7.5%) and TB at one (1.5%). These figures may be an underestimation of the prevalence of these infectious disease conditions in young men in general, and more specifically in incarcerated juveniles (Gow et al. 2012), for the same reasons mentioned in the discussion of the infection rates in female detainees. As mentioned earlier in the discussion, TB may be more prevalent amongst those who hail from lower socio-economic areas and live in close proximity of each other without proper hygiene facilities (Wood et al. 2010, Fuge &Ayanto 2015). It can, therefore, not be ruled out that infectious disease may have played a role in the presence of undernutrition in male detainees at admission to the correctional facility.

The majority of male detainees were categorized as being physically active (83.6%) and the time they spent doing physical activity per week (combination of moderate and vigorous activity) was seven times higher than the WHO recommendation of 150 minutes per week (WHO, 2010). These detainees were clearly more active than 15-24 year old males who participated in the 2003 SADHS for whom a prevalence for being physically active of 34% was documented. A prominent difference between male and female detainees in terms of physical activity levels is that females did hardly any recreational physical activity, while male detainees spent almost half an hour a day doing recreational physical activity prior to incarceration. This difference explains the significantly higher total time spent doing physical activity by male than female detainees, as time spent walking or cycling to places was 60 minutes for both genders. National surveys have also shown that males spend more time doing sport/being physically active than females (Shisana et al., 2013; SADHS, 2003).

The higher levels of physical activity in male detainees when compared to the general population, may be linked to illicit substance use, as was argued for female detainees. Results support this possibility as increased frequency of illicit substance use was associated with decreased time spent being sedentary in male detainees. On the other hand, increased frequency of smoking was associated with decreased levels of total physical activity in male detainees. Kaczynski et al. (2008) found that the association between smoking and physical activity in adolescents could in actual fact be both positively or negatively associated. Kackzynski et al. (2008) indicated that these seemingly contradictory results may be the result of a variety of factors that may determine whether adolescents who smoke, take part in physical activity. These factors may be psychological or physiological in nature or involve educational background. Furthermore, physical activity intensity also seemed to play a role as those who took part in vigorous physical activity were less prone to smoke than those who did moderate physical activity (Kaczynski et al., 2008).

Although physical activity did not emerge as a significant predictor of any of the nutritional status indicators for male detainees, it can be argued that it contributed to increased energy needs that may have been difficult to meet in a food insecure environment. Against expectations, time spent being sedentary emerged as a statistical, but probably not a clinical significant predictor of a lower BMI. Increased time spent being sedentary is typically associated with an increased risk for overweight/obesity (World Health Organization, 2000). More in line with what could be expected, the negative effect of more time spent being sedentary on LBM is reflected in the finding that increased time spent being sedentary was a statistical, albeit probably not a clinical significant predictor of a lower cAMA. LBM is typically increased when people take part in physical activity, both aerobic and strength exercises, while decreased physical activity combined with increased time spent being sedentary may limit LBM proliferation (Stang & Larson, 2016).

Chapter 6: Summary, limitations, conclusions and recommendations

6.1 Summary of the profiles and malnutrition risks of on-remand juvenile male and female detainees in Pollsmoor correctional facility, Cape Town

A summary of the profiles of female and male on remand detainees is presented in *Table 51*.

Females were characterised by a double burden of malnutrition, namely undernutrition and overweight/obesity (*Table 51*). On average their fat stores, and to a lesser extent their LBM levels, were compromised, with indicators of chronic undernutrition being present. Coloured and black African ethnicities were equally represented in the sample, with Afrikaans being the most common and Xhosa the second most common home language reported. Only a few had completed grade 12, and half had given birth to one or more children. Body image distortion was present in that half of the overweight/obese females perceived themselves to be normal or underweight. Although a regular meal pattern was evident, food insecurity, associated with lower availability of fruit, vegetables and milk in the home, as well as lower frequency of vegetables being served at meal times, was present. Food choices showed frequent intake of low nutrient high-energy food items (table sugar, crisps, white bread, fizzy drinks that contain sugar and non-fibre containing starches) and less frequent intake of nutrient dense foods (fruits, vegetables, dairy and quality proteins), while knowledge of what to eat to be healthy seemed to be poor. Physical activity levels were high, with walking/cycling to get to places being a major contributor to time spent doing physical activity. Daily illicit substance use was the most common risk taking behaviour, especially amongst the females from the coloured ethnic group. Daily smoking was also common, also specifically amongst those from the coloured ethnic group, while alcohol use seemed to be less prominent. Female detainees were also characterized by the presence of depression and anxiety symptoms. The prevalence of infectious disease was reportedly low, but may have been an underestimation (*Table 51*).

Male detainees were characterised by undernutrition, but none of them were overweight or obese (*Table 51*). Their fat stores and LBM levels were compromised, with indicators of chronic

undernutrition also being present, but less so than for female detainees. The majority of males indicated that they were from the coloured ethnic group and that they had Afrikaans as home language. As was the case for the females, only a few had completed grade 12. Two forms of body image distortion were present in approximately half of the male sample, namely underweight males perceiving themselves to be normal or overweight and normal weight males perceiving themselves to be underweight. Skipping of breakfast and lunch was evident, while food insecurity, associated with lower frequency of intake from all food groups, and was present in more males than females. Similar to females, food choice data showed frequent intake of low nutrient high-energy food items (table sugar, crisps, brown bread, white bread and oils) and less frequent intake of nutrient dense foods (fruits, vegetables, dairy and quality proteins), while knowledge of what to eat to be healthy seemed to be poor. Physical activity levels were high, with both walking/cycling to get to places and recreational physical activity contributing to time spent doing physical activity. Daily illicit substance use was the most common risk taking behaviour followed by daily smoking (both highest in the coloured males and both higher than in females), while daily alcohol intake was not common. Male detainees were also characterized by the presence of depression and anxiety symptoms that were positively associated with illicit substance use. As for females, the prevalence of infectious disease was reportedly low, but may have been an underestimation (*Table 51*).

Table 51: Summary of the profiles of juvenile female and male on remand detainees.

Female	**Male**
Socio-demographics	
Coloured and black African ethnicities approximately equally represented.	Majority were from the coloured ethnic group.
Majority Afrikaans home language.	Majority Afrikaans home language.
Few completed grade 12.	Few completed grade 12.
One in two females report having a child.	Not applicable.
Majority lived with their parents.	Majority lived with their parents.
Majority were in the correctional facility for less than a week.	Majority were in the correctional facility for less than a week.
Nutrition status and body image	
Double burden of malnutrition: 15% underweight 17.3% overweight 5.8% obese.	Single burden of malnutrition: 18% underweight 0% overweight 0% obese.
Underweight more prevalent amongst detainees from the coloured ethic group and those who had Afrikaans as home language.	Underweight more prevalent amongst detainees from the coloured ethic group and those who had Afrikaans as home language.

Fat stores and LBM compromised, although LBM to a lesser extent.	Both fat stores and LBM compromised.
1 in 5 may have suffered from chronic undernutrition.	1 in 10 may have suffered from chronic undernutrition.
Body image distortion: 1 in 2 overweight females perceived their weight as normal or underweight. Half of the normal and underweight females perceived their weight correctly.	Body image distortion: 1 in 2 underweight males perceive their weight as normal or overweight. Half of the normal and underweight males perceived their weight correctly.
Meal pattern and food choices	
Skipping of meals was not common.	Skipping of breakfast and lunch was present.
Six most frequently consumed foods in descending order: table sugar, crisps, white bread, fizzy drinks that contain sugar, non-fibre containing starches (e.g. white rice, pasta, mealie pap) and eggs	Six most frequently consumed foods in descending order: table sugar, crisps, brown bread, white bread, fruit (apples, bananas) and oils.
Fruit, vegetables and dairy not consumed daily.	Fruit, vegetables and dairy not consumed daily.
Intake of quality proteins was low at approximately one time a day.	Intake of quality proteins was low at approximately one time a day.
Food security	
30.8% reported to have experienced either moderate (23.1%) or severe (7.7%) hunger.	43.3% reported to have experienced either moderate (27%) or severe (16%) hunger.
Lower food security associated with lower availability of fruit, vegetables and milk in the home. Lower frequency of vegetables being served at meal times.	Lower food security associated with lower frequency of intake of all eight food groups.
Risk taking behaviours	
Smoking daily 65% Alcohol daily 0% Illicit substance use daily 31%.	Smoking daily 76% Alcohol daily 1.5% Illicit substance use daily 39%.
Coloured ethnic group was more likely to have used illicit substances daily than black Africans.	Illicit substance use was equally common among black African and coloured ethnic groups.
Coloured ethnic group was more likely to smoke than black Africans.	Coloured ethnic group was more likely to smoke than black Africans.
75% experienced moderate to very-high and depression and anxiety symptom levels.	75% experienced moderate to very-high depression and anxiety symptom levels.
No association between illicit substance use and the level of symptoms of depression and anxiety	Frequency of illicit substance use increased as the level of symptoms of depression and anxiety increased.
14% reported to have HIV or TB (possible underestimation).	9% reported to have HIV or TB (possible underestimation).
Physical activity 5 times higher than WHO recommendations.	Physical activity 7 times higher than WHO recommendations.

Walking/cycling to get to places contributed majorly to time spent doing physical activity (60 MET min); recreational physical activity minimal.	Both walking/cycling to get to places (60 MET min) and recreational physical activity (26 MET min) contributed to time spent doing physical activity.

Predictors of the nutritional status indicators in juvenile female and male on remand detainees investigated in this research, namely BMI, cAMC and MHGS, are summarized in Table 52.

Predictors of probable clinical significance for BMI in the female detainees were frequency of vegetable intake (+), frequency of high-fat snack intake (+), frequency of dairy food intake (-), illicit substance use (-), physical activity in MET minutes (-) and availability of fruit juice in the home (-) (Table 52). Predictors of probable clinical significance for cAMA were Afrikaans home language and depression and anxiety symptoms (-). Predictors for cAMA that were statistically significant, but probably not of clinical significance were frequency of vegetable intake (+) and knowledge of what to eat to be healthy (-). Predictors of probable clinical significance for MHGS were Afrikaans home language (-) and anxiety and depression symptoms (-) (Table 52).

A predictor of probable clinical significance for BMI in males was having Afrikaans as home language (-). Predictors for BMI that were statistically significant, but probably not of clinical significance were availability of fruit juice in the home (+) and minutes being sedentary per week (-). Predictors of probable clinical significance for cAMA were frequency of snacking between meals per week (+) and having Afrikaans as home language (-). Predictors for cAMA that were statistically significant, but probably not of clinical significance were frequency of fats and oils intake (+), frequency of starch intake (-) and minutes being sedentary per week (-). Predictors of probable clinical significance for MHGS were hunger score (-), having Afrikaans as home language or isiXhosa as home language (-). Predictors for MHGS that were statistically significant, but probably not of clinical significance were frequency of fats and oils intake (+), school grade achieved (+); knowledge of healthy eating (+); availability of milk in the home (-) and frequency of protein intake (-).

Table 52: Malnutrition predictors in juvenile female and male on remand detainees.

Predictors of probable clinical significance	
Females	**Males**
Afrikaans as home language: lower MHGS and lower cAMA	Afrikaans as home language: lower BMI, cAMA and MHGS.
Not significant	Snacking between meals: greater cAMA.
Higher frequency of intake of vegetable food group: higher BMI	Not significant

Higher frequency of intake of dairy food group: lower BMI.	Not significant
Higher frequency of intake of high-fat snacks: higher BMI	Not significant
Not significant	Higher hunger score: lower MHGS
More frequent illicit substance use: lower BMI	Not significant
Higher anxiety and depression score: lower cAMA and a lower MHGS	Not significant
Higher physical activity MET minutes per week: lower BMI.	Not significant
Statistically significant but probably not clinically significant predictors	
Better knowledge of healthy eating: reduced LBM	Better knowledge of healthy eating: increased MHGS
Higher frequency of intake of vegetables food group: greater cAMA.	Higher frequency of intake of starch food group: lower cAMA Higher frequency of intake of the fats and oils group: greater cAMA and MHGS Higher frequency of intake of the quality protein group intake: lower MHGS
Not significant	Availability of milk in the home: lower MHGS
Availability of fruit juice in the home: lower BMI	Availability of fruit juice in the home: greater BMI
Not significant	Increased time spent being sedentary: lower BMI and cAMA.
Not significant	Higher school grade achieved: higher MHGS

6.2 Study limitations

The following limitations need to be considered in the interpretation of the results of this research:

Socio-demographic, anthropometric, body weight perceptions and weight loss attempts, meal pattern, availability of healthy food in the home, basic nutrition knowledge, food frequency questionnaire, physical activity, anxiety and depression and risk taking behaviour data was collected using a questionnaire that may result in incorrect reporting. However, the interviewer was very experienced and appropriate probing and clarification of responses as necessary may have reduced this possibility.

Detailed information on usual dietary intake would have provided more insights in total energy, macronutrient and micronutrient intake in the week prior to incarceration and the association thereof with the investigated nutritional status indicators. Using a dietary record method or repeated 24-hour dietary recall was not feasible as the detainees were seen once off subsequent to admission to the correctional facility. The time available for all data collection was only 45 minutes, impeding the feasibility of conducting a full diet history or completing a comprehensive quantified FFQ. Although the indicator food list (FFQ) used in this research was not quantified, the validity of the frequency of intake method used is confirmed by the findings of Senekal et al. (2009) who tested the validity of the reported frequency of intake of indicator foods during the past week against a 7-day food intake record.

Confirmation of micronutrient status, especially iron and vitamin A as well as tests for HIV/AIDS, TB, Hepatitis C would have provided important insights, but were not feasible within the context of the vulnerable study sample and the limited budget.

Finally, a larger sample size may have made it possible to confirm the clinical significance of the predictors that were statistically significant, but probably not of clinical significance. Confirmation of the novel criterion cut-offs formulated for the interpretation of clinical significance of significant predictors in this research in further research in larger samples that may include alternative target populations, would be of great value.

6.3 Conclusions

The key conclusion of this research is that both female and male juveniles were prone to be malnourished at admission to the correctional facility (Pollsmoor prison). Females had a double burden of malnutrition, with both underweight and overweight/obesity being present, while underweight was the key malnutrition problem in males. As a result of the poor food choices that were evident in both groups it cannot be ruled out that key micronutrient deficiencies such as iron, zinc and vitamin A deficiencies may have been present.

It can further be concluded that being from the coloured ethic group and having Afrikaans as a home language increased the risk of being underweight at admission to the correctional facility for both male and female juveniles.

For female detainees, it can be concluded that low frequency of intake of vegetables, high levels of physical activity, frequent use of illicit substances and the presence of depression and anxiety in the month preceding the study increased the risk of being undernourished as

reflected by BMI, cAMA and MHGS, while greater frequency of consumption of high fat snacks increased the risk for being overweight/obese. Although food insecurity did not emerge as a significant predictor of underweight in females, the level of food insecurity documented for these detainees remains a concern. Better knowledge of what to eat to be healthy does not seem to protect against undernutrition, but rather predict poorer nutritional status. A further factor that did not emerge as a predictor of the nutritional status indicators assessed in this research that remains a major concern is the large number of pregnancies that was documented. It cannot be ruled out that these pregnancies, which mostly took place during adolescence, contributed to micronutrient deficiencies, especially iron deficiency.

For male detainees, it can be concluded that food insecurity, associated with lower frequency of intake form all the investigated food groups, and lower snacking between meals predicted the risk of being undernourished. Unlike the situation for female detainees, nutrition knowledge may reduce the risk for undernutrition in male detainees. Although illicit substance use, smoking and the presence of symptoms of depression and anxiety in the month preceding the study did not emerge as significant predictors, the proportions of male detainees who partook in these risk taking behaviours and exhibited high scores for depression and anxiety symptoms remains a major concern.

Based on the results of this study it is projected that the following factors may need to be considered as potential barriers in nutrition intervention planning: food insecurity in the home environment, tendency to make poor food choices that may be ingrained in this age group, possibly poor nutrition knowledge, substance abuse/addiction, the tendency towards body shape distortion, the presence of depression and anxiety and possibly the presence of infectious disease.

6.4 Recommendations

6.4.1 Overarching recommendations

The study results clearly indicate that malnutrition is a problem that needs to be screened for when juveniles are admitted to correctional facilities, with the period of incarceration being an ideal opportunity to address the identified nutrition related problems and if possible, contributing factors. The main recommendation from this study is for DCS to implement a nutritional status screening procedure when a juvenile is admitted to a correctional facility for identification/diagnosis of nutrition related problems and associated factors for referral for

nutrition and other health support within the facility (see section 6.4.2 for more detail). A further recommendation is that the DCS continue to implement the ration scale for juveniles as discussed in section 6.4.3 for more detail. The final recommendation is that a nutrition related health education intervention targeted at juveniles be developed and rolled out in Pollsmoor correctional facility and possibly in further correctional facilities under the auspices of DCS or the Department of Social Welfare (see section 6.4.4 for more detail).

The following are recommendations for further research on the nutritional status of incarcerated juveniles:

- Confirmation of the predictors of nutritional status documented in this research in a further sample of juvenile on remand detainees from a random sample of correctional facilities across the country.
- Confirmation of the criteria for interpretation of the clinical significance of statistically significant predictors of BMI, cAMA and MHGS developed for the purposes of this research in the random sample mentioned in the previous point.
- Testing of the feasibility of the implementation of the proposed screening procedure in a DCS facility while on remand detention.
- Investigation of the effect of implementation of the nutritional screening tool on the improvement of malnutrition in juveniles during incarceration, bearing in mind socio-ecological determinants of malnutrition
- Development, implementation and evaluation of a comprehensive nutrition and risk taking behaviour intervention programme to address nutrition related health problems and related risks taking behaviour in the juvenile population.

6.4.2 Nutritional status screening procedure for on remand detainees at admission to a correctional facility

A proposal for assessments to be included in the suggested screening procedure is presented in Table 53. The screening procedure includes anthropometric measures, MHGS, biochemical measures for infectious disease and anaemia, food security questions, a screening questionnaire for the presence of symptoms for depression and anxiety, as well as pregnancy history in female detainees.

6.4.3 Continued implementation of the 2003 (DOH) DCS ration scale

Analysis of the menu offered to juveniles in Pollsmoor correctional facility (see section 2.9.3 for detail on this analysis) showed that their macro-and micro-nutrient requirements would be met if the menu is served as planned. It could thus be expected that the nutritional status of juveniles who were undernourished at admission to the facility, may improve during incarceration due to the increased frequency of intake of the dairy, quality protein and fruit and vegetables.

The 2003 therapeutic manual as developed by the Department of Health which is used by the DCS is an appropriate document for the ease of use in a correctional facility. The referral guidelines are clear, and the medical professionals prescribe these diets as needed. The only pitfalls are that the management of these therapeutic diets are made difficult by the lack of medical professionals and specifically the lack of dietitians in the correctional facility. Further, the fact that these diets are not computerised and only on hard-copy makes it very difficult for the facility to remove those inmates' diets who have left in a timeous manner. The communication between the clinic/ medical professional and the foodservice unit is tedious because of a lack of computerisation between the admissions office, clinics, foodservice unit and on release.

It is thus recommended that:

I. the 2003 DCS ration scale should be followed as stipulated for juveniles, with the exception of dairy, which should be increased to the stipulated EAR of 1000mg per day (by adding another portion of dairy to the ration scale the EAR of calcium for juveniles may be achieved).
II. that the DCS therapeutic manual as developed in collaboration with the Department of Health should be used in conjunction with the health professionals working at DCS (as is the current practice in Pollsmoor).
III. That the correctional facilities investigate the use of computerised systems to connect with the foodservice unit, admissions and release office.
IV. The employment of a dietitian who should take responsibility for prescribing therapeutic diets and monitoring outcomes, as well as training of DCS facility staff in the correct preparation and delivery of these therapeutic diets, should be considered.

6.4.4 Nutrition related health education intervention for incarcerated juveniles

Based on the results of this research it is recommended that the following components should be considered for inclusion in a nutrition related health intervention for incarcerated juveniles:

Nutrition component

- Insights in and understanding of the South African Food Based Dietary Guidelines and the application thereof to ensure sufficient and health food choices
- Insights in dietary and lifestyle recommendations for optimal bone and teeth health.
- Insights in the prevalence and consequences of anaemia and the dietary choices for the prevention thereof.
- Insights in dietary and lifestyle recommendations for NCD development.
- Insights in the difference between nutrient dense foods and low-nutrient energy dense foods.
- Insights in the importance of a regular meal pattern in ensuring that dietary needs are met.
- Insights in best nutritional value for money (food insecurity was very prevalent among on remand detainees).

Body image component

- Insights in body weight for healthy females within the context of cultural body shape ideals/stereotypes.

Mental health component

- Insights in mental health risks and the implications thereof within the context of incarceration.
- Insights in self-help strategies during times of anxiety and depression.
- Insights in stress and crisis management.
- Insights in depression and suicidal thoughts to facilitate seeking of help.
- Insights in the value of providing support to friends/cell mates.
- Insights in where to get advice on/support for dealing with mental health issues.

Substance abuse component

- Insights in and understanding of the deleterious effects of smoking, alcohol abuse and illicit substance use on health.

- Insights in strategies that can be used to stop the risk taking behaviours and the availability of support in this regard.

Family planning component

- Insights in the importance of family planning for the health of the mother and the baby.
- Insights in and understanding of family planning practices and sources of advice/support in this regard.

Table 53: Proposal for assessments to be included in a nutrition related health screening procedure for juveniles at admission to a correctional facility

Screening components	Motivation	Measurement tools/equipment	Guidelines for referral for nutrition support and additional treatment	Actions upon release	Articulation with national health programmes
Anthropometry:					
Weight Height Calculate BMI	A higher prevalence of under nutrition was found for male and female on remand detainees than the general population of the same age in South Africa. Although lower than national statistics, overweight/obesity in females also needs to be identified. These results were supported by three other anthropometric measures of lean body mass (cAMA), fat mass (triceps skinfold) and mid-upper arm circumference (MUAC). BMI is the ideal way to identify detainees in need of supplementary nutrition to ensure recovery from undernutrition.	• Scale and wall mounted stadiometer. • Calculate BMI as: weight (kg)/ height (m^2) • Figure 5: BMI and cut-offs for adults Figure 5 can be used to determine BMI without the need of a calculator.	1. BMI<18.5 should receive the DCS high-energy therapeutic diet with supplemental drink containing macro-and micronutrients. 2. BMI<18.5 should further be referred to the correctional facility's clinic for further investigation of causes. 3. Weekly follow-up visits to the correctional facility clinic to monitor weight change.	Measure weight & height. Classify BMI According to indicated cut-offs	Refer underweight juveniles (BMI<18.5) to the community health care centre (CHC) /clinic nearest to their home for admission to the therapeutic nutrition programme Refer to social worker to assist the adolescent with application to social grants that may be applicable: *Child support grant. *Social relief of distress grant (valid for 3 months only). Connect needy adolescents with Foodbank SA (now food forward) facilities who can give them food parcels. https://foodforwardsa.org/ http://www.gov.za/node/727380

Screening components	Motivation	Measurement tools/equipment	Guidelines for referral for nutrition support and additional treatment	Actions upon release	Articulation with national health programmes
Maximum handgrip strength (MHGS)	The MGHS of 19% of females and 12% of males fell below the 10th percentile, indicating that the presence of chronic undernutrition is a concern. MHGS is a more sensitive measurement tool of overall health as muscle tissue is the first to reflect inadequate intakes. MHGS may identify long term health problems before actual diagnosis of such conditions.	• A handgrip dynamometer. • Use Table 67 in Appendix 6.1 to identify juveniles who have a MHGS <10th percentile.	1. MHGS < 10thshould receive the DCS high-energy therapeutic diet with the supplemental drink. 2. BMI<18.5 should further be referred to the correctional facility's clinic for further investigation of causes. 3. Weekly follow-up visits to the correctional facility clinic to monitor MHGS.	MHGS Refer to clinic if MHGS<10th percentile. Measure and classify	Department of health clinics for supplementary nutrition. Refer those who have MHGS < 10th percentile to the community health care centre/clinic nearest to their home for consideration for admission to the therapeutic nutrition programme. Refer to social worker to assist the adolescent with application to social grants that may be applicable: *Child support grant. *Social relief of distress grant (valid for 3 months only).
Biochemistry:					
HIV/AIDS	Although the proportion of detainees who reported having HIV/AIDS was low, it may have been an underestimation. The prevalence of infectious diseases in correctional facilities for the adult population for HIV is 20-23% (Scheibe et al., 2011) or as high as 43% in the under 25 age category (Gow et al., 2012).	Rapid skin prick test. The Desmond Tutu Foundation instituted HIV screening of all newly admitted inmates at Pollsmoor.	1. Refer to correctional facility clinic for ARV treatment if positive for HIV. 2. Prescribe a high fruit and vegetable therapeutic diet with the supplemental drink.	Refer to clinics to continue treatment.	Department of health clinics for continued ARV treatment. Refer those who have MHGS < 10th percentile to the community health care centre/clinic nearest to their home for consideration for admission to the therapeutic nutrition programme.

Screening components	Motivation	Measurement tools/equipment	Guidelines for referral for nutrition support and additional treatment	Actions upon release	Articulation with national health programmes
	Early identification of HIV infection and treatment with ARVs prolongs life expectancy.				Refer to social worker to assist the adolescent with application to social grants that may be applicable: *Child support grant. *Social relief of distress grant (valid for 3 months only).
TB	Although the proportion of detainees who reported having TB was low, it may have been an underestimation. TB can be as high as 67% in South African data (Wood et al., 2010). Confined space in the correctional facility increases risk of TB infection of inmates. TB infection increases the nutritional needs and may lead to weight loss if left untreated. By improving the nutritional status recovery may be improved.	Sputum sample The Desmond Tutu Foundation instituted HIV screening of all newly admitted inmates at Pollsmoor.	1. If positive, refer to the correctional facility clinic for TB treatment 2. Separate from the rest of the inmates to prevent infection of other inmates. 3. Prescribe a high energy therapeutic diet with the supplemental drink until TB has been cured/ inmate released.	Refer to clinics to continue treatment.	Department of health clinics for continued treatment. Refer those who have MHGS < 10^{th} percentile to the community health care centre/clinic nearest to their home for consideration for admission to the therapeutic nutrition programme. Refer to social worker to assist the adolescent with application to social grants that may be applicable: *Child support grant. *Social relief of distress grant (valid for 3 months only).

Screening components	Motivation	Measurement tools/equipment	Guidelines for referral for nutrition support and additional treatment	Actions upon release	Articulation with national health programmes
Hepatitis B and C	Although Hepatitis was not mentioned as an infectious disease suffered by any of the detainees, they may be at risk as a result of intra-venous illicit substances use. Hepatitis B and C prevalence is known to be as high as 17-25% in low to middle income countries when inmates are tested (Fazel & Baillargeon, 2011) Hepatitis is a communicable disease and should be treated to prevent further infections. Hepatitis infection increases the nutritional needs and may lead to weight loss if left untreated. By improving the nutritional status recovery may be improved.	Blood test.	1. If positive, refer to the correctional facility clinic for treatment. 2. Prescribe a therapeutic diet with the help of the dietitian.	Retest for hepatitis before referral to community health care centre.	Department of health clinics for continued treatment. Refer those who have MHGS < 10th percentile to the community health care centre/clinic nearest to their home for consideration for admission to the therapeutic nutrition programme. Refer to social worker to assist the adolescent with application to social grants that may be applicable: *Child support grant. *Social relief of distress grant (valid for 3 months only).
Haemoglobin (females and males)	South African statistics indicate that **24%** of females between 15-24 years of age suffer with anaemia and **17%** with low blood ferritin levels, while 9% of males suffer with anaemia (Shisana et al., 2013). Due to high HIV infection rates and LND food intake these statistics are	Blood haemoglobin.	1. Refer to clinic to investigate cause of anaemia. Could be lack of iron in diet or chronic infections. 2. Prescribe a high protein diet with iron supplements. 3. Treat chronic infections like hookworm. 4. Treat HIV/ TB infection.	Check again to refer to clinic if needed for supplementation continues.	Department of health clinics for continued treatment. Refer those who have MHGS < 10th percentile to the community health care centre/clinic nearest to their home for consideration for admission to the therapeutic nutrition programme.

Screening components	Motivation	Measurement tools/equipment	Guidelines for referral for nutrition support and additional treatment	Actions upon release	Articulation with national health programmes
	probably much higher in the inmate population.				Refer to social worker to assist the adolescent with application to social grants that may be applicable: *Child support grant. *Social relief of distress grant (valid for 3 months only).
Risk taking behaviour and mental health					
Pregnancy	Statistics indicate that 6% of females are pregnant at entry to a correctional facility (Snell, 1994).	Urine stick test.	1. Prescribe the correctional facility diet for pregnant and lactating mothers, which contains extra fruit and the supplemental drink. 2. Refer to correctional facility for appropriate perinatal care (regular checks of mother and baby).	Refer to relevant CHC depending on whether the baby has been born or not.	Department of health clinics for continued treatment. Refer those who have MHGS < 10^{th} percentile to the community health care centre/clinic nearest to their home for consideration for admission to the therapeutic nutrition programme. Refer to social worker to assist the adolescent with application to social grants that may be applicable: *Child support grant. *Social relief of distress grant (valid for 3 months only).

Screening components	Motivation	Measurement tools/equipment	Guidelines for referral for nutrition support and additional treatment	Actions upon release	Articulation with national health programmes
Depression and anxiety	Symptoms of depression and anxiety were experienced by juvenile male (75%) and female (75%) detainees during the month prior to the study using the Kessler 10 screening tool. Prevention or treatment of mental illness is key to optimal health in general, and more specifically to healthy eating. Frequency of illicit substance use increased as the level of distress increased in the juvenile male sample.	Kessler 10 screening tool. (see Table 68 in Appendix 6.1).	Interpretation of the Kessler 10 score: • Score from 20-24: likely to have a mild mental disorder • Score from 25-29: likely to have a moderate mental disorder • Score from 30 and higher: likely to have a severe mental disorder Any score above **20** should be referred to the DCS psychologist who can refer to the DCS psychiatrist as recommended by ((Shisana et al., 2013; Andrews & Slade, 2001; Kessler & Mroczek, 1994).	Reassess the mental health of those who were not taken up in treatment programs. Determine need for referral to external treatment and follow-up options of all inmates at release.	Department of social services and Department of Health. The CHC should refer people to the regional hospital where a psychiatrist and psychologist may be seen. If needed the person will be referred to a psychiatric hospital for support. Advocacy regarding the importance of mental health care services at primary and secondary health care level is very important. **Adcock Ingram Depression and Anxiety Helpline** 0800 70 80 90 **Destiny Helpline for Youth & Students** 0800 41 42 43 **ADHD Helpline** 0800 55 44 33 **Department of Social Development Substance Abuse Line 24hr helpline** 0800 12 13 14 SMS 32312

Screening components	Motivation	Measurement tools/equipment	Guidelines for referral for nutrition support and additional treatment	Actions upon release	Articulation with national health programmes
					Suicide Crisis Line 0800 567 567 **SADAG Mental Health Line** 011 234 4837 **Akeso Psychiatric Response Unit 24 Hour** 0861 435 787 **LifeLine Southern Africa** 24-hour crisis intervention service. “Emotional First Aid station”. Free, confidential telephone counselling, rape counselling, trauma counselling, Aids counselling, and a range of other services. Not-for-profit organisation. • National counselling line: 0861-322-322 Counsellors help callers with challenges such as trauma, suicide, and relationship issues. • Website: www.lifeline.co.za • National Aids helpline: 0800-012-322 Run in conjunction with the Department of

Screening components	Motivation	Measurement tools/equipment	Guidelines for referral for nutrition support and additional treatment	Actions upon release	Articulation with national health programmes
					Health, this national toll-free helpline receives around 3 000 calls a day. • Stop Gender Violence helpline: 0800-150-150 National toll-free helpline for survivors, witnesses and perpetrators of gender-based violence.
Food security and food choices					
Food insecurity questions	Food insecurity (hunger) was very prevalent in the study sample (43% of males and 31% of females reported moderate to severe hunger levels) and was associated with the nutritional status of especially male detainees	Food security questionnaire (See Table 69 in Appendix 6.1)	Interpretation of hunger score: • Score of 0-1: little to no hunger in the household • Score of 2-3: moderate hunger in the household • Score of 4-6: severe hunger in the household • Refer those with a score of 2 and higher to the social worker, who may be able to identify the	Check the score given in the admission hunger score screening tool. Refer those with a score of 2 and higher to external institutions/ NGOs for	Department of social services. Refer to social worker to assist the adolescent with application to social grants that may be applicable: *Child support grant. *Social relief of distress grant (valid for 3 months only). Connect needy adolescents with Foodbank SA (now food forward) facilities who can give them food parcels.

Screening components	Motivation	Measurement tools/equipment	Guidelines for referral for nutrition support and additional treatment	Actions upon release	Articulation with national health programmes
			need of socio- and financial support on release from the correctional facility. This may prevent recidivism in the long run.	follow-up and support.	https://foodforwardsa.org/ http://www.gov.za/node/727380
Smoking, alcohol use and use of illicit substances	Daily smoking and illicit substance use was very high in the study on juveniles. Illicit substance abuse may not be reported accurately due to reservations regarding possible further prosecution once inside the correctional facility. Although these behaviours may have an important impact on nutritional status, it screening for these behaviours at admission is most probably not feasible.	Not applicable	All juveniles should receive education on the negative effects that smoking, alcohol abuse and illicit substance abuse may have on their health.	If the social worker in the facility is aware that a detainee is in need of support for addressing risk taking behaviour, they should refer them to juvenile support centres.	The South African Depression and Anxiety Group (Sadag) has partnered with the Department of Social Development in launching a toll-free substance abuse helpline in an effort to increase access to help, support and appropriate treatment for substance users. The toll-free helpline number is 0800 121314 Alcoholics anonymous 0861 HELP AA (435-722) Western cape AA: 021 418 0908 westerncape@aasouthafrica.org.za

BMI= Body mass index, MHGS=Maximum hand-grip strength, HIV= human immunodeficiency virus, TB=tuberculosis, LND= Low nutrient dense

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Appendix 2.1 :RDA/ AI for key nutrient needs of adolescents

Table 54: RDA/ AI for energy, macro-nutrient and key micro-nutrient requirements of late adolescents age 18 to 21

Energy and nutrients	***RDA/ AI****	
	Males	***Females***
Energy (kJ)	*12881-13238*	*9946-10093*
Protein (g/day) *g/kg/day*	*56-58* *0.8*	*46* *0.8*
Protein % of TE *(minimum requirements)*	*10-35*	*10-35*
Carbohydrates (g/d)	*130*	*130*
Carbohydrates % of TE	*45-65*	*45-65*
Sugar % of TE	*<10*	*<10*
Dietary fibre (g/d)	*38*	*25-26*
Fats % of TE	*20-35*	*20-35*
Saturated fats % of TE	*<10*	*<10*
Omega 6 fatty acids (g/d); % TE	*17; 5-10*	*12; 5-10*
Omega 3 fatty acids (g/d); % TE	*1.6; 10*	*1.1; 10*
Calcium (mg/d)	*1000-1300*	*1000-1300*
Iron (mg/d)	*8-11*	*15-18*
Magnesium (mg/d)	*400-410*	*310-360*
Zinc (mg/d)	*11*	*8-9*
Vitamin A (µg/d)	*900*	*700*

(B2) Riboflavin (mg/d)	*1.3*	*1.0-1.1*
(B3) Nicotinic acid (mgNE/d)	*16*	*14*
(B5) Pantothenic acid/ Pantothenate (mg/d)	*5*	*5*
(B6) Pyridoxine (mg/d)	*1.3*	*1.3*
(B7) Biotin (µg/d)	*25-30*	*25-30*
(B9) Folic acid (µg/d)	*400*	*400*
Vitamin C (mg/d)	*75-90*	*65-75*
Vitamin D (µg/d)	*5*	*5*
Vitamin E (mg/d)	*15*	*15*
Vitamin K (µg/d)	*75-120*	*75-90*

TE= total energy

**Column 2&3 reference (Ross et al., 2011; Institute of Medicine (US). Panel on Dietary Reference Intakes for Electrolytes & Water, 2005; Trumbo et al., 2002; Trumbo et al., 2001; Institute of Medicine (US) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes and its Panel on Folate, Other B Vitamins, and Choline, 1998)*

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REPUBLIC OF SOUTH AFRICA

Page 1

MEALPLAN CYCLE: 01	12 DAY CYCLE MEALPLAN FOR JUVENILES: POLLSMOOR MANAGEMENT AREA											
	DAY1 1 Dec 03 Mon	DAY2 2 Dec 03 Tue	DAY 3 3 Dec 03 Wed	DAY 4 4 Dec 03 Thu	DAY 5 5 Dec 03 Fri	DAY 6 6 Dec 03 Sat	DAY7 7 Dec 03 Sun	DAY 8 8 Dec 03 Mon	DAY 9 9 Dec 03 Tue	DAY 10 10 Dec 03 Wed	DAY11 11 Dec 03 Thu	DAY 12 12 Dec 03 Fri
BREAKFAST	Comments	BREAKFAST TO BE SERVED NOT MORE THAN 14 HOURS AFTER THE LAST MEAL OF THE PREVIOUS DAY!!!										
Cereal:												
Maize meal		100-120g	100-120g	100-120g		100-120g	100-120g	100-120g		100-120g	100-120g	100-120g
Malta Bella	100-120g								100-120g			
Oats					100-120g							
Bran	6g	6g	6g	6g	6g	6g	6g	6g	6g	6g	6g	6g
Milk powder/milk fresh	21g	21g	21g	21g	21g	21g	21g	21g	21g	21g	21g	21g
Sugar	20g	20g	20g	20g	20g	20g	20g	20g	20g	20g	20g	20g
Salt	5g	5g	5g	5g	5g	5g	5g	5g	5g	5g	5g	5g
Sandwich:												
Brown bread	65g	65g	65g	65g	65g	65g	65g	65g	65g	65g	65g	65g
Margarine	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g
Syrup		10g	10g		10g	10g		10g	10g		10g	10g
Jam	10g			10g			10g			10g		
Fruit: Fresh/dried		160g/40g				160g/40g						
Beverages:												
Coffee	1g	1g	1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
Sugar	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g
Milk powder/milk fresh	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml
LIGHT MEAL	Comments	LIGHT MEAL TO BE SERVED NOT LESS THEN 4½ HOURS AND NOT MORE THEN 6 HOURS AFTER BREAKFAST!!!										
Sandwich:												
Brown bread	200g	200g	200g	200g	200g	200g	200g	200g	200g	200g	200g	200g
Margarine	25g	25g	25g	25g	25g	25g	25g	25g	25g	25g	25g	25g
Syrup		25g			25g	25g			25g		25g	
Jam	25g			25g			25g			25g		
Peanut butter			20g					20g				20g
Beverages:												
Soup powder		20g		20g			20g		20g			20g
Fruit drink powder	15g		15g		15g	15g		15g		15g	15g	

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MEALPLAN CYCLE: 01	12 DAY CYCLE MEALPLAN FOR JUVENILES: POLLSMOOR MANAGEMENT AREA											
	DAY1 1 Dec 03 Mon	DAY2 2 Dec 03 Tue	DAY 3 3 Dec 03 Wed	DAY 4 4 Dec 03 Thu	DAY 5 5 Dec 03 Fri	DAY 6 6 Dec 03 Sat	DAY7 7 Dec 03 Sun	DAY 8 8 Dec 03 Mon	DAY 9 9 Dec 03 Tue	DAY 10 10 Dec 03 Wed	DAY11 11 Dec 03 Thu	DAY 12 12 Dec 03 Fri
MAIN MEAL	*Comments*	MAIN MEAL TO BE SERVED **NOT** LESS THEN 4½ HOURS AND NOT MORE THEN 6 HOURS AFTER **LIGHT MEAL**!!!										
Protein:												
Fish			165g								165g	
Eggs					2 eggs				2 eggs			
Pork	184g					184g						184g
Chicken				200g				100g		200g		
Beef/Mutton/Goat		92g					184g					
Texturised Veg. Protein		20g						20g				
Starch:												
Mealie rice	100g		100g		100g		100g		100g		100g	
Samp		100g		100g		100g		100g		100g		100g
Vegetables:												
Two kinds to be served	325g	325g	325g	325g	325g	325g	325g	325g	325g	325g	325g	325g
Sugar	2g	2g	2g	2g	2g	2g	2g	2g	2g	2g	2g	2g
Beverages:												
Tea	1g	1g	1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
Sugar	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g
Milk powder/milk fresh	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml	7g/70ml
Additional items:												
Salt	0 - 10g	0 - 10g	0 - 10g	0 - 10g	0 - 10g	0 - 10g	0 - 10g	0 - 10g	0 - 10g	0 - 10g	0 - 10g	0 - 10g
Gravy powder	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g
Onions	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g
Tomato paste/puree	12g/24g											
Bread flour	12g											
Cooking oil	35g											
Potatoes	30g											
Curry powder	4g											
EVENING SNACK												
Brown bread	65g	65g	65g	65g	65g	65g	65g	65g	65g	65g	65g	65g
Margarine	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g	10g
Fruit	160g	160g	160g	160g	160g	160g	160g	160g	160g	160g	160g	160g

No deviations, unless authorized by the Area Commissioner.
Issue chicken to **prescribed** religious groups when pork is served.

signature rto emoved to avoid exposure online

Area Coordinator: [redacted]
NOBLE R.E

Area Commissioner: Pollsmoor
N.C MKETSHANE

RATION SCALE

Department of Correctional Services

1.1 **RATION SCALE FOR ADULT MALE AND FEMALE INMATES**

FOOD ITEM	AMOUNT / PERSON / DAY	EQUIVALENTS
Bread: Brown	265 g	Whole-wheat Bread / Maize Meal / Mealie Rice / Samp: Per Issue (189 Bread = 80 - 100 g Maize Meal / Mealie Rice / Samp)
Bread Flour	0 - 12 g Per Cycle	(12,5 kg Packing)
Cereals	100 - 120 g Per Day	Maize Meal, Maltabella, Oats
Coffee	1 g	Tea – 1 g
Cooking Oil	0 - 35 ml Per Cycle	
Fruit Drink Powder	15 g	Coffee/Tea 1 g, Sugar 10 g and Milk Powder 7 g / 70 ml Milk/Fruit 150 – 160g x 2
Curry Powder	0 - 4 g per Cycle	
Fruit	300 – 320 g per Cycle	150 - 160 g Fresh x 2 / 40 g Dried Fruits
Gravy Powder	0 - 10 g	
Margarine (White or Yellow)	35 g	Butter, Fat
Meat / Fish / Poultry	184 g / 165 g / 200 g (Bone allowances are included)	184 g Meat frozen 2 Eggs, Fresh / 260 g Offal / 92 g Meat / 100 g Poultry, 20 g TVP Dry
Milk – Fresh / Milk Powder	350 ml 35 g	Skim Milk Powder / Whey Powder (10 ml Fresh = 1 g Powder) 290 ml Daily + 60 ml (Additional)
Onions, Fresh as purchased	0 - 10 g	Leeks, Spring Onions, Onions Dehydrated (10 g fresh = 1 g Dehydrated)
Peanut Butter	60 g per Cycle	25 g jam / 25 g syrup
Potatoes, fresh as purchased	30 g per Cycle	30 g Fresh = 5 g Dehydrated
Salt	0 - 15 g	
Soup Powder	20 g	15 g = Fruit Drink Powder = 2 Self Produced Oranges

"WORK TOGETHER, ACHIEVE TOGETHER"

concept.ration scale.DCS.MPRamorotho.ab.2003.07.15

FOOD ITEM	AMOUNT/PERSON/DAY	EQUIVALENTS
Sugar	40 g + 2 g	(40 g daily + 2 g additional)
Syrup	205 g per Cycle (10 g x 8 & 25 g x 5)	Jam
Jam	140 g per Cycle (10 g x 4 & 25 g x 4)	Syrup
Tea	1 g	Coffee
Tomato Paste	1 g per Day	1 g Tomato Paste = 2 g Tomato Puree / g Tomato, Fresh
Vegetables, Fresh as purchased	325 g include preparation loss of 25 %	See point 6 for Dehydrated Vegetables
Vinegar	0 – 20 ml per Cycle	
Maize Meal, Mealie Rice, Samp	80 – 100 g	189 g Bread + 10 g margarine + 25 g jam/syrup

MRC FOODFINDER 3

Meal Analysis - Standard RDA

Name: Juvenile male
ID Number:
Gender: Male
Age: 18.0

Daily on 2017/07/24

9 BREAD SLICE 93X93X15MM one unit of Bread/rolls, Brown (fortified)	*450.00g*
2 125 ml/half cup of Maize Meal, Special,Raw (white, fortified)	*130.00g*
1 heaped ladle of Milk Blend, Powder	*35.00g*
42 n/a g of Sugar, White, Granulated	*42.00g*
45 n/a g of Margarine, Brick/hard	*45.00g*
1 level teaspoon of Syrup, Golden	*7.00g*
20 n/a g of Peanut Butter; Smooth Style	*20.00g*
2 125 ml/half cup of Soup Powder, Average Reconstit, Prepared With Water	*250.00g*
2 MEDIUM one unit of Egg, Chicken, Whole, Boiled / Poached	*90.00g*
2 SAMP 125 ml/half cup of Maize, Samp/rice, Cooked (white)	*250.00g*
1 RINGS 15 TO 20MM DIAM 125 ml/half cup of Carrot, Boiled, With Brick Margarine	*80.00g*
1 125 ml/half cup of Cabbage, Sautéed In Brick Margarine	*80.00g*
160 n/a g of Apple, Granny Smith, Raw	*160.00g*
5 n/a g of Salt, Table, Iodised	*5.00g*
2 heaped teaspoon of Gravy, Brown, Powder	*10.00g*
5 n/a g of Onion, Sautéed In Sunflower Oil	*5.00g*
1 5 ml/measuring teaspoon of Tomato Puree	*5.00g*
1 5 ml/measuring teaspoon of Sunflower Oil	*5.00g*
5 n/a g of Potato, Boiled With Skin (flesh And Skin)	*5.00g*
1 MUG plenty/large/thick of Tea, Brewed	*300.00g*

Macronutrients			
Description	*Amount*	*RDA*	*RDA %*
Moisture (g)	*1259.7*		
Energy (kJ)	*13049*	*12552*	*103.96%*
Nitrogen (g)	*12.12*		
Total protein (g)	*84.5*	*59*	*143.22%*
Plant protein (g)	*65.7*		

Animal protein (g)	*18.8*			
Total fat (g)	*92.8*			
Carbohydrate, avail. (g)	*454.9*			
Starch (g)	*1.2*			
Glucose (g)	*9.1*			
Fructose (g)	*13*			
Galactose (g)	*0*			
Sucrose (g)	*49.5*			
Maltose (g)	*0*			
Lactose (g)	*0.4*			
Total sugars (g)	*93.9*			
Added sugar (g)	*48.2*			
Total dietary fibre (g)	*54*			
Insoluble dietary fibre (g)	*5.4*			*
Soluble dietary fibre (g)	*4.2*			*
Ash (g)	*21.5*			
Non-starch polysaccharides (g)	*8.9*			
Insoluble NSP (g)	*4.7*			*
Soluble NSP (g)	*4.2*			*
Lignin (g)	*0.8*			*
Minerals				
Description	*Amount*	*RDA*	*RDA %*	
Ca (mg)	*509*	*1200*	*42.42%*	
Fe (mg)	*27.9*	*12*	*232.50%*	
Haem iron (mg)	*0*			*
Non-haem iron (mg)	*3.3*			*
Mg (mg)	*427*	*400*	*106.75%*	
P (mg)	*1324*	*1200*	*110.33%*	
K (mg)	*2308*			
Na (mg)	*7243*			
Cl (mg)	*967*			
Zn (mg)	*26.94*	*15*	*179.60%*	
Cu (mg)	*1.71*	*2*	*85.50%*	#
Cr (mcg)	*29.9*	*125*	*23.92%*	#
Se (mcg)	*30*	*50*	*60.00%*	
Mn (mcg)	*2359*	*3500*	*67.40%*	#
I (mcg)	*202*	*150*	*134.67%*	*
B (mcg)	*1350*			*
F (mcg)	*147*			*
Si (mcg)	*1306*			*
Vitamins				
Description	*Amount*	*RDA*	*RDA %*	
Vitamin A (RE) (mcg)	*3552*	*1000*	*355.20%*	

Retinol (mcg)	*59*			
Total carotenoids (mcg)	*15769*			
B-Carotene (mcg)	*13555*			*
A-Carotene (mcg)	*4408*			*
Cryptoxanthin (mcg)	*19*			*
Thiamin (mg)	*3.77*	*1.5*	*251.33%*	
Riboflavin (mg)	*2.07*	*1.8*	*115.00%*	
Niacin (mg)	*48*	*20*	*240.00%*	
Vitamin B6 (mg)	*10.949*	*2*	*547.45%*	
Folate (mcg)	*1023*	*200*	*511.50%*	
Vitamin B12 (mcg)	*1.9*	*2*	*95.00%*	
Pantothenate (mg)	*4.54*	*5.5*	*82.55%*	#
Biotin (mcg)	*58.2*	*65*	*89.54%*	#
Vitamin C (mg)	*53*	*60*	*88.33%*	
Vitamin D (mcg)	*14.38*	*10*	*143.80%*	
Vitamin E (mg)	*13.98*	*10*	*139.80%*	
A-Tocopherol (mg)	*10.14*			*
B-Tocopherol (mg)	*0.39*			*
D-Tocopherol (mg)	*0.21*			*
G-Tocopherol (mg)	*0.9*			*
A-Tocotrienol (mg)	*0.26*			*
B-Tocotrienol (mg)	*0.07*			*
D-Tocotrienol (mg)	*0*			*
G-Tocotrienol (mg)	*0*			*
Lycopene (mcg)	*56*			*
Lutein (mcg)	*323*			*
Vitamin K (mcg)	*215.95*	*65*	*332.23%*	*
Fatty acids & cholesterol				
Description	*Amount*	*RDA*	*RDA %*	
Saturated FA (g)	*21.24*			
Mono-unsaturated FA (g)	*35.64*			
Polyunsaturated FA (g)	*27.71*			
Single trans FA (g)	*0*			*
Double trans FA (g)	*0*			*
Total trans FA (g)	*0*			*
Cholesterol (mg)	*383*			
C4:0 (g)	*0*			
C6:0 (g)	*0.01*			
C8:0 (g)	*0.16*			
C10:0 (g)	*0.18*			
C12:0 (g)	*2.47*			
C13:0 (g)	*0*			*
C14:0 (g)	*1.06*			
C15:0 (g)	*0.02*			*

C16:0 (g)	*9.97*			
C17:0 (g)	*0.01*			*
C18:0 (g)	*4.38*			
C20:0 (g)	*0.32*			
C21:0 (g)	*0*			*
C22:0 (g)	*0.48*			
C23:0 (g)	*0*			*
C24:0 (g)	*0.18*			
C10:1 (g)	*0*			*
C12:1 (g)	*0*			*
C14:1 (g)	*0*			
C15:1 (g)	*0*			*
C16:1 (g)	*0.4*			
C17:1 (g)	*0*			*
C18:1 (g)	*31.74*			
C20:1 (g)	*0.19*			
C22:1 (g)	*0.04*			
C23:1 (g)	*0*			*
C24:1 (g)	*0*			*
C18:2 (g)	*24.69*			
C18:3 (g)	*0.11*			
C18:4 (g)	*0*			
C20:2 (g)	*0.05*			*
C20:4 (g)	*0.06*			
C20:5 (g)	*0.03*			
C22:2 (g)	*0.01*			*
C22:3 (g)	*0*			*
C22:4 (g)	*0*			*
C22:5 (g)	*0*			
C22:6 (g)	*0.06*			
C24:6 (g)	*0*			*
C20:3 (g)	*0*			
Amino Acids				
Description	*Amount*	*RDA*	*RDA %*	
Isoleucine (g)	*3.116*			
Leucine (g)	*6.662*			
Lysine (g)	*2.878*			
Methionine (g)	*1.61*			
Phenylalanine (g)	*3.813*			
Threonine (g)	*2.661*			
Tryptophan (g)	*0.958*			
Valine (g)	*3.889*			
Arginine (g)	*4.006*			
Histidine (g)	*1.903*			

Cystine (g)	*0.457*			
Tyrosine (g)	*0.468*			
Alanine (g)	*0.712*			
Aspartic acid (g)	*1.254*			
Glutamic acid (g)	*1.921*			
Glycine (g)	*0.45*			
Proline (g)	*0.773*			
Serine (g)	*0.994*			
Hydroxyproline (g)	*0*			*
Other components				
Description	*Amount*	*RDA*	*RDA %*	
Alcohol (g)	*0*			
Phytate (mg)	*113*			*
Malic acid (mg)	*1415*			*
Citric acid (mg)	*216*			*
Tartaric acid (mg)	*0*			*
Oxalic acid (mg)	*12*			*
Caffeine (mg)	*0*			*
Tannins (mg)	*0*			*
Energy Calculations				
Description	*Amount*	*Prudent Guideline*		
%Energy - Protein	*11.01%*	*+/- 15%E*		
%Energy - Fat	*26.32%*	*< 30%E*		
%Energy - Saturated SFA	*6.02%*	*< 10%E*		
%Energy - Mono-unsaturated MUFA	*10.10%*	*+ 10%E*		
%Energy - Polyunsaturated PUFA	*7.86%*	*~ 10%E*		
%Energy - Carbohydrate	*66.30%*	*+/- 55%E*		
%Energy - Alcohol	*0.00%*	*-*		

Legend

'' - There are many missing or no values for these Nutrients.*
Please consult the FoodFinder3 Manual -> Reports/Analysis: Meal Analysis.

'#' - Estimated safe and adequate daily dietary intake (value is the mean of the range)

'=' - RDA = Recommended Dietary Allowance

'+' - RDA % = Percentage of the Recommended Dietary Allowance

Appendix 3.1: Survey questionnaire

Questionnaire investigating the nutrition status and associated factors in juvenile male and female remand detainees at entry into Western Cape correctional service facilities

***Subject code**: _____*

When did you enter this facility	***Date: dd/mm/year***	***How long have you been here? _____days***
Are you male or female?	*Male*	*Female*
Are you pregnant	*Y*	*N*
Have you had a baby before?	*Y/ N*	*How many babies have you had?.....*

Physical information				
Measures	***1***	***2***	***3***	***Average***
Height (cm)		*NA*	*NA*	
Weight (kg)			*NA*	
MUAC (cm) ***Right arm***		*NA*	*NA*	
Triceps (mm) ***Right arm***				
MHGS (kg) ***Left hand***			*NA*	
MHGS (kg) ***Right hand***			*NA*	

If there are any questions you do not want to answer, you are free not to answer.

Language and school attendance:					
Which language do you speak?	*English*	*Afrikaans*	*Xhosa*	*Zulu*	*Other*
What is the highest qualification you have achieved?	*Primary school* *Grade 8, 9, 10 or 11, 12* *Post matric qualification*				

Personal details:				
1	*On which date were you born?*	*Day*	*Month*	*Year*

2	*How old are you today?*	*I am …….years old.*				
3	*Where were you born?*	……				
4	*Which race do you belong to?*	*African Black*	*White*	*Coloured*	*Indian*	*Other (specify) ……*
5	*In which city do you live?*	*I live in ……*				
6	*Where/ with whom did you live before coming to this Correctional facility?*	*With your parents*	*With family, but not parents*	*With friends*	*Other: Specify ……*	
7	*Did you have running water in the home where you lived?*			*Yes*	*No*	
8	*Did you have electricity in the home where you lived?*			*Yes*	*No*	
Measure of hunger:						
10	*In the last month at home (or where you lived), was there ever no food to eat of any kind in your house because there was not enough money to get food?*				*Y / N*	
10.1	*If yes, how often did this happen?*	*Rarely (1-2 times) (1)*	*Sometimes (3-10 times) (1)*		*Often (> 10 times (2)*	
11	*In the last month at home (or where you lived), did you or any household member/person go to sleep at night hungry because there was not enough food?*				*Y / N*	
11.1	*If yes, how often did this happen?*	*Rarely (1-2 times) (1)*	*Sometimes (3-10 times) (1)*		*Often (> 10 times) (2)*	
12	*In the last month at home (or where you lived), did you or any household member/person go a whole day and night without eating anything because there was not enough food?*				*Y / N*	
12.1	*If yes, how often did this happen?*	*Rarely (1-2 times) (1)*	*Sometimes (3-10 times) (1)*		*Often (> 10 times) (2)*	
Questions about your weight:						

12	*When you look at yourself now, do you think you are….*	*Too thin*	*Just about the right weight*	*Too chubby or fat*
13	*Have you tried to lose weight in the last year?*		*Yes*	*No*
	Questions about when you eat:			
14	*How many days a week do you usually eat at the following times…..?*			
14.1	*Breakfast*	*…….days out of 7*		
14.2	*Snack 10am*	*…….days out of **7***		
14.3	*Lunch*	*…….days out of 7*		
14.4	*Snack 3pm (between lunch and supper)*	*…….days out of 7*		
14.5	*Supper*	*…….days out of 7*		
14.6	*After supper*	*…….days out of 7*		
	Understanding of basic nutrition:			
15	*What do you think you must eat for you to be healthy?*	*(The respondent must be "prompted" until he/she says something: "do not know" is not acceptable, but do not give them the answer. If only one item is given, then all the other options are marked as NO)*		
			YES *Mentioned*	***NO*** *Not mentioned*
15.1	*Fruit (general or any specific fruit mentioned = YES)*			
15.2	*Vegetables (general or any specific vegetable mentioned = YES)*			
15.3	*Protein (meat, chicken, fish, eggs, dried legumes, peanut butter-anyone/ combination = YES)*			
15.4	*Dairy (milk, yogurt, cheese-anyone/combination = YES)*			
15.5	*Starches (bread, pasta, rice, porridge, cereals etc.-anyone/combination = YES)*			
15.6	*Fats (butter, margarine, oils, cream, lard etc.-anyone/ combination = YES)*			
15.7	*Sugars*			
15.8	*Water*			
15.9	*Anything else that does not fit in the above options*			
	Food availability:			

16	*How often are the following foods available in your home?*			*(Guideline: Not at all = "Never"; Sometimes = "Once a month/ maybe"; Often = "Every week"; Almost always = "Every day")*	
16.1	*Fruits are available in my home*	*Never*	*Sometimes*	*Often*	*Almost always*
16.2	*Vegetables are available in my home*	*Never*	*Sometimes*	*Often*	*Almost always*
16.3	*Vegetables are served at dinner at my home*	*Never*	*Sometimes*	*Often*	*Almost always*
16.4	*Milk or yoghurt or 'maas' is available at my home*	*Never*	*Sometimes*	*Often*	*Almost always*
16.5	*We have fruit juice at my home*	*Never*	*Sometimes*	*Often*	*Almost always*

Food frequency questionnaire:

17	*Think very carefully about what you ate and drank during the last week before coming to the facility. Please look through the following pictures and place the pictures of foods you ate during that week on one pile and those that you did not eat on another pile. Take the pictures that they chose and ask: "How many times did you eat this item per week?"* *(Write the **number of times eg. "2"** in the applicable column.)*			
	Food or drink			
17.1	*Red meat like beef, mutton, pork or sausage (boerewors)*	*Never*	*....times per week*	*....times per day*
17.2	*Organ meats like liver, kidneys, tripe etc.*	*Never*	*....times per week*	*....times per day*
17.3	*Processed meats like polony, vienna, russians or bully beef*	*Never*	*....times per week*	*....times per day*
17.4	*Chicken (not fried)*	*Never*	*....times per week*	*....times per day*
17.5	*Chicken **fried***	*Never*	*....times per week*	*....times per day*
17.6	*Fish: fresh, tinned or smoked or Bokkems (not fried)*	*Never*	*....times per week*	*....times per day*
17.7	*Fish **fried***	*Never*	*....times per week*	*....times per day*
17.8	*Eggs*	*Never*	*....times per week*	*....times per day*
17.9	*Milk, sour milk, maas or yoghurt (as a drink or in porridge)*	*Never*	*....times per week*	*....times per day*
17.10	*Cheese*	*Never*	*....times per week*	*....times per day*
17.11	*Legumes like sugar beans, baked beans or lentils*	*Never*	*....times per week*	*....times per day*
17.12	*White bread*	*Never*	*....times per week*	*....times per day*
17.13	*Brown bread*	*Never*	*....times per week*	*....times per day*
17.14	*Breakfast cereals like All bran, muesli, weetbix*	*Never*	*....times per week*	*....times per day*
17.15	*Oats porridge*	*Never*	*....times per week*	*....times per day*

17.16	*Rice, stywe-pap or slap pap (maize), pasta, samp, potato (mash/ boiled)*	*Never*	*….times per week*	*….times per day*
17.17	*Oranges or naartjies*	*Never*	*….times per week*	*….times per day*
17.18	*Apples, bananas, pears*	*Never*	*….times per week*	*….times per day*
17.19	*Orange or yellow vegetables like sweet potato, pumpkin, butternut, carrots*	*Never*	*….times per week*	*….times per day*
17.20	*Green vegetables like spinach, peas, beans broccoli*	*Never*	*….times per week*	*….times per day*
17.21	*Mixed vegetables (fresh, tinned or frozen)*	*Never*	*….times per week*	*….times per day*
17.22	*Cabbage, cauliflower, lettuce*	*Never*	*….times per week*	*….times per day*
17.23	*Tomato (raw or cooked)*	*Never*	*….times per week*	*….times per day*
17.24	*Margarine or butter or lard on bread or in porridge*	*Never*	*….times per week*	*….times per day*
17.25	*Peanut butter or Peanuts*	*Never*	*….times per week*	*….times per day*
17.26	*Fried potatoes or slap chips*	*Never*	*….times per week*	*….times per day*
17.27	*Other fried foods like fat cakes and doughnuts*	*Never*	*….times per week*	*….times per day*
17.28	*Pies, sausage rolls, samoosas*	*Never*	*….times per week*	*….times per day*
17.29	*Sugar*	*Never*	*….times per week*	*….times per day*
17.30	*Chocolate*	*Never*	*….times per week*	*….times per day*
17.31	*Sweets e.g. boiled, lollipops, jelly*	*Never*	*….times per week*	*….times per day*
17.32	*Cake, biscuits, muffins, scones*	*Never*	*….times per week*	*….times per day*
17.33	*Fruit juice*	*Never*	*….times per week*	*….times per day*
17.34	*Fizzy drinks like Coke, Cream Soda (not diet drinks)*	*Never*	*….times per week*	*….times per day*
17.35	*Crisps like Lays, Nik-Nacks, papas, pretzels*	*Never*	*….times per week*	*….times per day*
17.36	*Take outs (KFC, McDonalds)*	*Never*	*….times per week*	*….times per day*
17.37	*Jam, syrup, honey*	*Never*	*….times per week*	*….times per day*

Physical activity questions

"The next questions are about the time you spend doing different types of physical activities. You need to think about the time that you spend doing both vigorous and moderate activities in a usual week."
"Vigorous intensity activities are activities that require strenuous physical effort and cause large increases in breathing and heart rate."
"Moderate-intensity activities are activities that require moderate effort and cause small increases in breathing and heart rate."
"You need to think about all the activities you do at home, at work, travelling from place to place and during your spare time."

Work-related physical activity (paid or unpaid work outside your own home).

If you are unemployed think about the things that keep you physically active during the day. ***When answering the following questions, think back over the past 12 months and think of a usual week.***		
18.1	*Does your work involve vigorous activities like heavy lifting, digging, construction for at least 10 minutes at a time?*	*Y/ N*
18.2	*In a usual week, how many days do you do vigorous activities as part of your work?*	*Days ……*
18.3	*On a usual day when you do vigorous activities how much time do you spend doing such work?*	*Hours……* *Minutes……*
18.4	*Does your work involve moderate intensity activities like brisk walking or carrying light loads for at least 10 minutes at a time?*	*Y/N*
18.5	*In a usual week, how many days do you do moderate-intensity activities as part of your work?*	*Days ……*
18.6	*On a usual day when you do moderate-intensity activities how much time do you spend doing such work?*	*Hours……* *Minutes……*
18.7	*How long is your usual work day?*	*Hours……* *Minutes……*
Travel related physical activity: ***Other than activities that you've already mentioned, I would like to ask you about the travel to and from places (to work, shopping, market, church/ mosk etc.)***		
18.8	*Do you walk or use a bicycle for at least 10 minutes at a time to get to and from places?*	*Y/N*
18.9	*In a usual week, how many days do you walk or cycle for at least 10 minutes to get to and from places?*	*Days……..*
18.10	*On a usual day, how much time do you spend walking or cycling for travel?*	*Hours……* *Minutes……*
Non-work related and leisure/ spare time physical activity: ***The next questions exclude the work and transport activities you have already mentioned. Now I am going to ask you about activities you do for sport, fitness or recreation in your leisure or spare time.***		
18.11	*Do you do any vigorous intensity sport, fitness or recreational activities in your leisure or spare time, like running or strenuous sports like soccer or weightlifting, for at least 10 minutes at a time?*	*Y/ N*
18.12	*In a usual week, how many days do you do vigorous activities as part of your leisure time?*	*Days……*
18.13	*How much time do you spend doing this on a usual day?*	*Hours……* *Minutes……*
18.14	*Do you do any moderate-intensity sport, fitness or recreational activities in your leisure or spare time, like brisk walking, cycling or swimming, for at least 10 minutes at a time?*	*Y/ N*
18.15	*In a usual week, how many days do you do moderate-intensity activities as part of your spare time?*	*Days ……*
18.16	*How much time do you sped doing this on a usual day?*	*Hours……*

		Minutes……
Sitting/ resting activity: ***Now I would like to ask you about the time spent sitting or resting, not including sleeping in the past 7 days. This may include time sitting at a desk, riding in a car or taxi, visiting friends, reading, or sitting to watch television during working hours and spare time.***		
18.17	*Over the past 7 days, how much time did you spend sitting or reclining (lying down) on a usual **weekday** (excluding sleeping)?*	*Hours……* *Minutes……*
18.18	*Over the past 7 days, how much time did you spend sitting or reclining (lying down) on a usual **weekend day** (excluding sleeping)?*	*Hours……* *Minutes……*

Questions about how you feel:						
19	*I am going to list a few sentences about things that you may feel at times. Tell me which of these feelings you felt in the past month": (Make a cross in each line on the answer that is given)*					
19.1	*How often did you feel tired out for no good reason?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
19.2	*How often did you feel nervous?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
19.3	*How often did you feel so nervous that nothing could calm you down?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
19.4	*How often did you feel hopeless?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
19.5	*How often did you feel restless or fidgety?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
19.6	*How often did you feel so restless you could not sit still?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
19.7	*How often did you feel depressed?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
19.8	*How often did you feel that everything was an effort?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
19.9	*How often did you feel so sad that nothing could cheer you up?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
19.10	*How often did you feel worthless?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
	Totals:					
Questions about your habits:						

20.1	*Do you smoke cigarettes?*	*Yes, I smoke every day (2)*	*Yes, I smoke but only sometimes (1)*	*No, I do not smoke (0)*
20.2	*Do you drink alcohol?*	*Yes, every day (2)*	*Yes, but only sometimes (1)*	*No, never (0)*
20.4	*Did you take any drugs (including dagga) in the past?"*	*Yes every day (2)*	*Yes, but only sometimes (1)*	*No, never (0)*
Questions about your health:				
21	*Please indicate (YES or NO) whether you have been diagnosed with any of the following conditions:*			
21.1	*An eating disorder*		*Yes*	*No*
21.2	*Type 1 diabetes mellitus (take pills for high sugar)*		*Yes*	*No*
21.3	*Type 2 diabetes mellitus (take insulin injections for high sugar)*		*Yes*	*No*
21.4	*High blood pressure*		*Yes*	*No*
21.5	*A hormone problem that may affect your weight*		*Yes*	*No*
21.6	*Any other disease that may affect your weight (e.g.TB)*		*Yes*	*No*
21.7	*Other*		*Yes*	*No*

Comments:

_____

__

Appendix 3.2: Participant information

The nutritional status and associated factors in juvenile male and female remand detainees at entry into Western Cape correctional service facilities: A cross-sectional comparative study

Investigators: Prof. M.Senekal, Mrs M Theron and Prof L Artz
Division of Human Nutrition, Department of Human Biology, Faculty of Health Sciences
University of Cape Town (UCT)

Dear Study Participant

You are invited to take part in our study that is about the nutritional status of remand detainee juveniles when they are admitted to a Correctional facility. We will also look at factors that may be associated with their nutritional status, for example what they eat, how active they were before being admitted to the facility and their understanding of healthy eating. This information will help us to understand the nutrition problems and food needs of juveniles at admission to a Correctional facility. The results on nutritional and nutrition knowledge needs of juveniles at entry to a DCS will be given to the Department of Correctional Services for their consideration. It will also help us to develop a nutrition screening tool that can be used to identify any nutrition problems juveniles may have when they enter a correctional facility in the future.

You can take part in this study if you are 18 to 21 years old, if you have been in the Correctional facility for less than two weeks and if you understand and can converse in English or Afrikaans. If you are pregnant you can unfortunately not take part in the study.

If you choose to join the study, we will do the following:

1. *Measure how tall you are, measure how much you weight, the thickness of the skin on your upper arm, the circumference of your upper arm and how strong the muscles in your hand are.*
2. *Interview you to complete a questionnaire about the following: where live, what and when you eat, what you know about healthy eating, the exercise you do, how you feel about your body, whether you experience anxiety, and whether you smoked, used alcohol or drugs.*

3. *All of this will take about one hour of your time.*

You will not benefit directly from this study, but on completion of all the assessments you will receive information on whether your weight is right (normal), too low (underweight) or too high (overweight). You will also receive a sheet that contains information on the following: healthy weight, healthy eating and tips to increase your weight if you are underweight and also tips to lose weight if you are overweight. If any serious health related problems are noted while we are doing the assessments, for example being very underweight, you will be encouraged to talk to the medical/health professional at the facility about this.

We want you to know that it is safe to take part in the study. People who make sure those studies are safe, the Human Research Ethics Committee (HREC) at our university, have looked at what we want to do and agreed that it is safe. You can stop taking part in the study at any time. It will not count against you in any way.

It is very important that you understand that we give you a number so that nobody will know the answers you gave us. Your information will be stored in a computer and can only be used by us for research.

If you have any questions about the study you can talk to the researchers, Marjanne Senekal (021 406 6784) Marieke Theron (021 650 4966). The HREC can be contacted on 021 406 6338 in case you have any questions regarding your rights and welfare as research subjects on the study.

Appendix 3.3: Informed Consent form

The nutritional status and associated factors in juvenile male and female remand detainees at entry into Western Cape correctional service facilities: A cross-sectional comparative study

(HREC Ref:** 409/2014**)

Investigators: Mrs M Theron, Prof. M Senekal and Prof L Artz (UCT)

Declaration by participant:

By signing below, you…… (write in your name and surname) agree to take part in this research study. The study has been explained to you and you have had the opportunity to ask questions about it and your questions have been answered well. You know that you are free to ask questions at any time during the assessments. The decision to be a part of this study is your own. You know that you are free to withdraw from the study at any time, and that it will not count against you in any way. You have carefully read/ listened to the information and understand the study and what will be expected of you.

……
Your signature

……..
Date

Declaration by investigator:

I declare that I did not force the participant to take part in this study and that I will do no harm to the participant. I will ensure that their personal information is kept confidential and that their privacy will be protected.

……
Investigator name (print)
……
Investigator signature

……
Date

Appendix 3.4: National DCS approval of research letter

correctional services

Department:
Correctional Services
REPUBLIC OF SOUTH AFRICA

Private Bag X136, PRETORIA, 0001 Poyntons Building, C/O WF Nkomo and Sophie De Bryn Street, PRETORIA

Tel (012) 307 2770, Fax (012) 328-5111

Mrs. M Theron
P.O. Box 1847
Sun Valley
7985

Dear Mrs. Theron

RE: FEEDBACK ON THE APPLICATION TO CONDUCT RESEARCH IN THE DEPARTMENT OF CORRECTIONAL SERVICES ON "THE NUTRITIONAL STATUS AND ASSOCIATED FACTORS IN JUVENILE MALE AND FEMALE REMAND DETAINEES AT ENRTY INTO WESTERN CAPE CORRECTIONAL SERVICE FACILITIES: A CROSS-SECTIONAL COMPARATIVE STUDY"

It is with pleasure to inform you that your request to conduct research in the Department of Correctional Services on the above topic has been approved.

Your attention is drawn to the following:

- The relevant Regional and Area Commissioners where the research will be conducted will be informed of your proposed research project.
- Your internal guide will be **Ms G.P Pienaar, Regional Coordinator: Development and Care: Western Cape**. You are requested to contact her at the telephone number: **021 550 6006** ; before the commencement of your research.
- It is your responsibility to make arrangements for your interviewing times.
- Your identity document and this approval letter should be in your possession when visiting the Correctional Centre.
- You are required to use the terminology used in the White Paper on Corrections in South Africa (February 2005) e.g. "Offenders" not "Prisoners" and "Correctional Centres" not "Prisons".
- You are not allowed to use photographic or video equipment during your visits. However, the audio recorder is allowed.
- You are required to submit your final report to the Department for approval by the Commissioner of Correctional Services before publication (including presentation at workshops, conferences, seminars, etc) of the report.
- Should you have any enquiries regarding this process, please contact the Directorate Research for assistance at telephone number (012) 307 2770 / (012) 305 8554

Appendix 4.1: MUAC and triceps percentiles

Table 55: Number of male juvenile on remand detainees falling into MUAC percentiles per age category (CDC percentile tables; Fryar et al. 2012)

Percentiles	**% (n)**	**Age 16**	**Age 17**	**Age 18**	**Age 19**	**Age 20-23**
5th	*53.7 (36)*	*0*	*1*	*11*	*9*	*15*
10th	*22.4 (15)*	*0*	*1*	*3*	*3*	*8*
15th	*6.0 (4)*	*0*	*0*	*1*	*3*	*0*
25th	*12 (8)*	*0*	*1*	*2*	*0*	*5*
50th	*4.5 (3)*	*1*	*0*	*0*	*2*	*0*
75th	*1.5 (1)*	*0*	*0*	*1*	*0*	*0*
85th	*0*	*0*	*0*	*0*	*0*	*0*
90th	*0*	*0*	*0*	*0*	*0*	*0*
95th	*0*	*0*	*0*	*0*	*0*	*0*
Total	*100 (67)*					

Half of the adolescent males have a MUAC measure falling in the 5th percentile for their age category. Only 1.5 % of the male adolescents have a MUAC measure above the 50th percentile for their age category. Ninety-four percent of the adolescent males fall below the 50th percentile for their age category.

Table 56: Number of female juvenile on remand detainees falling into MUAC percentiles per age category (CDC percentile tables; Fryar et al. 2012)

Percentiles	**% (n)**	**Age 15**	**Age 16**	**Age 17**	**Age 18**	**Age 19**	**Age 20-23**
5th	*7.7 (4)*	*0*	*0*	*0*	***1***	***1***	***2***
10th	*9.6 (5)*	*0*	*0*	*0*	***1***	***3***	***1***
15th	*5.8 (3)*	*0*	*0*	*0*	*0*	*0*	***3***
25th	*11.5 (6)*	*0*	*0*	*0*	***2***	***2***	***2***
50th	*23.1 (12)*	*0*	*0*	***1***	***2***	***3***	***6***
75th	*30.8 (16)*	***1***	*0*	*0*	***4***	***6***	***5***
85th	*3.8 (2)*	*0*	*0*	*0*	***1***	*0*	***1***
90th	*3.8 (2)*	*0*	*0*	*0*	***1***	***1***	*0*
95th	*3.8 (2)*	*0*	*0*	*0*	*0*	***2***	*0*
Total	*100 (52)*		*0*				

In contrast to the males, only 34% of female adolescents' MUAC fall below the 50th percentile, with 23% of female's MUAC falling on the 50th percentile and 43% being above the 50th percentile.

Table 57: Number of male juvenile on remand detainees falling into triceps percentiles per age category (CDC percentile tables; Fryar et al. 2012)

Percentiles	**% (n)**	**Age 15**	**Age 16**	**Age 17**	**Age 18**	**Age 19**	**Age 20-23**
5th	*50.7 (34)*	***0***		***1***	***11***	***7***	***15***
10th	*16.4 (11)*			***2***	***3***	***3***	***3***
15th	*3.0 (2)*				***1***	*0*	***1***
25th	*11.9 (8)*				***1***	***4***	***3***
50th	*13.4 (9)*		***1***		***1***	***2***	***5***

75th	*3.0 (2)*				***1***	***1***	*0*
85th	*1.5 (1)*				*0*	*0*	***1***
90th	*0*				*0*	*0*	*0*
95th	*0*				*0*	*0*	*0*
Total	*100 (67)*						

Table 58: Number of male juvenile on remand detainees falling into triceps percentiles per age category (CDC percentile tables; Fryar et al. 2012)

Percentiles	***% (n)***	***Age 15***	***Age 16***	***Age 17***	***Age 18***	***Age 19***	***Age 20-23***
5th	*19.2 (10)*				***2***	***4***	***4***
10th	*7.7 (4)*				*0*	***1***	***3***
15th	*5.7 (3)*				***1***	*0*	***2***
25th	*13.4 (7)*			***1***	***1***	***3***	***2***
50th	*25.0 (13)*	***1***	*0*		***3***	***4***	***5***
75th	*11.5 (6)*				***3***	*0*	***3***
85th	*7.7 (4)*				*0*	***3***	***1***
90th	*1.9 (1)*				*0*	***1***	*0*
95th	*7.7 (4)*				***2***	***2***	*0*
Total	*100 (52)*	***1***	***0***	***1***	***12***	***18***	***20***

Appendix 4.2: Female and male correlation tables

Table 59: Juvenile on remand female correlation table with BMI, cAMA and MHGS

Variable	sex=0 Correlations (DCS data combined final) Marked correlations are significant at p < ,05000 N=51 (Casewise deletion of missing data)		
	bmi	cAMA_m+f	mhgs_ave
height	-,0050	,2098	,3552
	p=,972	p=,140	p=,011
weight_1	,9328	,5840	,3799
	p=0,00	p=,000	p=,006
bmi	1,0000	,5342	,2559
	p= ---	p=,000	p=,070
muac_1_mm	,8915	,7371	,2974
	p=,000	p=,000	p=,034
triceps1_ave	,8293	,2287	,1849
	p=,000	p=,106	p=,194
cAMA_m+f	,5342	1,0000	,2986
	p=,000	p= ---	p=,033
mhgs_ave	,2559	,2986	1,0000
	p=,070	p=,033	p= ---
age	-,0620	,1251	-,1281
	p=,666	p=,382	p=,370
school	,1828	-,0052	,1098
	p=,199	p=,971	p=,443
duration_days	,3229	,1878	,4055
	p=,021	p=,187	p=,003
hunger_score	-,0920	,0058	-,0844
	p=,521	p=,968	p=,556
breakfast	,0220	,0767	,1058
	p=,878	p=,593	p=,460
lunch	,1531	-,0530	,2199
	p=,283	p=,712	p=,121
supper	,1672	-,1268	,2224
	p=,241	p=,375	p=,117
eat_snacks	,0525	,0842	,2284
	p=,714	p=,557	p=,107
fruit_home	,0362	-,1004	,0727
	p=,801	p=,483	p=,612
veg_home	,1320	,0324	,0947
	p=,356	p=,821	p=,509
veg_served	,1801	,0714	,1108
	p=,206	p=,619	p=,439
milk_home	,1485	,0185	,1763
	p=,298	p=,898	p=,216
fruitjuice_home	-,0364	-,0869	,0970
	p=,800	p=,544	p=,498
8group_protein	,2721	,0425	,0719

	p=,053	p=,767	p=,616
8group_dairy	-,0902	-,0120	,0556
	p=,529	p=,934	p=,699
8group_starch	-,0552	-,0778	,1194
	p=,700	p=,587	p=,404
8group_fruit	,1273	,2984	,0535
	p=,373	p=,033	p=,709
8group_veg	,3196	,1865	-,0046
	p=,022	p=,190	p=,975
8group_fats	-,1656	-,1609	-,0017
	p=,245	p=,259	p=,990
8group_snacks	-,0365	-,0291	-,1147
	p=,799	p=,839	p=,423
8group_sugarprod	-,1395	,0643	,0211
	p=,329	p=,654	p=,883
tot_met_week	-,2990	-,1671	-,2404
	p=,033	p=,241	p=,089
tot_min_rest_day	,0045	,1675	,0477
	p=,975	p=,240	p=,739
feel_total	-,1990	-,2571	-,5596
	p=,161	p=,069	p=,000
smoke	-,5294	-,2607	-,0843
	p=,000	p=,065	p=,556
alcohol	,2734	,0343	,0889
	p=,052	p=,811	p=,535
drugs	-,4882	-,1812	-,2014
	p=,000	p=,203	p=,156
risk_taking	-,4682	-,2315	-,1259
	p=,001	p=,102	p=,379
parity_cat	.0387	.0099	-.3586
	p=.785	p=.944	p=.009

Table 60: Categorical demographic variables for BMI females (column % (n))

Variables	*Underweight*	*Normal weight*	*Over weight*	*Obese*	*p-value (chi-square test)*
Race					***0.01***
African black	*25 (2)*	*28.1 (9)*	*88.9 (8)*	*100 (3)*	
White	*0*	*3.1 (1)*	*0*	*0*	
Coloured	*75 (6)*	*68.8 (22)*	*11.1 (1)*	*0*	
Language					***0.035***
English	*12.5 (1)*	*12.5 (4)*	*11.1 (1)*	*33.3 (1)*	
Afrikaans	*62.5 (5)*	*59.4 (19)*	*0*	*0*	
isiXhosa	*25.0 (2)*	*18.8 (6)*	*77.8 (7)*	*66.7 (2)*	
Other	*0*	*9.4 (3)*	*11.1 (1)*	*0*	
Birth place					*0.17*
Live with whom					*0.47*
Electricity					*0.55*
Tap/ water					*0.21*
Parity					*0.72*

Table 61: Categorical demographic variables for cAMA percentile categories for females

	Wasted & below average	*Average*	*Above average and High muscle mass*	*p-value*
Race				*0.42*
Language				*0.33*
Birth place				*0.49*
Live with whom				*0.30*
Perception of weight				*0.67*
Weight loss in last year				*0.31*
Parity				*0.77*

Table 62: Categorical demographic variables for MHGS of females

	Percentile <25 *% (n)*	*50th* *% (n)*	*>75th* *% (n)*	*p-value*
Race				*0.44*
Language				*0.49*
Birth place				*0.30*
Live with whom				*0.11*
Perception of weight				*0.63*
Weight loss in last year				*0.61*
Parity *None* *One child* *Two children* *Three children* *Four children*	 *0* *0* *50 (1)* *0* *50 (1)*	 *52 (26)* *44 (22)* *2 (1)* *2 (1)* *0*	 *0* *0* *0* *0* *0*	***0.00****

**Spearman rank order correlation*
Pearson chi-square test for all other data

Male correlation tables

Table 63: Juvenile on remand male correlation table with BMI, cAMA and MHGS

Variable	sex=1 Correlations (DCS data combined final) Marked correlations are significant at p < ,05000 N=67 (Casewise deletion of missing data)		
	bmi	cAMA_m+f	mhgs_ave
height	,2459	,4750	,6752
	p=,045	p=,000	p=,000
weight_1	,7871	,7466	,6628
	p=,000	p=,000	p=,000
bmi	1,0000	,7134	,3831
	p= ---	p=,000	p=,001
muac_1_mm	,8305	,9184	,5402
	p=,000	p=0,00	p=,000
triceps1_ave	,5424	,1428	,3215
	p=,000	p=,249	p=,008
cAMA_m+f	,7134	1,0000	,4746
	p=,000	p= ---	p=,000
mhgs_ave	,3831	,4746	1,0000
	p=,001	p=,000	p= ---
age	,0809	,1319	-,0485
	p=,515	p=,287	p=,696
school	,0971	,1119	,3859
	p=,434	p=,367	p=,001
duration_days	,0265	,0143	-,0839
	p=,831	p=,909	p=,500
hunger_score	-,1600	-,0633	-,3206
	p=,196	p=,611	p=,008
breakfast	-,0402	-,0702	,1584
	p=,746	p=,572	p=,200
lunch	-,0054	,0698	,2620
	p=,965	p=,574	p=,032
supper	,0587	-,0494	,1021
	p=,637	p=,691	p=,411
eat_snacks	,0561	,1908	,0766
	p=,652	p=,122	p=,538
fruit_home	,1251	,0674	,0497
	p=,313	p=,588	p=,690
veg_home	,2101	,1141	,0966
	p=,088	p=,358	p=,437
veg_served	,1164	,0663	,0861
	p=,348	p=,594	p=,489
milk_home	,0199	,0584	-,0171
	p=,873	p=,639	p=,891
fruitjuice_home	,2692	,0945	,0166
	p=,028	p=,447	p=,894
8group_protein	,1219	-,0011	-,0840
	p=,326	p=,993	p=,499

8group_dairy	,1536	,0728	,0709
	p=,215	p=,558	p=,569
8group_starch	,0091	-,0274	-,0917
	p=,942	p=,826	p=,460
8group_fruit	,1607	,0978	,0722
	p=,194	p=,431	p=,562
8group_veg	-,0088	,0705	,0375
	p=,943	p=,571	p=,763
8group_fats	,0976	,2156	,0919
	p=,432	p=,080	p=,460
8group_snacks	,0712	,0897	-,2137
	p=,567	p=,471	p=,082
8group_sugarprod	,2120	,1198	,0304
	p=,085	p=,334	p=,807
tot_met_week	,0652	-,0109	,0484
	p=,600	p=,930	p=,697
tot_min_rest_day	-,1718	-,2550	-,1757
	p=,165	p=,037	p=,155
feel_total	-,0739	-,1034	-,0304
	p=,552	p=,405	p=,807
smoke	,0152	-,0606	-,1815
	p=,903	p=,626	p=,142
alcohol	-,0191	,0574	,0662
	p=,878	p=,645	p=,594
drugs	,0038	-,0070	-,0264
	p=,976	p=,955	p=,832
risk_taking	,0013	-,0076	-,0674
	p=,992	p=,951	p=,588

Table 64: Categorical demographic variables for BMI in males

Variables	Underweight	Normal weight	p-value (Pearson chi-square test)
Race			0.34
Language			0.64
Birth place			0.58
Live with whom			0.37
Electricity			0.23
Tap/ water			0.90

Table 65: Categorical demographic variables for cAMA percentile categories of males

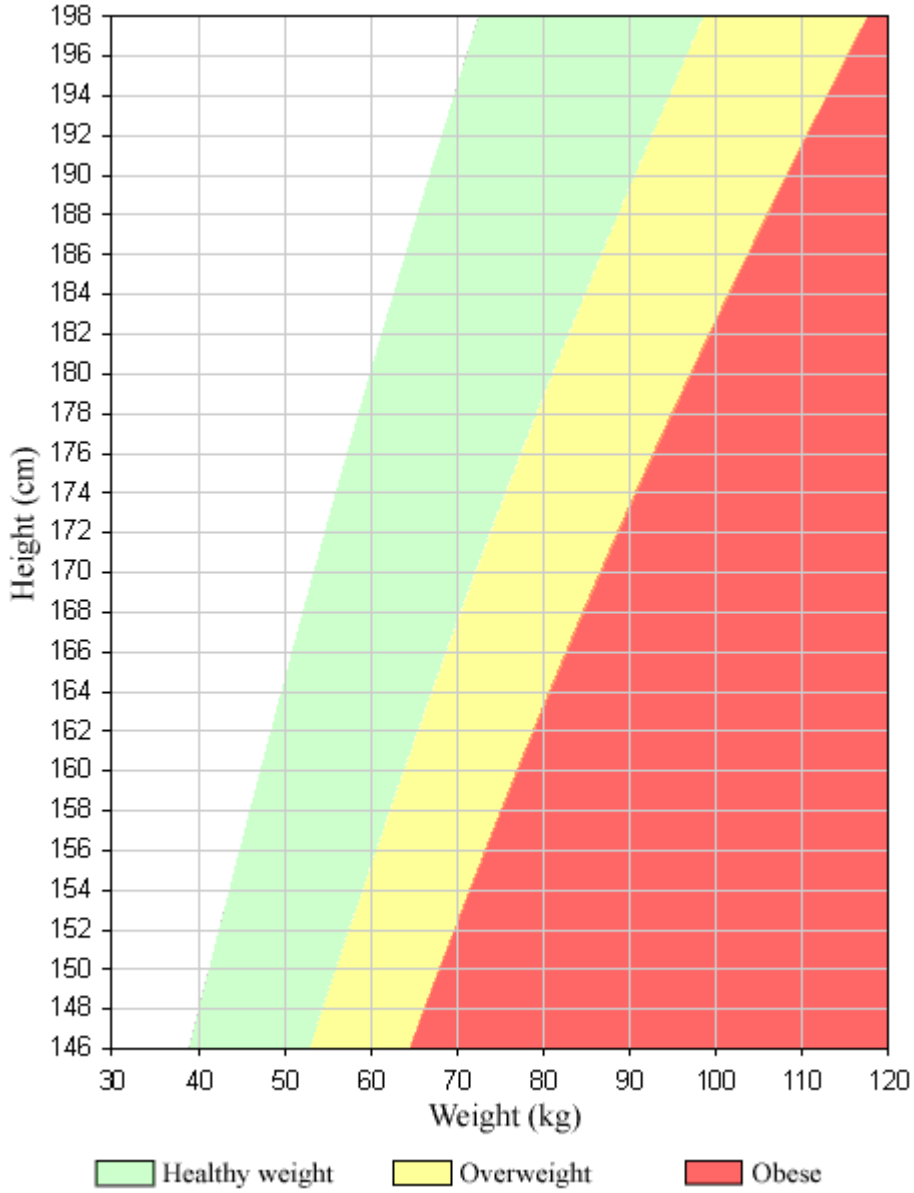
	Wasted & below average muscle mass % (n)	*Average muscle mass % (n)*	*Above average and High muscle mass % (n)*	*p-value*
Race				*0.69*
Language				*0.12*
Birth place				***0.01***
Cape town	*95.5 (43)*	*72.7 (16)*	*0*	
Eastern Cape	*2.2 (1)*	*13.6 (3)*	*0*	
Gauteng	*2.2 (1)*	*0*	*0*	
Other	*0*	*13.6 (3)*	*0*	
Live with whom				*0.32*
Perception of weight				*0.86*
Weight loss in last year				***0.04***
Yes	*17.8 (8)*	*100.0 (22)*	*0*	
No	*82.2 (37)*	*0*	*0*	

Table 66: Categorical demographic variables for MHGS of males

	Percentile <25	*50^{th}*	*$>75^{th}$*	*p-value*
Race				*0.16*
Language				*0.23*
Birth place				*0.25*
Live with whom				*0.19*
Perception of weight				*0.40*
Weight loss in last year				*0.75*

Appendix 6.1: Juvenile on-remand screening tool

Body Mass Index (BMI) for Adults



Adapted from: U.S. National Heart, Lung and Blood Institute; U.S. National Institutes of Health (2000).The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. (NIH Publication No. 00-4084). Available online: http://www.nhlbi.nih.gov/guidelines/obesity/prctgd_c.pdf

For adults 18 years and older:

- A BMI below 18.5 (shown in white) is considered underweight.
- A BMI of 18.5 to 24.9 (green) is considered a normal weight.
- A BMI of 25 to 29.9 (yellow) is considered overweight.
- A BMI of 30 or higher (red) is considered obese.

Figure 5: BMI and cut-offs for adults

Table 67: MHGS percentiles for 18-21-year-old males and females (kgf) (Dodds et al., 2014)

Gender	**10th**	**25th**	**50th**	**75th**	**90th**
Male	*30*	*35*	*40*	*46*	*52*
Female	*21*	*24*	*28*	*32*	*36*

Table 68: Questions about how you feel

	I am going to list a few sentences about things that you may feel at times. Tell me which of these feelings you felt in the past month: ***(Circle the answer that is given)***					
1	*How often did you feel tired out for no good reason?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
2	*How often did you feel nervous?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
	If answer is "none of the time" skip question 3.					
3	*How often did you feel so nervous that nothing could calm you down?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
4	*How often did you feel hopeless?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
5	*How often did you feel restless or fidgety?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
	If answer is "none of the time" skip question 6.					
6	*How often did you feel so restless you could not sit still?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
7	*How often did you feel depressed?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
8	*How often did you feel that everything was an effort?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
9	*How often did you feel so sad that nothing could cheer you up?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
10	*How often did you feel worthless?*	*None of the time (1)*	*A little of the time (2)*	*Some of the time (3)*	*Most of the time (4)*	*All of the time (5)*
	Totals:					
	Grand total:					

Table 69: Questions about food availability in the last month at home

Circle the answers that the inmate gives:			
In the last month at home (or where you lived), was there ever no food to eat of any kind in your house because there was not enough money to get food?			*Y / N*
If no, skip to next question. ***If yes, how often did this happen?***	*Rarely* *(1-2 times)* *(1)*	*Sometimes* *(3-10 times)* *(1)*	*Often* *(> 10 times* *(2)*
In the last month at home (or where you lived), did you or any household member/person go to sleep at night hungry because there was not enough food?			*Y / N*
If no, skip to next question. ***If yes, how often did this happen?***	*Rarely* *(1-2 times)* *(1)*	*Sometimes* *(3-10 times)* *(1)*	*Often* *(> 10 times)* *(2)*
In the last month at home (or where you lived), did you or any household member/person go a whole day and night without eating anything because there was not enough food?			*Y / N*
If no, skip to the end. ***If yes, how often did this happen?***	*Rarely* *(1-2 times)* *(1)*	*Sometimes* *(3-10 times)* *(1)*	*Often* *(> 10 times)* *(2)*
Only add the numbers in brackets up if it was given as an answer. ***Circle the total that you found:***	*0 1 2 3 4 5 6*		