The Economics of School-Based Sexual and Reproductive Health Education Interventions

By

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Abstract

Background

Promoting the sexual and reproductive health (SRH) of adolescent girls remains central to enabling their health, education, and economic prospects. Comprehensive school-based sexual and reproductive health education (SBSHE) has been recognised as a key strategy for promoting adolescent SRH. However, there is little evidence on the cost and cost-effectiveness of such programmes, limiting investment and priority-setting decisions.

Methods

The thesis aimed to understand the economic costs of adolescent sexual and reproductive health services and to evaluate the potential value of a school-based sexual and reproductive health education intervention targeted at adolescent girls in South Africa. A critical review was conducted to understand the methods for conducting community-based health promotion interventions similar to SBSHE interventions. The economic data was collected within a cluster randomised trial. The Goals for Girls trial assessed a sports-based comprehensive SBSHE intervention targeting adolescent girls aged 14 to 17 compared to usual practice. Intervention costs were estimated from a Department of Education provider perspective, using a mixed-method costing approach. The costs of averted basic and emergency intrapartum care were estimated at two levels of care from a Department of Health provider perspective. Subsequently, the economic burden of adolescent girl SRH services was described from a Department of Health provider perspective. In addition, the value of the intervention was assessed via a modelled cost-consequence analysis from a multi-sector perspective across a range of intermediate (% time in school, % pregnant, and % giving birth by five years) and final outcomes (life years and quality-adjusted life years)

Results

The results of the critical review showed that the methodological quality of the included studies was good overall. However, the methods applied did not adequately address the methodological issues of conducting economic evaluation in community-based health promotion.

The costs of a sports-based SBSHE intervention were $ 9.9 per learner per session and $69.43 per learner graduating (seven of ten sessions). Sensitivity analysis indicated that these costs were sensitive to learner participation rates. The mean cost per patient for vaginal delivery at a maternity obstetric unit and obstetric hospital was US$142.47 and US$557.49, respectively, compared to US$943.33 for a c-section. Clinical costs, including personnel, were the leading drivers of costs in both facilities. The estimated undiscounted cost of SRH services per learner over a five-year period was $289.66, with contraceptives and obstetric services accounting for 48% and 47%, respectively. The total societal costs of the comprehensive SBSHE intervention were $447.07, while life years and quality-adjusted life years were estimated at 4.9 and 4.4 respectively. In scenario analysis, increasing levels of abstinence or contraceptives both improved biological outcomes, although the latter generated significantly higher contraceptive costs. One-way sensitivity analyses revealed that changes in the discount rate and the utilisation of the intervention had the most impact on societal costs.

Conclusion

The findings from this thesis are significant for promoting ASRH in South Africa. The findings can contribute to decision-making for comprehensive SBSHE interventions. Including a multisector perspective supports transparency and can foster collaboration across sectors.

Declaration

With this, I declare that this thesis represents my own work and has not been previously submitted for any other degree at the University of Cape Town or any other institution. Where information has been derived from other sources, this is disclosed through explicit references throughout the thesis.

Signed: by the student

Printed name: Funeka Bango

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Dedication

To my beloved husband, Lizo, and our cherished children, Qhamani and Bubukho, your love, support and patience throughout this journey made this PhD possible.

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Abbreviations

AGYW	Adolescent girls and young women
AIDS	Acquired immunodeficiency syndrome
ALOS	Average length of stay
ASRH	Adolescent sexual and reproductive health
BIA	Budget impact analysis
CBA	Cost-benefit analysis
CBHP	Community-based health promotion
CCA	Cost-consequence analysis
CEA	Cost-effectiveness analysis
CET	Cost-effectiveness threshold
CHCs	Community health centres
cRCTs	Cluster-randomised controlled trials
CRD	Centre for Reviews and Dissemination
CSE	Comprehensive sexuality education
C-section	Caesarean section
CUA	Cost-utility analysis
DALY	Disability-adjusted life year
DBE	Department of Basic Education
DCEA	Distributional cost-effectiveness analysis
DTHF	Desmond Tutu Health Foundation
ECEA	Extended cost-effectiveness analysis
EE	Economic evaluation
G4G	Goals for Girls
GRS	Grassroot Soccer
HICs	High-income countries
HIV	Human immunodeficiency virus
ICBs	Intersectoral costs and benefits
ICER	Incremental cost-effectiveness ratio
iMMR	Institutional maternal mortality ratio
ISA	Intersectoral action for health
ITT	Intention-to-treat
JBI	Joanna Briggs Institute
KGIS	Keeping Girls in School
LMICs	Low- and middle-income countries
LO	Life Orientation

MOU	Midwife obstetric unit
NGOs	Non-governmental organisations
NICE	National Institute for Health and Care Excellence
NVD	Normal vaginal delivery
OH	Obstetric hospital
PPH	Postpartum haemorrhage
PROM	Prolonged rupture of membranes
QALY	Quality-adjusted life year
SBA	Skilled birth attendant
SBSHE	School-based sexual and reproductive health education
SDGs	Sustainable Development Goals
SKILLZ	SKILLZ Health for Girls
SRH	Sexual reproductive health
SSA	Sub-Saharan Africa
STI	Sexually transmitted infections
UNESCO	United Nations Educational Scientific and Cultural Organization
UNFPA	United Nations Population Fund
WCED	Western Cape Education Department
WHO	World Health Organization
WTP	Willingness to pay

CHAPTER 1

1 Chapter 1: Introduction

Promoting the sexual and reproductive health (SRH) of adolescent girls remains central to enabling their health, education, and economic prospects (National Department of Health South Africa, Statistics South Africa & South African Medical Research Council (SAMRC), 2019; Chimbindi et al., 2020). In South Africa, the public health sector serves approximately 80% of the population, providing a range of SRH services, including contraceptives, terminations of pregnancy, maternal health services (antenatal, birth and postnatal) and diagnosis and treatment of sexually transmitted infections, including HIV/AIDS. These services are free at the point of use. Despite this, low uptake of contraceptives and high rates of unintended adolescent pregnancies and sexually transmitted infections (STIs) persist, particularly among socio-economically disadvantaged girls (Barron et al., 2022). Schools represent a critical setting for reaching young people through SRH promotion interventions (Meherali et al., 2021). The South African government has recognised this and has incorporated school-based comprehensive sexuality education (CSE) into the national curriculum (UNFPA, 2015). Whilst there is conflicting evidence on the effectiveness of these interventions and very limited information on cost or cost-effectiveness, CSE remains a key SRH promotion tool (Koch & Wehmeyer, 2021a; Adekola & Mavhandu-Mudzusi, 2023). The aim of the thesis is to assess the economic costs of adolescent sexual and reproductive health (ASRH) services and to evaluate the potential value of a comprehensive school-based sexual and reproductive health education (SBSHE) intervention targeted at adolescent girls in order to provide policy recommendations in South Africa.

This chapter provides the background to the research. The first section describes adolescent SRH globally, in low and middle-income countries and South Africa. The second section discusses the available literature on the effectiveness and cost-effectiveness of SBSHE interventions. It then moves into describing factors contributing to poor ASRH outcomes in South Africa, focusing on unintended pregnancy and the strategies for promoting ASRH in the country. Linked to this, the chapter describes the intervention that provides some of the data for the thesis before summarising research gaps, the research aim, and objectives. The section concludes with an outline of the remainder of the thesis.

1.1 Research background

1.1.1 Defining sexual and reproductive health

Sexual and reproductive health is a critical aspect of overall health and well-being, as well as social and economic development in all communities. Good SRH indicates a state of complete physical, mental and social well-being in a wide range of aspects relating to SRH (UNFPA, 2022). The global understanding of SRH has advanced over time. While the two domains in SRH are interrelated, appreciating the properties of each is essential for ensuring that they are both regarded equally in programme design. Sexual health is a broader domain which includes aspects of sexuality beyond reproduction and has relevance throughout an individual's life span (WHO, 2023a). It is defined as "a state of physical, emotional, mental and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction or infirmity" (WHO, 2006). This demands a positive and respectful approach to all the dimensions of sexuality and sexual

relationships, emphasising safety in sexual experiences, including freedom from coercion, discrimination and violence. To attain and maintain sexual health, sexual rights must be respected, protected and fulfilled. Consequently, sexual health includes issues related to sexual orientation, expression, pleasure, relationships, and gender identity (WHO, 2023a). Sexual ill health includes STIs (including HIV) and related complications, unintended pregnancy, abortion, sexual dysfunction, violence, and harmful practices (e.g., female genital mutilation).

Likewise, reproductive health is a state of complete physical, mental and social well-being and not merely the absence of ill health relating to the reproductive system, its functions and processes (WHO, 2024a). This includes the ability to have a satisfying and safe sex life and the ability and freedom to reproduce if, when and how often an individual desires. It also includes the right to information and access to contraceptive methods and appropriate health care services for safe pregnancy and childbirth.

While a distinction can be made between the domains of SRH, this thesis considers the inherent interrelation of the two domains and includes the promotion of good SRH.

1.1.2 Adolescent sexual and reproductive health

Promoting ASRH is a public health priority, given the significant social, economic and health consequences posed by adverse ASRH outcomes, including unintended pregnancy, unsafe abortion, and STIs, including HIV (Papri et al., 2016; World Health Organization (WHO), 2020). The period of adolescence, from approximately 10 to 19

years, is a critical stage of life characterised by rapid biological, emotional, and social development, generating unique social and physical vulnerabilities, particularly for girls (Laski, 2015; WHO, 2021). Consequently, poor ASRH constitutes a major component of global sexual and reproductive ill health (Morris & Rushwan, 2015; Zepro et al., 2023).

1.1.3 The epidemiological burden of adolescent sexual and reproductive ill-health

Globally, the burden of curable STIs remains significant, with more than one million infections acquired daily, contributing to health and economic burdens (Fu et al., 2022; WHO, 2024b). The highest reported rates are among adolescents and youth aged between 15 and 24 years (Yuh et al., 2020), and adolescent girls are at a disproportionately higher risk of acquiring STIs (Masanja et al., 2021). Globally, adolescents and young people represent a growing proportion of people living with HIV (UNICEF, 2024), and adolescent girls are disproportionately affected by HIV, accounting for more than two-thirds of all new HIV infections among adolescents (UNAIDS, 2022; UNICEF, 2024). In addition, while global adolescent birth rates have decreased with time, the number of childbirths to adolescents remains high. Thirteen per cent of adolescent girls give birth before the age of 18 years, and the associated maternal conditions are among the top causes of morbidity and mortality (UNICEF, 2022). When including all pregnancies and not just births, the number of pregnancies is higher. Adolescent pregnancies are more likely to be unintended (defined as untimely or unwelcome) (Santelli et al., 2003), and 61% of all unintended pregnancies end in abortion (Bearak et al., 2020). Compared to adult mothers, pregnant adolescents are more likely to have unsafe abortions, leading to an increase in morbidity and mortality. Modern

contraceptives are critical for avoiding unintended pregnancies; however, the unmet need (those who want to avoid pregnancy but are not on contraception) is higher for adolescents than older women (Sully et al., 2020).

The burden of global adolescent sexual and reproductive ill health is concentrated in low- and middle-income countries (LMICs). Asia and Sub-Saharan Africa (SSA) contribute the greater share of the curable STI burden (Fu et al., 2022), with SSA accounting for 40% of global STI infections (Wang et al., 2023). Adolescent girls and young women (AGYW) are disproportionately affected (Dadzie et al., 2022). Moreover, in SSA, adolescent girls are still disproportionately affected by HIV. In 2023, approximately six times as many adolescent girls were newly infected with HIV than adolescent boys (UNICEF, 2024). Furthermore, in LMICs, there are an estimated 21 million adolescent pregnancies per annum, with 20% of women falling pregnant by age 20 (Kassa et al., 2018; Akseer, Catherine Keats, et al., 2022).

Sub-Saharan Africa continues to have twice the global average of adolescent birth rates (United Nations, 2022). More than one in five AGYW in SSA have an unmet contraception need (Sidibé et al., 2022), approximately 50% of adolescent pregnancies are unintended (Sully et al., 2020), and more than 50% result in abortion (Mohamed et al., 2023). A high proportion (97%) of these abortions are unsafe (Singh et al., 2018; World Health Organization (WHO), 2019). Consequently, complications from pregnancy and childbirth are a leading cause of death among girls aged 15–19 years in LMICs (Chakole et al., 2022).

In South Africa, AGYW demonstrate the highest curable STI incidence (Frank et al., 2023), which predisposes them to a higher risk of HIV acquisition (Kharsany et al., 2020). In a country that bears the largest global HIV burden, an estimated third of all new HIV infections are among AGYW (Simbayi et al., 2019). Thirty-one per cent of adolescent girls have an unmet need for contraception (Jonas, Mathews, et al., 2022). South Africa has one of the highest adolescent pregnancy rates globally. Data from the South African Demographic and Health Survey indicate that nearly 20% of women have started childbearing by age 18 (National Department of Health South Africa, Statistics South Africa & South African Medical Research Council (SAMRC), 2019).

1.1.4 Factors contributing to adolescent pregnancy

Adolescent pregnancy is a dynamic and complex social phenomenon attributable to multiple and interdependent individual-level (personal) and situational elements (Jonas et al., 2016; Yakubu & Salisu, 2018). The interplay between these different factors is depicted in the socioecological model in Figure 1, argued to be a comprehensive theory-based framework for identifying the associations between diverse personal and environmental elements affecting human health (Stokols, 1996). Such frameworks are applicable to understanding complex topics such as the risks to ASRH (Hall et al., 2018). As shown, individual risk factors include substance misuse, education level, and self-esteem. Situational features cover interpersonal, community level and policy-related factors. Examples of these factors in LMICs include peer pressure, gender-based violence, poverty, early marriage practices, lack of sexual education, limited access to

SRH services and restrictive laws and policies (Chung, Kim & Lee, 2018; Yakubu & Salisu, 2018).

Gender plays a significant role in shaping these risk factors, resulting in girls being more vulnerable to adverse sexual health outcomes compared to boys (Marshall et al., 2024). At the individual level, gender influences the knowledge, attitude and behaviours related to sexual health. Due to cultural norms, girls are socialised to bear the responsibility of preventing pregnancy and managing reproductive health, while boys are often pressured to demonstrate sexual prowess, which could discourage responsible sexual behaviour (Larsson et al., 2022). In addition, gender-based differences in power dynamics and body autonomy can affect the ability of adolescent girls to negotiate safe sexual practices (Decker et al., 2021). At the interpersonal level, there are often unequal expectations around sexual behaviour, which perpetuate behaviours that demonstrate masculinity from boys, while girls may face stigma for perceived sexual activity (Rogers et al., 2023). These risks can be further compounded at the community level through restrictive gender roles and inequalities at the societal level, which may predispose adolescent girls to gender-based violence (Janighorban et al., 2022). Lastly, policy-level factors can influence adolescent girls' access to education, healthcare and economic opportunities (Sampa et al., 2021).

Adolescent pregnancy imposes a wide range of potentially negative consequences. Pregnant adolescents are at risk of leaving school, resulting in lower educational opportunities, under or unemployment and poverty (Humberstone, 2018; Otegbayo et al., 2023). The multiple sequelae of adolescent pregnancy place children of adolescent mothers at risk of adolescent pregnancy, perpetuating the cycle (Hendrick & Maslowsky,

2019). In addition to the negative socio-economic impact, adolescent pregnancy is associated with higher risks of maternal morbidity and mortality (Kassa et al., 2018), particularly in LMICs (Brosens et al., 2017; Karataşlı et al., 2019; Mekonnen, Dune & Perz, 2019; Akseer, Keats, et al., 2022). Maternal complications include hypertensive disorders of pregnancy, puerperal endometritis, obstetric fistulae, and systemic infections (Ganchimeg et al., 2014; UNICEF, 2022). Adverse neonatal outcomes include prematurity, low birth weight, and infants that are small for gestational age (García-Basteiro et al., 2017; Pusdekar et al., 2020; Kassa et al., 2021). These complications impose high healthcare costs on LMIC health systems (Mori et al., 2020). Complications related to pregnancy and childbirth are also the leading cause of death for adolescent girls aged 15 to 19 (Noori et al., 2022).

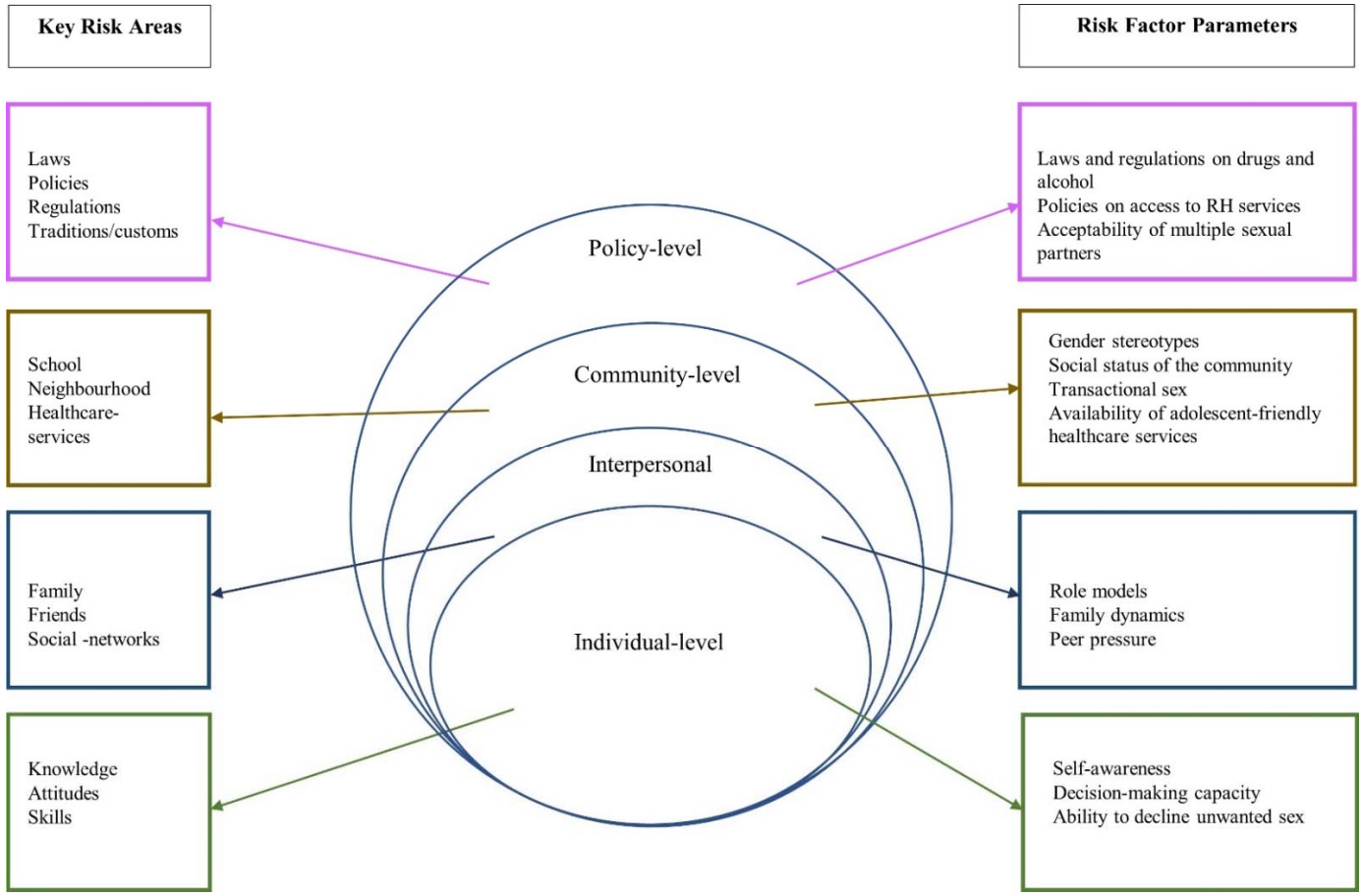


Figure 1. Socio-ecological model of adolescent sexual and reproductive health

Note: Reproductive Health (RH). Adapted from Mekonnen, T., Dune, T. & Perz, J. Maternal health service utilisation of adolescent women in sub-Saharan Africa: a systematic scoping review. BMC Pregnancy Childbirth 19, 366 (2019). https://doi.org/10.1186/s12884-019-2501-6. (Retrieved August 13, 2021)

1.1.5 Approaches to adolescent sexual and reproductive health promotion

While sexually transmitted infections (STIs), including HIV/AIDS and unintended adolescent pregnancy, have multiple risk factors, they are preventable (Pires et al., 2021; Mohamed et al., 2023). Sexual and reproductive health promotion refers to the process of enabling individuals and communities to increase control over and improve their sexual and reproductive health (Homme et al., 2023). It is a comprehensive, multi-faceted approach which encompasses strategies that aim to enhance sexual well-being and involves the development and implementation of strategies, programs, and policies designed to improve knowledge, attitudes, and behaviours related to sexual health, prevent sexually transmitted infections and unintended pregnancies, and promote healthy and respectful relationships (Khalesi et al., 2016; WHO, 2017). Sexual education, also referred to as sexuality education, sex education, sexual health or SRH education, is one of the strategies that target the individual and interpersonal levels (see Figure 1). It has been recognised as a fundamental human right and is key to reducing risky sexual behaviour among adolescents (Kirby et al., 1994; Muñoz, 2010; United Nations Population Fund (UNFPA), 2014; Ramírez-Villalobos et al., 2021). Comprehensive sexual education (CSE) is defined as "a curriculum-based process of teaching and learning about the cognitive, emotional, physical and social aspects of sexuality". It empowers adolescents to protect their health through a framework of knowledge, skills, attitudes, and values (UNESCO, 2018:16). In addition to promoting sexual well-being in adolescents, CSE is gender-focused and is designed to cultivate gender equity (Chandra-mouli et al., 2013; Haberland & Rogow, 2015). Well-implemented CSE interventions have the potential to support safer sexual behaviour in adolescents and

positively impact SRH, including reducing sexually transmitted infections (STIs), including HIV, and unintended pregnancy (Morris & Rushwan, 2015; Salam et al., 2016; UNESCO, 2021). While CSE can be delivered in or out of school, many adolescents can be reached through the school system (UNFPA, 2020).

Collaboration between the health and education sectors is considered critical to the provision of CSE in schools (Dawson, Wijewardena & Black, 2014; Obach, Sadler & Cabieses, 2019; UNFPA EECARO, World Health Organization & BZgA Federal Centre for Health Education, 2020). Coordinated intersectoral action to improve health is necessary to address complex and persistent health challenges. Intersectoral action for health (ISA), described as the collaboration of several sectors in addition to the health sector when designing and implementing public policies to address complex risk factors, improve health, and health equity, is advocated by the WHO Commission on Social Determinants of Health as a necessary strategy to improve health outcomes and equity (Marmot et al., 2008; Rantala, Bortz & Armada, 2014). Multisectoral action, described as the intentional partnership among multiple stakeholders towards achieving a policy outcome, is often used interchangeably with ISA (Salunke & Lal, 2017; Zhong & Fouque, 2020). There is an established consensus that the inclusion of multiple sectors leverages the understanding of public health issues, the reach of the intervention, and resources (Salunke & Lal, 2017). This is key to successfully implementing many prevention interventions and essential for facilitating the achievement of Sustainable Development Goals (SDGs) (Trowbridge et al., 2022).

Despite this recognition, however, only a small proportion of health expenditure is spent on prevention interventions, even in upper-middle and high-income countries (Gmeinder, Morgan & Mueller, 2017). Health promotion interventions are infamously underfunded due to the historical focus on traditional medical disciplines (Coe & De Beyer, 2014). Although consensus has now been reached between governments and public health leaders, there are still significant gaps in funding for public health interventions (Jones et al., 2021). Public resources are limited, and policymakers must prioritise interventions that produce the most significant benefit per dollar invested (Alayli-Goebbels et al., 2014).

1.1.6 School-based sexual and reproductive health education

One of the global goals on the 2030 agenda for sustainable development is to achieve universal access to SRH education and services, ensure reproductive rights, and achieve gender equality and empowerment of women and girls (United Nations. Department of Economic and Social Affairs, 2018). Comprehensive SBSHE interventions, also referred to as school-based sexual and reproductive health promotion in this thesis, are CSE programmes delivered in a school setting as part of the curriculum (Sani et al., 2016; United Nations Educational Scientific and Cultural Organization (UNESCO), 2018). These interventions are argued to be key to achieving SDGs three and five, especially in LMICs where adverse adolescent sexual and reproductive health (ASRH) outcomes persist (UNESCO, 2021). Comprehensive SBSHE interventions are classified as community-based health promotion (CBHP) interventions. The rationale for their implementation is that health behaviour is influenced by the social context (Elder et al., 1993). The WHO also recommends

comprehensive SBSHE interventions as part of the health-promoting schools' framework (World Health Organization, 2021). Community-based health promotion interventions can improve the financial viability of universal health coverage in resource-limited settings (Coe & De Beyer, 2014).

Available evidence suggests that comprehensive SBSHE is an effective strategy for reducing the risk of STIs and pregnancy in LMICs (Fonner et al., 2014; Xu et al., 2020). Despite this evidence and recommendations by the WHO, several barriers impede the effective implementation and evaluation of these programmes in LMICs. While there are multiple available curricula, notable research gaps exist, which challenge effective CSE implementation and scale-up (Darroch et al., 2016; Johnson, 2016). These include a limited understanding of impact mechanisms to support implementation and a lack of coordination between different stakeholders (Keogh et al., 2018; UNESCO, 2019; Ivanova et al., 2020). In addition, social and cultural norms, especially in SSA, are barriers to the implementation of CSE programmes (Achen et al., 2023).

Addressing gender norms in CSE has become a global priority and is one of the key strategies for improving the effectiveness of CSE programmes (Achen et al., 2023). As gender equality is intrinsically linked to SRH, programmes that pay explicit attention to topics of gender and power are significantly more likely to be successful in improving SRH outcomes (UNFPA EECARO, World Health Organization & BZgA Federal Centre for Health Education, 2020). While it is critical to engage both boys and girls using an approach that actively challenges

gender norms (gender-transformative approach) in CSE, designing programmes that align with contextual needs and unique risks faced by different subgroups is essential (Sianis et al., 2024). Therefore, a key consideration in the design and implementation of CSE programmes is whether to adopt a mixed-gender (boys and girls) or a gender-specific approach. These delivery approaches can influence participant engagement and outcomes. Although some of the content related to gender and sexuality is the same, boys and girls have unique needs (Mmari, Simon & Verma, 2024). Curricula can be tailored according to these needs. Girls might need empowering programmes that promote agency (Lassi et al., 2024), while boys need programmes that help them recognise male privilege and power, enabling them to challenge stereotypes (Keddie et al., 2023).

Another barrier to implementing CSE programmes is the lack of economic assessment, which leads to insufficient evidence to justify investment. This results in a lack of prioritisation and insufficient funding allocated to CSE programmes (Mcdaid, Kluge & Figueras, 2018).

1.1.7 Effectiveness of school-based sexual and reproductive health education

School-based sexual and reproductive health education has been a topic of extensive global research for decades, with evidence on effectiveness and impact from systematic reviews and reviews of reviews (Peters et al., 2009; Mason-Jones et al., 2012; Lima-Serrano & Lima-Rodríguez, 2014; Sani et al., 2016; Denford et al., 2017; Abrams, Nordmyr & Forsman, 2023; Niland, Flinn & Nearchou, 2024). Given the potential range of curricula and approaches, the literature is diverse. There is a differentiation between two main types of SBSHE interventions: abstinence-only education and CSE (comprehensive SBSHE). The former approach is more common in the United States and focuses on reducing sexual activity until marriage, minimising information on contraception or safe sex practices (Zeiler, 2014). In contrast, CSE provides a broader curriculum that includes information on abstinence, contraception, STI prevention, sexual orientation, gender identity and healthy relationships. Comprehensive SBSHE programmes aim to equip adolescents with the knowledge and skills to make informed decisions about their sexual health and behaviour (United Nations Educational Scientific and Cultural Organization (UNESCO), 2018).

Evidence on the effectiveness of the different SRH education programmes indicates that comprehensive SBSHE is more effective than abstinence-only education in achieving various key outcomes, including delayed sexual debut**,** increased use of contraceptives, lower rates of STIs and pregnancy, and improved sexual knowledge and behaviour (Hoefer & Hoefer, 2017).

Notwithstanding, evidence of the overall effectiveness of SBSHE in preventing sexual ill-health is mixed and is demonstrated by the persistently high rates of adolescent sexual ill-health. While there has been progress in some of the key indicators of adolescent SRH, there is an indication of unequal progress, both within and between countries (Liang et al., 2019). These trends suggest that SBSHE programmes may be inadequate. Part of this has been attributed to differences in the content, messages, and approaches to delivering SBSHE across different contexts (Leung et al., 2019). These include cultural and religious opposition, variability in curriculum quality, and policy and funding constraints. Due to the significance of this contextual dependency on effectiveness, we focus on assessing the literature on the effectiveness of SBSHE interventions in sub-Saharan Africa.

1.1.8 Effectiveness of school-based sexual and reproductive health education interventions in sub-Saharan Africa

School-based SRH education is a critical area of focus in sub-Saharan Africa due to high rates of STIs, including HIV/AIDS, unintended adolescent pregnancies, child marriages and gender-based violence (Wangamati, 2020). In 2013, 20 countries in Eastern and Southern Africa signed a commitment to address young people's SRH through comprehensive SBSHE (UNFPA, 2015). However, the region faces several unique challenges for comprehensive SBSHE policy and implementation due to socio-cultural, economic, and infrastructural factors (Achen et al., 2023). This has resulted in studies on the effectiveness of these programmes in sub-Saharan Africa showing mixed results.

We found several studies and systematic reviews evaluating the outcomes and impact of SBSHE programmes and interventions in SSA. These presented a mixed picture of the effectiveness of the interventions and the methods used to evaluate them. An earlier systematic review highlighted a lack of evidence for SBSHE programmes, reporting limited evidence on behaviour change outcomes compared to knowledge and attitude-related outcomes (Paul-ebhohimhen, Poobalan & Van, 2008). A subsequent review done in 2011 reported a proliferation of studies between 2005 and 2008. This review reported a lack of impact of SBSHE on biological outcomes. The authors suggested that this did not negate the significance of these programmes but instead highlighted the need for supplementary interventions (Mavedzenge et al., 2011). Another review, which included systematic reviews and primary studies, found that there is strong evidence that SBSHE improves knowledge and has some impact on some behaviours, including delaying sexual debut and safer sex practices, including condom use, but no significant impact on HIV and STI incidence (UNFPA, 2016). Another 2016 comprehensive review of SBSHE for preventing STIs, including HIV in SSA, highlighted the paucity of published studies using experimental or quasi-experimental methods (Sani et al., 2016). The review found no evidence of effectiveness in reducing HIV, and only one study reported a reduction in other STIs. The review did, however, find some evidence of self-reported behaviour change. The authors proposed an assessment of the implementation process in future studies, which will provide guidance on the mechanisms of interventions. A later review done in 2020 found that evaluations of SBSHE were dominated by experimental designs. However, these interventions often

require comprehensive evaluations as they consist of multiple elements and activities (Ivanova et al., 2020).

Despite evidence of implementation of SBSHE in SSA, a 2023 review found prevailing gaps in SRH knowledge and behaviours. Thirteen of the 20 included studies in this review were in a school setting (Amanu, Birhanu & Godesso, 2023). Another recent review of the challenges in comprehensive SBSHE research in SSA presented four themes including the comprehensiveness of the curricula, gender norms, implementation barriers, and challenges with delivery methods. A gap between policy and implementation was recognised, fueled by multiple factors, including social, cultural, and gender norms. In addition, the stigma surrounding ASRH drive inconsistencies in implementation. Furthermore, this review reiterates previous literature suggesting the implementation of supplementary interventions across multiple socioecological levels (Achen et al., 2023). A 2024 scoping review of the effectiveness of SRH interventions on pregnancy and contraceptive use, including secondary outcomes, i.e., increased knowledge of contraceptives. While the review found evidence of the effectiveness of SRH education interventions, including those based in schools, on contraceptive use and pregnancy, most of these interventions were implemented in combination with other interventions (Chipako, Singhal & Hollingsworth, 2024).

1.1.9 The economic consequences of adolescent sexual and reproductive ill-health

In LMICs, adolescent sexual and reproductive ill health has profound economic consequences, impacting individuals, families and society at large. These include increased healthcare costs (short-term and long-term), and costs related to lost productivity. Short-term healthcare costs include the costs of treating STIs, including HIV, complications from unsafe abortions, and maternal and childcare costs, including pregnancy, intrapartum and postnatal care and related complications. Adolescent girls who fall pregnant are more likely to drop out of school, limiting employment opportunities and perpetuating the cycle of poverty. Due to the significance of these costs, investments in promoting ASRH that can yield economic returns are critical.

The role of economic evaluation in adolescent sexual and reproductive health

Economic assessment of public health interventions is a critical component in evidence-based public health (Rabarison et al., 2015). Economic evaluation (EE) is an explicit framework that enhances the priority-setting process by informing resource allocation and generating evidence on the optimal use of scarce resources (Wiseman et al., 2016). Efficient resource allocation is especially important in LMICs, where there are limited resources and multiple competing interests (Kaur et al., 2019).

Notwithstanding, ad hoc processes are often observed in these settings, resulting in inequitable resource allocation (Lane et al., 2020). Among other factors, the absence of

reliable evidence is recognised as a barrier to transparency in the priority-setting process in LMICs.

In view of the high rates of adverse SRH outcomes among adolescents in LMICs and associated healthcare costs, economic evaluation is a critical tool for decisions on intervention scalability and the sustainability of prevention approaches (Meherali et al., 2021). Economic analysis of prevention interventions allows for comparison with other interventions to inform investments in optimising ASRH.

1.1.10 Adolescent pregnancy in South Africa

Adolescents in South Africa aged between 10-19 years constitute a considerable share of the total population at 17.4% (Statistics South Africa, 2021). The youth are an important part of society, and they have the potential to greatly contribute to the future of the country; however, this contribution is dependent on their well-being. Adolescents in South Africa face a myriad of challenges, including sexual ill-health. Gender disparities in sexual ill-health place adolescent girls at a disproportionately high risk of acquiring HIV and other STIs (Mabaso et al., 2021; Govender et al., 2022). In addition, they are at a higher risk of unplanned pregnancy and motherhood compared to older women (Woldesenbet et al., 2021). Consequently, in South Africa, adolescent girls have been highlighted as a priority population for sexual health interventions (SANAC, 2017).

Factors contributing to adolescent pregnancy in South Africa

South Africa is a country characterised by diverse socio-economic and cultural landscapes and faces considerable challenges related to adolescent pregnancy (Statistics South Africa, 2021). The phenomenon has far-reaching consequences on the health, education, and economic prospects of young mothers, as well as broader societal impacts (Yakubu & Salisu, 2018). South Africa has one of the highest rates of adolescent pregnancy in sub-Saharan Africa (Maharaj, 2022). Several studies show that the rates of adolescent pregnancy are unevenly distributed, with higher prevalence in rural areas and among economically disadvantaged communities (Mkhwanazi, 2010; Jonas et al., 2016; Risenga & Mboweni, 2023). Trends over the past two decades reveal a persistent problem, with some fluctuations due to varying levels of intervention and socioeconomic changes (Mchunu et al., 2012; Jonas et al., 2016; Barron et al., 2022).

Several intertwined factors contribute to the high rates of adolescent pregnancy in South Africa. The country has a unique combination of social, cultural and economic factors that shape and drive social and gender norms. Gender inequality is a key structural and social determinant of adolescent SHR (Jacobs, George & De Jong, 2021). Like many African countries, South Africa has a deeply rooted patriarchal system which influences the differences in how boys and girls are socialised. Poverty and socio-economic deprivation play a crucial role, as many young women engage in early sexual activity due to a lack of access to education and economic opportunities (Yaw Amoateng, Sunday Ewemooje & Biney, 2022). Young women frequently engage in age-disparate and transactional sexual

relationships wherein their agency gets compromised, exposing women to risky sexual behaviour (George, Beckett, Reddy, Govender, Cawood, Khanyile & Kharsany, 2022; Qoza, van Heerden & Essack, 2023). The prevailing cultural norms perpetuate harmful gender stereotypes and social norms that increase the vulnerability of adolescent girls to adverse SRH outcomes (Marshall et al., 2024). The traditional power dynamics largely uphold male dominance in sexual relationships, constraining independent decision-making. In some communities, early marriage and childbearing are still prevalent and culturally endorsed practices (Rice, 2018). Males often dominate sexual relationships, limiting the girls' ability to negotiate safe sexual practices like the use of family planning and contraceptives, including condoms (Kriel et al., 2019; Duby et al., 2023). Furthermore, boys often determine the timing of sex. Cultural norms and societal attitudes towards sexuality also influence adolescent pregnancy rates (Skobi & Makofane, 2017). In some communities, fertility is perceived to affirm womanhood, which may increase the risk of early pregnancy (Marshall et al., 2024).

Socio-cultural norms also influence adolescent girls' access to SRH information, particularly on contraception. Discussing SRH is often considered inappropriate, and girls are discouraged from seeking SRH knowledge as SRH curiosity might be misconstrued for promiscuity. This results in gaps in understanding and perpetuates adverse SRH outcomes. In addition, moral norms may stigmatise premarital sex and contraceptive use. This extends to healthcare facilities where adolescent girls often face judgement and stigma from healthcare workers, which deters them from seeking care (Holtman, Bimerew & Mthimunye,

2024). These socio-cultural factors, coupled with poor socio-economic circumstances, are also associated with high levels of gender-based violence.

School attendance and academic performance can improve pregnancy prevention efforts (Stoner et al., 2019). Girls who stay in school are less likely to engage in risky sexual behaviour and less likely to become pregnant (George, Beckett, Reddy, Govender, Cawood, Khanyile, Kharsany, et al., 2022). However, school dropout rates remain high, particularly among young girls, perpetuating the cycle of early pregnancy and limited economic prospects (Desai et al., 2024).

Strategies for adolescent pregnancy prevention in South Africa

In response to the persistent and complex issue of adolescent pregnancy, South Africa has implemented a multifaceted approach to mitigate this challenge, which includes various policies and strategies. This approach addresses the unique needs and vulnerabilities of adolescents, ensuring their right to sexual and reproductive health, and is shaped by a progressive and comprehensive legislative framework. Various strategies have been proposed and implemented to mitigate adolescent pregnancies in South Africa, and these are discussed below.

Policy measures

Effective policy measures are essential to support and sustain efforts to reduce adolescent pregnancy rates. The South African government has developed several policies and action plans. The policies emphasise a collaborative multi-sectoral approach involving education, health, social development, and other relevant sectors to address the complex nature of adolescent pregnancy (Republic of South Africa, 2023). One such policy is the National Adolescent Sexual and Reproductive Health and Rights Framework Strategy (ASRH&R) 2014-2019. This ASRH&R strategy involves several focused interventions by multiple departments at national, provincial and district levels, and civil society. It is focused on five priority areas covering coordination between stakeholders, CSE, strengthening health service delivery, community-supportive networks and evidence-based revision of legislation, policies, and guidelines (Republic of South Africa, 2015).

Healthcare services

Access to adolescent-friendly healthcare services is crucial in preventing adolescent pregnancies (Ninsiima, Chiumia & Ndejjo, 2021). South Africa has taken steps to improve the availability and accessibility of reproductive health services for young people through a robust legislative framework. Adolescents have specific legal protections enabling them to independently access SRH services without parental consent, emphasizing the importance of autonomy and access to essential services. The legislative framework allows adolescents to consent to various SRH interventions, such as HIV testing, contraceptives, and

termination of pregnancy, based on age, capacity, and public policy requirements. In addition, while the legal age of consent to sex is 16 years in the country, there are legal amendments that decriminalise consensual sexual activities between adolescent peers aged 12-15, provided there is no more than a 2-year age gap between them (Strode & Essack, 2017).

Effective community-supportive networks

Community-based interventions play a pivotal role in addressing the cultural and social determinants of adolescent pregnancy (Mohamed et al., 2023). Programmes that engage parents, community leaders, and peers in conversations about sexual and reproductive health have shown promise. These initiatives often involve workshops, peer education, and community campaigns aimed at changing attitudes towards adolescent pregnancy and promoting healthy behaviours among adolescents (Duby et al., 2021).

By fostering a supportive community environment, these programmes help to create a more conducive atmosphere for adolescents to make informed choices (WHO, 2018).

Educational interventions

Comprehensive SBSHE forms the cornerstone of educational interventions aimed at preventing adolescent pregnancies (Francis, 2010). The South African government, through a partnership between the Department of Basic Education and the Department of Health, has integrated CSE into the school curriculum, targeting students from primary to high

school levels. The challenge of the HIV/AIDS epidemic highlighted the urgent need for effective sexuality education to provide young people with information to navigate their sexual health responsibly. This resulted in the incorporation of CSE into the national life skills school curriculum within the school subject of Life Orientation more than two decades ago (Koch & Wehmeyer, 2021a). The CSE curriculum covers several aspects, including human development, relationships, personal skills, society and culture, sexual behaviour, and health. It is designed to be inclusive of all genders and aims to equip learners with accurate information and promote an understanding of the covered topics through open discussions. These discussions are meant to create an understanding of sexuality and gender and encourage mutual understanding and respect for the opposite gender (Pillay, 2022). The implementation of CSE in South African schools has faced several challenges. These span across individual, interpersonal, school, and community-level factors (George, Beckett, Reddy, Govender, Cawood, Khanyile, Kharsany, et al., 2022). There are gaps and barriers in the education system that hinder the effective implementation of CSE, and these vary by geography and socio-economic factors (Swanepoel & Beyers, 2019). There is a disconnect between the curriculum's intentions and the actual delivery of CSE in practice. This is influenced by several factors, including challenges with teacher training and capacity in the context of different cultural norms and community practices, previous trauma and various psychological problems experienced by learners (Pillay, 2022; Macleod & du Plessis, 2024). Research on cultural norms and practices indicates that there are negative stereotypes that perpetuate gender inequality (Khuzwayo & Taylor, 2018). This can limit the ability of adolescent girls to negotiate safe sexual practices and predispose them to

unprotected sex and sexual violence. There is some evidence that these stereotypes are sometimes reestablished in a classroom setting with boys and girls (Shefer et al., 2015). These factors create a necessity for contextual and culturally relevant approaches to tailor CSE to local settings and values (Koch & Wehmeyer, 2021a).

Cultural tailoring of interventions to address the disparities faced by adolescent girls is critical. There is evidence that social influence can reinforce key SRH messages of school-based CSE programmes and that such interventions could be gender-specific. Same-sex group discussions can enhance the impact of CSE, and peer support in groups of adolescent girls can have a positive impact on SRH outcomes (Davids, Kredo & Mathews, 2020; Mohamed et al., 2023).

1.1.11 Introduction to the intervention

Description of the intervention

The intervention under consideration for this thesis is a girl-centered comprehensive SBSHE intervention. The intervention was implemented in selected no-fee public secondary schools in the Western Cape Province of South Africa. Public schools in South Africa are assigned to fee-paying and no-fee schools according to the socio-economic status of the school and the surrounding community. The intervention was evaluated within the Goals for Girls (G4G) study, a cluster randomised trial run by the Desmond Tutu Health Foundation. The trial aimed to evaluate the feasibility, acceptability, and impact of integrating an in-school classroom-based SRH education programme with an after-school sports-based

programme amongst female adolescent learners. The trial had two arms: the control arm was the national sexual education curriculum offered within the school subject called Life Orientation. In addition to the national offering, the intervention arm offered the SKILLZ Health for Girls programme (SKILLZ) (Grassroot Soccer, 2021). SKILLZ is an after-school programme that uses interactive sports-based (soccer) lessons. Its objectives include increasing knowledge and awareness about HIV/AIDS, enhancing various life skills such as decision-making, encouraging learners to adopt healthy behaviours, empowering adolescent girls by building their confidence and self-efficacy, addressing issues of gender equity, and building and strengthening support networks (Grassroot Soccer, 2021; Pike, Coakley, Ahmed, et al., 2023). SKILLZ was delivered by trained near-peer coaches (age 18-30 years) through a 10-session tailored curriculum, with each session lasting 45 minutes to an hour. These sessions were spread over five months, equivalent to two school terms. The trial compared the effects of the intervention versus the control on biomedical and socio-behavioural outcomes among school-going adolescent girls. The primary biomedical outcomes evaluated in the trial were STI prevalence, specifically *Chlamydia Trachomatis* (CT) and *Neisseria Gonorrhoea* (GC), HIV incidence and pregnancy incidence.

Socio-behavioural outcome measures included self-reported HIV risk, gender norms, and changes in self-concept (Pike, Coakley, Ahmed, et al., 2023).

Study setting and population

The trial was conducted in the Klipfontein/Mitchells Plain health sub-district, a peri-urban area located in Cape Town, Western Cape Province, South Africa. This area has an

estimated population of approximately 1 million, and the population of young people is estimated to be around 200,000 youth aged 15-22 years. The total sample size of 2791 learners was recruited from 38 secondary schools, with a school as the unit of randomisation. Eligibility criteria included being female and a secondary school learner in Grades 8-10, estimated to be between 14 and 17 years old. The study, which started in January 2018, ran for 24 months and was completed in December 2019 (Pike, Coakley, Lee, et al., 2023).

1.2 Problem statement and rationale

There is limited evidence on the economic burden of ASRH and the cost and cost-effectiveness of SBSHE programmes in South Africa (Kaiser et al., 2021). While such programmes require a multi-sectoral approach, with each sector playing a critical enabling and supporting role, in South Africa, comprehensive SBSHE is implemented by the Department of Education within the school setting, using their resources. In addition to operational costs, which cover implementation logistics and school resources, additional resources are required to cover various domains, including teacher training and capacity building, operational logistics, and monitoring and evaluation. These programmes may also represent an opportunity cost to the learners. Even more significant are the cost implications to sectors like the Department of Health as they need to supply contraceptives and other health-related products to support ASRH.

The immediate benefits of these programmes include reduced healthcare costs from fewer STIs, HIV cases, antenatal care cases and births, and long-term outcomes include quality-adjusted life years (Sully et al., 2020). However, such outcomes do not capture the full value of such interventions (Goldfarb & Lieberman, 2021). Other outcomes may include psychological and emotional well-being, social and educational outcomes, and health equity. These factors, in combination, create research gaps regarding the value of comprehensive SBSHE programmes in South Africa in the backdrop of a limited body of literature and application of economic evaluation methods in priority setting for multisectoral resource allocation (Ramponi et al., 2024).

By investigating the value of girl-centered SHSHE intervention in South African schools, we can identify strategies to maximise the long-term benefits of preventing sexual ill health in adolescent girls and young women. Estimating the economic value of sexual and reproductive health education interventions in schools can inform policymakers and educators about ways to enhance such programs and ensure consistent and effective delivery. Through this research, we can gain insights into the potential value of SHSHE programmes and add to the evidence base for stakeholders to address one of the country's persistent public health challenges.

1.3 Research aim

The aim of the thesis is to understand the economic costs of adolescent sexual and reproductive health (SRH) services and to evaluate the potential value of a school-based

sexual and reproductive health education intervention(s) targeted at adolescent girls in South Africa.

1.4 Objectives

The objectives of the thesis are as follows:

- Objective 1: To describe methods for the economic evaluation of community-based health promotion interventions through a critical review of the literature.
- Objective 2: To estimate the costs of providing a girl-centered comprehensive sexual and reproductive health education intervention in a school setting from a Department of Education provider perspective.
- Objective 3: To estimate the costs of vaginal and c-section deliveries at two levels of care from a Department of Health provider perspective.
- Objective 4: To describe the economic costs of adolescent girl sexual and reproductive health services from a Department of Health provider perspective.
- Objective 5: To assess the value of an adolescent girl-centered comprehensive sexual and reproductive health education intervention via a modelled cost-consequence analysis and a multi-sector perspective.
- Objective 6: To propose policy recommendations regarding investments in girl-centered sexual health education interventions.

1.5 Thesis outline

The thesis consists of three sections.

Section One introduces the thesis, offers a contextual background, and the focus of the research. In addition, this section provides a theoretical background and general principles of economic evaluation. Based on a review of the literature, this section also describes a methodological approach to economic evaluation in community-based health promotion.

Section Two presents the empirical work conducted to assess the cost of implementing a community (school) based comprehensive SBSHE intervention. In addition, unit costs of labour and delivery are estimated to support budgeting, planning, and forecasting and as input to the economic evaluation of comprehensive SBSHE. The section concludes by presenting a multi-sectoral cost-consequence analysis. The analysis illustrates the impact of a comprehensive SBSHE intervention on SRH service costs as well as on a range of intermediate and final outcomes.

Section Three is the concluding part of the thesis. It presents the overall discussion, strengths, and weaknesses of the thesis. This section also presents policy implications of the research, suggestions for future research, and a conclusion.

The outline of the thesis is presented below.

Section One

Chapter One (the current chapter) is an introductory chapter that provides the background and rationale for this thesis. It provides a description of adolescent SRH globally, in low and middle-income countries, particularly SSA, and South Africa. In addition, the chapter presents comprehensive SBSHE as one of the critical strategies for promoting ASRH. The available literature on the effectiveness and cost-effectiveness of SBSHE interventions is then presented. The chapter then moves into reviewing the literature on adolescent pregnancy in South Africa, including contributing factors and strategies for its prevention. Linked to this, the intervention under review in the thesis is then introduced. The next section of the chapter summarises research gaps and presents the research aim and objectives. The section concludes with an outline of the remainder of the thesis.

Chapter Two presents the key concepts that underpin standard methods for economic evaluation of healthcare interventions. It also presents the fundamental principles and types of economic evaluation and discusses the challenges of applying standard economic evaluation methods to SBSHE interventions.

Chapter Three presents a critical review of the available literature to assess the application of economic evaluation methods to community-based health promotion interventions.

Section Two

Chapter Four presents the costs of implementing the SKILLZ intervention, a comprehensive SBSHE intervention implemented within the G4G trial. As examples of cost analyses of multisectoral interventions are limited, this chapter presents an example of a cost analysis of a multisectoral, comprehensive SBSHE intervention.

Chapter Five presents the estimated costs of vaginal and c-section deliveries at two levels of care (i.e., a midwife-led facility for low-risk births and a referral hospital) from a Department of Health (provider) perspective.

Chapter Six presents a cost consequence analysis within a Markov modelling framework over a five-year time horizon (the duration of secondary school). Using baseline data from girls enrolled in the trial, it estimates the costs of providing needed SRH services from the Department of Health perspective (STI and HIV treatment, contraceptives, termination of pregnancy, antenatal and obstetric services), the costs of a comprehensive SBSHE intervention (department of education perspective) and transport costs for the learners (limited learner perspective). A range of intermediate (% pregnant, % giving birth, % time spent in school), and final outcomes (life years, quality-adjusted life years) are presented. Extreme scenario analysis is used to illustrate how costs shift across sectors and how outcomes change if an intervention is effective in improving SRH outcomes.

Section Three

Chapter Seven presents the discussion and closing remarks of the thesis, including the limitations and strengths of the research. In addition, we consider the policy implications of the results from all the chapters. The findings are considered for decision-making in the South African context. The conclusion and recommendations for further research are then made.

1.6 Ethical considerations

The University of Cape Town's Faculty of Health Sciences Human Research Ethics Committee granted ethical approval for the Goals for Girls trial (HREC REF: 138/2018). In addition, further HREC approval was granted for the research contained in this PhD thesis (HREC REF Number 045/2020). Where necessary, additional institutional approvals were obtained and are described in the relevant results chapters.

CHAPTER 2

2 Chapter 2: Fundamental concepts and methods for economic evaluation

This chapter presents a brief overview of the standard economic evaluation methods for evaluating healthcare interventions. In addition, the chapter describes the significance of economic evidence for ASRH and considers the challenges that arise when undertaking health economic analysis to assess school-based health education (SBSHE) interventions, highlighting the implications for researchers and decision-makers. The different types of economic evaluation studies are defined, and the steps for conducting these evaluations, including the study perspective and timeframe, identifying, measuring, and valuing resource use and benefits, combining these costs and consequences, and interpreting the results, are described. This chapter provides the relevant background for Chapter 3, the critical literature review of economic evaluation studies of individual-level community-based health promotion interventions

2.1 The significance of economic evidence in decision-making for adolescent SRH

Given the disproportionate disease burden of poor ASRH in LMICs and associated health and socioeconomic consequences, effective and cost-effective interventions targeted at promoting ASRH are necessary. Generating economic evidence for these interventions is fundamental for supporting priority setting in these resource-constrained settings. While the effectiveness of ASRH promotion interventions is widely documented, the paucity of studies assessing the cost, cost-effectiveness, affordability, and sustainability of these interventions is concerning (Fatusi, 2016). This is a significant

gap in the literature for robust decision-making and stakeholder engagements regarding the value of these interventions. Considering the significant investments made through the resources involved in implementing ASRH promotion interventions, there is a need to focus on assessing the value of these interventions to maximise the objective gains in SRH, given available resources (Otieku et al., 2024).

2.2 Exploring the challenges of applying standard economic evaluation methods to SBSHE

Economic evaluation is a particular area of health economics that is concerned with providing evidence on allocating scarce resources to gain the best value for money. It is defined as the comparative analysis of alternative courses of action in terms of both their costs and benefits (Drummond et al., 2015). Efficiency results when benefits are maximised and opportunity costs are minimised. Opportunity cost is a fundamental concept in economic evaluation. It is described as the value of benefits foregone by choosing to use resources for a particular intervention over the next best alternative intervention (Palmer & Raftery, 1999). Economists, therefore, consider the costs of healthcare interventions or programmes as not just the money expenditure but also the potential benefits sacrificed by allocating scarce resources to one programme versus another. Economic evaluation provides evidence of interventions' feasibility, scalability, and sustainability (WHO, 2022).

School-based sexual and reproductive health education is a health promotion intervention, and conducting an economic evaluation of these interventions involves several unique challenges. These challenges can affect the accuracy and reliability of the

evaluation, making it difficult to draw definitive conclusions about the cost-effectiveness of such programs. Health promotion is a complex and multidisciplinary area encompassing a wide range of activities to improve the health and well-being of individuals and communities. It is defined as “the process of empowering people to increase control over their health and its determinants through health literacy efforts and intersectoral action to increase healthy behaviours.” (WHO EMRO, 2018). Evidence suggests that effective comprehensive SBSHE interventions require multisectoral programming, several interacting components, and some flexibility in implementation. (Plesons et al., 2019; Ivanova et al., 2020).

2.3 Types of economic evaluation

All forms of economic evaluation concern choices between alternative courses of action. To be called complete, an economic evaluation must be comparative and consider both costs and consequences. All types of economic evaluation measure costs; what differs between the different types of economic evaluation is the approach to measuring and valuing the effects of the healthcare interventions being considered (Drummond et al., 2015). Such consequences may be estimated from a study, a meta-analysis, mathematical modelling, or a combination. Three main types of economic evaluation compare both costs and consequences and include Cost-benefit analysis, cost-effectiveness analysis, and cost-utility analysis. Another economic evaluation approach presents the costs and consequences in a disaggregated manner, i.e., cost-consequence analysis.

Cost-benefit analysis (CBA)

Cost-benefit analysis is said to be the gold standard of economic evaluation because all costs and benefits are converted to a common metric, which is monetary (Drummond & Stoddart, 1985). This is important for decision-making regarding programmes with different outcomes. Conducting CBAs is, however, not without difficulty, as valuing health outcomes in monetary terms is controversial and methodologically challenging.

Cost-effectiveness analysis (CEA)

Cost-effectiveness analysis is the most straightforward and commonly used form of economic evaluation. This type of analysis is suitable for comparing interventions that address the same health problem (Stone et al., 2005)Effectiveness in CEA can be measured using either intermediate or final outcomes. The latter is preferable, but in many instances, measuring final outcomes is complex, and this quantification may be costly. The benefits are presented as natural units of effects, i.e., the number of cases averted, or life-years saved. The focus on the single-dimension outcome is seen as a weakness of this type of economic evaluation.

Cost-utility analysis (CUA)

Some literature doesn't distinguish between CEA and CUA, viewing cost-utility analysis as a form of cost-effectiveness analysis. Still, unlike CEA, benefits are expressed as a generic measure. The most widely used generic measure is a quality-adjusted life year (QALY), although disability-adjusted life years (DALYs) are also used (Riewpaiboon, 2016). The summary measure in CUA is then presented as a cost per QALY gained or

DALY averted. This makes CUA a preferred type of economic evaluation because it allows comparisons across different diseases and populations. In addition, its benefit is that the comparison in value for money can be made across different fields of care (Drummond et al., 2015).

Cost-consequence analysis (CCA)

Cost-consequence analysis is similar to cost-effectiveness analysis in terms of the questions addressed. The difference between the two is that CCA is used to evaluate interventions with multiple outcomes. However, in this type of economic evaluation, the costs and benefits are not combined into a single measure but are presented independently (Gray et al., 2010). This is the simplest way of reporting costs and consequences and is believed to be the most comprehensive presentation of the information describing the value of the healthcare intervention. However, it is considered limited for decision-making because it is impossible to directly compare interventions with different types of outcomes (Mauskopf et al., 1998).

2.4 Measuring costs

In economic evaluation, costs are defined as the monetary value of resources used to produce an intervention or medical service based on the concept of opportunity cost (Mogyorosy & Smith, 2005). Cost analysis is the process that estimates these costs and involves the systematic collection and assessment of the costs associated with the particular service or intervention being evaluated. Cost estimation in economic evaluation is a four-step process, including the identification, measurement and valuing

of costs and the calculation of the total costs of the intervention (Gray et al., 2010). Total cost corresponds to the amount of cost that arises as a result of the intervention being produced. Incremental cost represents the change in total cost associated with moving from one intervention to another more costly intervention.

The quality of an economic evaluation depends in part on the quality of the measurement of costs; therefore, comprehensive identification of the resource items relevant to the alternatives being compared in the analysis is recommended. Accurate costing can thus contribute to the efficient use of resources (Mogyorosy & Smith, 2005). Intervention costs, follow-up costs, and cost-offsets, which come about when the intervention results in a cost reduction for other healthcare services, are of great consequence in economic evaluation.

The decision about which costs are included in the evaluation is determined by the viewpoint of the costing (Gray et al., 2010). The main costing perspectives described in the literature are that of the provider/payer, patient, and society. Analysis from the provider's perspective only includes costs incurred by the provider of the services, usually a Ministry of Health. The societal perspective is the broadest and considers all costs regardless of who incurs them.

The choice of perspective has implications for economic evaluation of SBSHE interventions. A narrower perspective only considers maximising outcomes within one sector (Claxton, Sculpher & Culyer, 2007). As SBSHE interventions include multiple sectors, the perspective chosen must reflect the opportunity cost and benefits to all

sectors concerned. Using a broader perspective, however, implies including all relevant elements, which may be challenging to implement due to its comprehensiveness. Accommodating all the stakeholders will significantly increase the economic data required for the analysis and may influence which data collection methods can be used (Sittimart et al., 2024). Current evidence shows that even when SBSHE studies are done from a societal perspective, they tend to have a limited scope (Schnitzler et al., 2022).

The approach to estimating costs in economic evaluation is broadly classified into two: top-down and bottom-up (Olsson, 2011). In the top-down approach, also known as gross costing, resources are viewed as bundles and a total budget is allocated to specific services such as hospital days. The bottom-up approach (micro-costing) is a more particular approach to cost measurement and is considered the most accurate and the "gold standard" (Clement et al., 2009). It involves collecting data on the frequency of resource use. In addition, there is a general framework for the classification of costs. The most common categorisation of costs includes direct, indirect, and intangible costs. Direct costs represent the quantity of the resources explicitly used for the intervention/service, and there is a distinction between medical and non-medical direct costs. Direct costs can be either fixed costs (FC) or variable costs (VC). Fixed costs do not vary over the short term (one year) and are not linked to consumption (Drummond et al., 2015). Capital costs are fixed costs and are defined as the costs expended to secure the capital assets of a programme or service. These would include the costs for buildings, furniture, and equipment. Variable costs vary with the amount of production of an intervention or service and take account of, amongst others, personnel, materials, and operating costs. Indirect costs, also referred to as productivity costs, are incurred

due to time lost due to illness (Riewpaiboon, 2014). Intangible costs are linked to loss and suffering and are challenging to quantify.

A distinction is also made between financial costs and economic costs. Financial costs only consider the actual cost of care, while economic costs include the value of resources for which there is no direct monetary expenditure, for example, the inputs of volunteer staff. The time frame for which costs are observed is also essential in economic evaluation studies (Riewpaiboon, 2016). A decision problem determines the timeframe of analysis, and this choice can significantly affect the cost-effectiveness of an intervention. The concern is choosing an appropriate period to fully appreciate the variations in costs and consequences of healthcare interventions (Kim et al., 2017).

Furthermore, for economic evaluation studies to be influential in decision-making regarding resource allocation, accurate measurement and valuation of all costs of an intervention are fundamental. Some health interventions have costs and benefits that extend to other sectors. These are known as intersectoral costs and benefits (ICBs) (Mayer et al., 2017). These ICBs can contribute considerably to interventions' total monetary costs and benefits. The inclusion or exclusion of ICBs within economic evaluation can have severe consequences for the outcome of such studies. Including these costs and benefits is essential; therefore, it is vital to develop methods for their valuation (Drost et al., 2017).

The responsibility and the impact of comprehensive SBSHE are wide-ranging, including education, health, and social sectors. Consequently, related costs fall on the different

sectors and contribute to the total costs of these interventions with significant consequences to the conclusions of economic evaluation (Drost et al., 2017). While previous research has highlighted the importance of including ICBs within economic evaluation studies and the importance of developing methods to measure and value these effects, an intersectoral approach is required to identify the broad costs (Weatherly et al., 2009). There are, however, challenges in working across sectors; these include, among others, a lack of a common language, a lack of understanding of processes, and differing priorities (Brooke-Sumner, Lund & Petersen, 2016). Another challenge might be the distribution of costs, where costs are concentrated in one sector, but the benefits are diffuse (Ramponi et al., 2024). Sometimes, there is a time lag between incurring the costs of the intervention and realising the benefits. In addition, identifying and collecting data on resource use for evaluating SBSHE interventions can present a significant challenge, as attributing costs specifically to the SRH intervention can be difficult if the program is integrated into broader educational activities. Shared costs need to be carefully allocated to avoid misrepresentation. Moreover, measuring costs such as administrative costs for a specific SBSHE intervention are often harder to quantify. This equally applies to estimating economic costs. Some SBSHE interventions rely on volunteer time. Estimating these costs accurately requires careful consideration and robust methodologies. While there are multiple ways to evaluate volunteer time in the literature (Turner et al., 2019), estimating the opportunity cost of their time can be challenging. These challenges include considerations regarding the main activity the volunteers are giving up (Michaels-Igbokwe et al., 2016).

2.5 Measuring benefits

The goal of welfare economics, which is the foundation of economic evaluation, is to maximise societal well-being, given the prevailing resource constraints. While it might be straightforward to measure and cost resource use, health consequences are not as specific, and their assessment is less obvious (Brazier et al., 2016). Intervention effects are usually not guaranteed. Instead, there is typically a range of possible outcomes. Furthermore, health effects are multi-dimensional, and they vary over time. Healthcare studies use many measures of health outcomes to establish the effects of an intervention. Consequently, there are different outcome measures for different types of interventions, making it challenging to make decisions on the best use of available resources (Whitehead & Ali, 2010). Therefore, how benefits are measured and valued is crucial for economic evaluation in healthcare and, ultimately, for decision-making on allocating limited resources.

Three main types of outcomes are used in economic evaluation: clinical outcomes, utility outcomes and monetary outcomes (Silva, Silva & Pereira, 2016).

- *Clinical outcomes* are regarded as natural units. They are the signs and symptoms of clinical conditions or the response to clinical management.

- *Summary measures of health* are multi-dimensional measures of health benefits which aggregate the quality and the quantity of life (Brazier et al., 2016). Quality-adjusted life years and DALYs are examples of these health outcomes that are used in economic evaluation studies (Whitehead & Ali, 2010). These measures summarise

the impact of a treatment or intervention on two themes of a patient's life: the length of life and the health-related quality of life.

- *Monetary outcomes* refer to the quantification of costs and benefits associated with health interventions in monetary units. This approach is used in cost-benefit analysis and allows for a straightforward comparison between interventions in diverse areas. The human capital and willingness to pay approaches are the most used for converting clinical consequences into monetary units. The human capital approach considers the value of lost productivity due to illness, disability, or premature death that could have been avoided by implementing a particular intervention. Willingness to pay is the recommended method, and it reflects the maximum amount individuals are willing to spend to gain a specific health benefit or avoid a health detriment (Silva, Silva & Pereira, 2016).

Measuring the benefits of SBSHE may present challenges, including attributing benefits to specific interventions, assessing long-term impacts, quantifying intangible benefits, and addressing equity considerations. It can be difficult to attribute observed changes in sexual health outcomes directly to the intervention under evaluation, especially when non-experimental study designs are implemented or when multiple programs or external factors influence the behaviours of learners. Under non-experimental evaluation conditions, isolating the effects of SBSHE interventions from other influences, such as parental guidance, peer influences, or broader social changes, may be challenging.

The benefits of SRH education interventions may be delayed. While intermediate outcomes might be evident in the short term, final biological outcomes, including a reduction in unintended pregnancies, often accrue over a more extended period. This delay makes it challenging to capture the full impact of interventions within the typical evaluation period. This is a contentious issue because of the varied time frames at which these interventions can be judged successful or failed. Another consideration when assessing long-term benefits is the necessity for discounting to account for the time value of money, which can complicate the valuation process.

The effectiveness and, consequently, cost-effectiveness of SBSHE interventions require behaviour change. Behaviour, in this instance, is an intermediary process but one critical to achieving the desired final outcome. However, standard methods of economic evaluation tend to ignore intermediary outcomes. In addition, SBSHE interventions can have intersectoral outcomes, including health, education, and socioeconomic benefits (Santhya & Jejeebhoy, 2015). Interventions that target behavioural factors associated with sexual health decision-making can improve agency and self-esteem, which are intangible benefits. These benefits can be difficult to measure. Capturing the breadth of these outcomes may be challenging.

Furthermore, evaluating the equity impact of SBSHE is critical. For example, assessing whether interventions equitably benefit all relevant subgroups can be challenging due to variations in socioeconomic status, cultural background, and access to resources. In evaluating SBSHE interventions, it is essential to understand these variations which create barriers to behavioural change since they are typically related to inequalities, a

necessary objective for public health interventions to address. Therefore, the QALY approach might not be ideal when evaluating SBSHE interventions as it can present an incomplete picture, as maximisation of health status and health-related function is not the only objective of these interventions (Owen et al., 2011). However, including the equity impact may require presenting this impact across the different subgroups, which requires detailed and disaggregated data, as in distributional cost-effectiveness analysis.

Distributional cost-effectiveness analysis is a framework that can be used to assess the equity impact of interventions (Asaria, Griffin & Cookson, 2016; Cookson et al., 2021). Thus, while ensuring equity in outcomes is crucial, it adds complexity to the analysis (Meunier et al., 2023). All this can have real consequences for decision-making, as using inappropriate or deficient measurements to assess SBSHE interventions can provide misleading findings (Payne, Mcallister & Davies, 2013).

2.6 Decision rules in economic evaluation

In cost-benefit analysis, the policy question is whether one specific health intervention or programme is worthwhile. There are two most commonly used summary measures for CBA:

- *Net benefits*, which is the present value of benefits minus the costs. If the net benefit is positive, meaning that the monetary benefits exceed the costs, then the particular intervention is considered worthwhile (Morris et al., 2012).

- *The benefit-cost ratio* is the present value of benefits divided by the present value of costs (Stone et al., 2005).

Within the cost-effectiveness analysis framework, which includes both CEA and CUA, the decision on the preferred alternative is based on assessing the costs in relation to the unit of effect. The main result is the incremental cost-effectiveness ratio (ICER), calculated as the incremental change in costs divided by the incremental difference in health outcome, where the numerator is a measure of cost, and the denominator is a measure of effectiveness and must be comparable between two interventions under evaluation. This ratio provides an innate metric that decision-makers can use to judge the cost-effectiveness of a new intervention compared to other interventions. To assess if the additional benefits are worth the additional cost, cost-effectiveness can be determined by a decision rule. The cost-effectiveness threshold (CET) is defined as the "maximum cost per health outcome that a health system is willing to pay" (McDougall et al., 2020) and represents the opportunity cost of investing healthcare resources in a particular program (Grosse, 2008). There are three main approaches to estimating CET (Edoka & Stacey, 2020; Sun et al., 2023):

- The willingness-to-pay (WTP), which is representative of welfare economics
- The historical precedent method, based on the value of an already funded technology or expert consensus
- The opportunity cost method, which represents the opportunity cost of health spending which displaces other interventions

To determine cost-effectiveness, an intervention's ICER, which is typically a cost per QALY gained or cost per DALY averted, is compared to the CET. Incremental cost-

effectiveness ratios that fall below the CET are considered cost-effective, with those that fall above the threshold considered not cost-effective (Gafni & Birch, 2006).

Due to the characteristic flexibility in the application of comprehensive SBSHE interventions, interventions can change during implementation. This can complicate the interpretation of economic evaluation results. These interventions characteristically address multiple health and social issues simultaneously, which can be challenging in evaluation compared to more narrowly focused healthcare interventions. Consequently, the range of outcomes attributed to these interventions has implications for the reporting format and interpretation of economic evaluation results.

In CBA of SBSHE interventions, converting health and social benefits into monetary terms can be complex. Benefits such as improved mental health, enhanced relationships, and better educational outcomes are not easily quantified in economic terms and can be subject to variability.

In CEA and CUA, interpreting decision rules in the economic evaluation of SBSHE interventions involves comparing the results of economic evaluation to appropriate thresholds. Appropriate thresholds can be challenging to determine and can vary by context and societal values. Even when these thresholds have been established, the diverse outcomes of SBSHE interventions may not be easily comparable to a single threshold. This necessitates a nuanced approach to interpreting the results.

In analyses which assess the distributional impact of SBSHE interventions, the interpretation of these results may be complex. In addition, there might not be other similar studies to compare to, as frameworks used to assess the equity impact in economic evaluation studies are relatively new (Cookson et al., 2017, 2021; Steijger et al., 2023).

Chapter 3

3 Chapter 3: Economic evaluation of individual-level community-based health promotion interventions: a critical review of the literature

Abstract

Background: Community-based health promotion, with its potential long-term impact on health and social and economic outcomes, is a significant area of interest. Despite a body of literature suggesting the effectiveness of such interventions, the economic evaluation literature is limited, with remaining questions as to whether traditional methods are able to appropriately capture value. This study aims to critically review these methods and to make recommendations for future applications to strengthen priority setting.

Methods: The study undertook a systematic search and critical review of full economic evaluation studies of community-based health promotion (CBHP) interventions. A bespoke data collection tool was created to capture data regarding the methodological characteristics of included studies.

Results: Twenty-two studies were included, of which 21 were undertaken in high-income countries. There was significant heterogeneity in the included studies, which focused on a range of different CBHP interventions. While a variety of economic evaluation approaches were employed, cost-utility analysis was the most common (n=15). Using a traditional checklist, the methodological quality of the included studies was assessed to be good overall. However, applied methods did not adequately address the methodological issues of conducting economic evaluation in CBHP.

Conclusion: This study suggests the need for methodological and conceptual development if economic evaluation is to be applied to CBHP interventions. In addition to the documented issues of attributing intervention effects in the case of complex interventions, clarity is needed regarding how or whether to represent intersectoral costs and outcomes and how value for money should be assessed.

3.1 Background

Health promotion interventions are firmly on the global agenda owing to their potential to avert a range of preventable conditions as well as their broader economic and social benefits. Within this terrain, setting- or community-based approaches foreground the social context within which people engage in daily activities and wherein multiple factors interact to shape health and well-being (Whitelaw et al., 2001; Torp, Kokko & Ringsberg, 2014; World Health Organization, 2019). School-based sexual and reproductive health promotion interventions are a key example of such approaches. Schools provide access to a diverse population of adolescents (Laurenzi et al., 2024), allowing these interventions to reach learners from various backgrounds (Lima-Serrano & Lima-Rodríguez, 2014; Niland, Flinn & Nearchou, 2024), with the potential to improve health, education, employment, and social equity outcomes (Sully et al., 2020).

While CBHP interventions are recognised as potentially effective, such interventions are complex. An established literature illustrates the multiple challenges with attributing intervention outcomes in complex interventions (Wildman & Wildman, 2019; Skivington et al., 2021; Bates, 2022). In addition to this, traditional economic evaluation methods

may require modification if they are to be applied to these interventions, with the literature suggesting the importance of considering intersectoral costs and outcomes and a lack of clear guidance regarding the interpretation of economic evaluation results in terms of value for money (Weatherly et al., 2009; Bojke et al., 2018; Huter et al., 2018; Seleznova et al., 2021).

This study aims to describe and critically evaluate the methods applied in the economic evaluation of CBHP interventions and to make recommendations for conceptual and methodological improvements. Our study defines CBHP interventions as those that aim to change health behaviour through individual-level strategies delivered within community settings (e.g., schools and workplaces).

Overview of economic evaluation

Before assessing appropriate methods for the economic evaluation of CBHP interventions, it is necessary to first describe 'standard' economic evaluation, typically defined as the comparative analysis of the costs and outcomes of alternative courses of action (i.e. the intervention(s)) towards the achievement of a common objective (Drummond et al., 2015). While all economic evaluations consider costs, defined as the value of resources used to produce a particular level of output (Mogyorosy & Smith, 2005), four main types of economic evaluation are identified in the literature according to the type of outcome that is measured, which then relates back to the extent to which value for money can be assessed, as shown in Table 1.

Table 1. Key features of economic evaluation

Category of economic evaluation	**Type of costs**	**Type of outcome(s)**	**Summary measure**	**Assessment of value for money**
Cost-effectiveness analysis	Provider: health care costs Patient	Uni-dimensional health outcomes specified in natural units e.g. cases cured, life years gained	Incremental health care cost per unit of health gain	Limited. Can compare summary measure against evaluations using same outcome measure
Cost-utility analysis	Health care costs	Multi-dimensional health outcomes e.g. QALYs, DALYs	Incremental health care cost per QALY gained or DALY averted	Intermediate. Can compare summary measure against evaluations using same outcome measure as well as to a setting specific cost-effectiveness threshold to determine value for money.
Cost-benefit analysis	Health care and non-health care costs	Monetised health and non-health outcomes	Net benefits (present value of monetised outcomes minus health care and non-health care costs)	Broad. If net benefits exceed zero, value for money is obtained.
Cost-consequence analysis	Health care and non-health care costs	Multiple health and non-health outcomes e.g. life years gained AND educational attainment	None. Health care and non-health care costs and outcomes are presented separately	Not defined.

(Sources: Drummond et al. 2015; Rabarison et al.2015)

The scope of costs within economic evaluation is defined to be broad enough to capture any changes that result from intervention implementation (Mendoza-Jiménez, van Exel & Brouwer, 2024). This includes the costs of the intervention as well as any cost offsets (i.e. changes in costs) that the intervention generates where, for example, interventions to

improve diabetic control within primary care could avert the costs of managing complications in hospitals. If the intervention also results in changes in costs from the perspective of users and their households (e.g. changes in the frequency of primary care visits - generating opportunity costs of time, user fees, lost income; or changes in health status - generating broader economic productivity changes), then these should be included, and costing is undertaken from a 'societal perspective'. More specifically, the literature delineates between a provider/payer/health system perspective versus a patient/user/household perspective, with the societal encompassing all perspectives.

As mentioned, the different types of evaluation measure different outcomes and have different associated summary measures, which in turn determines the extent to which value for money can be assessed. Many argue that coherence is needed between the numerator and denominator of these summary measures –if the outcome is a measure of health, then only healthcare costs can be included in the numerator and value for money should be established by comparing the summary measure to similar measures in the literature or to a similarly constituted supply-side cost-effectiveness threshold. An implication is that even if the appropriate scope of costs for a CUA requires a societal perspective when comparing the incremental cost-effectiveness ratio (ICER) to a supply-side cost-effectiveness threshold, patient costs are removed from the ICER and are presented separately. In contrast, in CCA, a very broad range of costs and outcomes can be accommodated, but no summary measures are calculated, and more limited discussions of value for money are possible.

3.2 Methods

We used a systematic method to conduct a critical literature review to describe the existing methods for conducting economic evaluation of CBHP interventions (Centre for Reviews and Dissemination University of York, 2009; Grant & Booth, 2009; Gomersall et al., 2015).

3.2.1 Literature sources and search strategy

Between February 2020 and June 2021 and again in July 2023, we searched for relevant literature in seven databases, including PubMed and Scopus; through EBSCO Host, we searched Cumulative Index of Nursing and Allied Health Literature, Africa-Wide Information, APA Psych Info, Health Source: Nursing Academic Edition, EconLit. The initial search strategy, keywords and medical subject heading (MeSH) terms were developed, piloted, and revised for PubMed (Appendix A), and adapted for the other databases to account for different search terms.

We included literature published between 01/01/2002 and 05/07/2023. We chose 2002 as our start year as this was when the discussion on the challenges of applying economic evaluation methods to public health interventions started gaining prominence (Wanless, 2002).

3.2.2 Inclusion criteria

Table *2* presents our inclusion criteria using the population, intervention, comparator, outcome, and study design (PICOS) framework. Participants were defined as any identified or at-risk non-clinical population. Interventions were limited to health

promotion interventions delivered in a community setting (e.g. school, workplace, church, etc.), using individual-level strategies. We, therefore, excluded health promotion interventions delivered in healthcare settings or via smartphones, social media, etc or ones that focused on community mobilisation or policy-level strategies. The comparator was not limited and could be any intervention, whether community-based or not. Outcomes were not restricted. We included any type of full economic evaluation. While we included studies from any country setting, studies were excluded if they were not in the English language.

Table 2. PICOS criteria

Participants/population	Any identified or at-risk non-clinical population
Intervention(s)	Individually focused community-based health promotion interventions
Comparator(s)	Any comparator
Outcome(s)	Any outcome measure
Study design/type	Any full economic evaluation

3.2.3 Data extraction

Based on existing templates (CRD, 2009 & JBI, 2015) and methodological guidance (Drummond et al., 2015) our included economic evaluations. The tool was piloted on three studies and adapted accordingly.

3.3 Results

3.3.1 Study selection

The results of the database searches were exported to EndNote X9 reference management software. A combined total of 7245 relevant records across all databases were identified. After removing duplicates, protocol papers, reviews and overviews, the remaining 6398 titles and abstracts were screened using the inclusion and exclusion criteria in Rayyan, a web-based tool for screening and study selection. Of the remaining titles and abstracts, 39 full texts were reviewed, of which 19 were excluded. An additional two articles were found from hand-searching to make a total of 22 included studies (Beard et al., 2006; Vijgen et al., 2008; Johansson et al., 2009; Rosenthal et al., 2009; McAuley et al., 2010; Barton et al., 2012; Hollingworth et al., 2012; Moodie et al., 2013; Sutherland et al., 2016; Akanni, Smith & Ory, 2017; Neumann et al., 2017; Robertson et al., 2017; Anderson et al., 2018; Anokye et al., 2018; Fitzgerald et al., 2018; Gilmer et al., 2018; Panca et al., 2018; Canaway et al., 2019; Smith et al., 2019; Wang et al., 2019; Sathish et al., 2020; van den Brand et al., 2020). An adapted PRISMA flow diagram that represents the flow of information through the different phases of identification, screening, eligibility, and inclusion is presented in Figure 2.

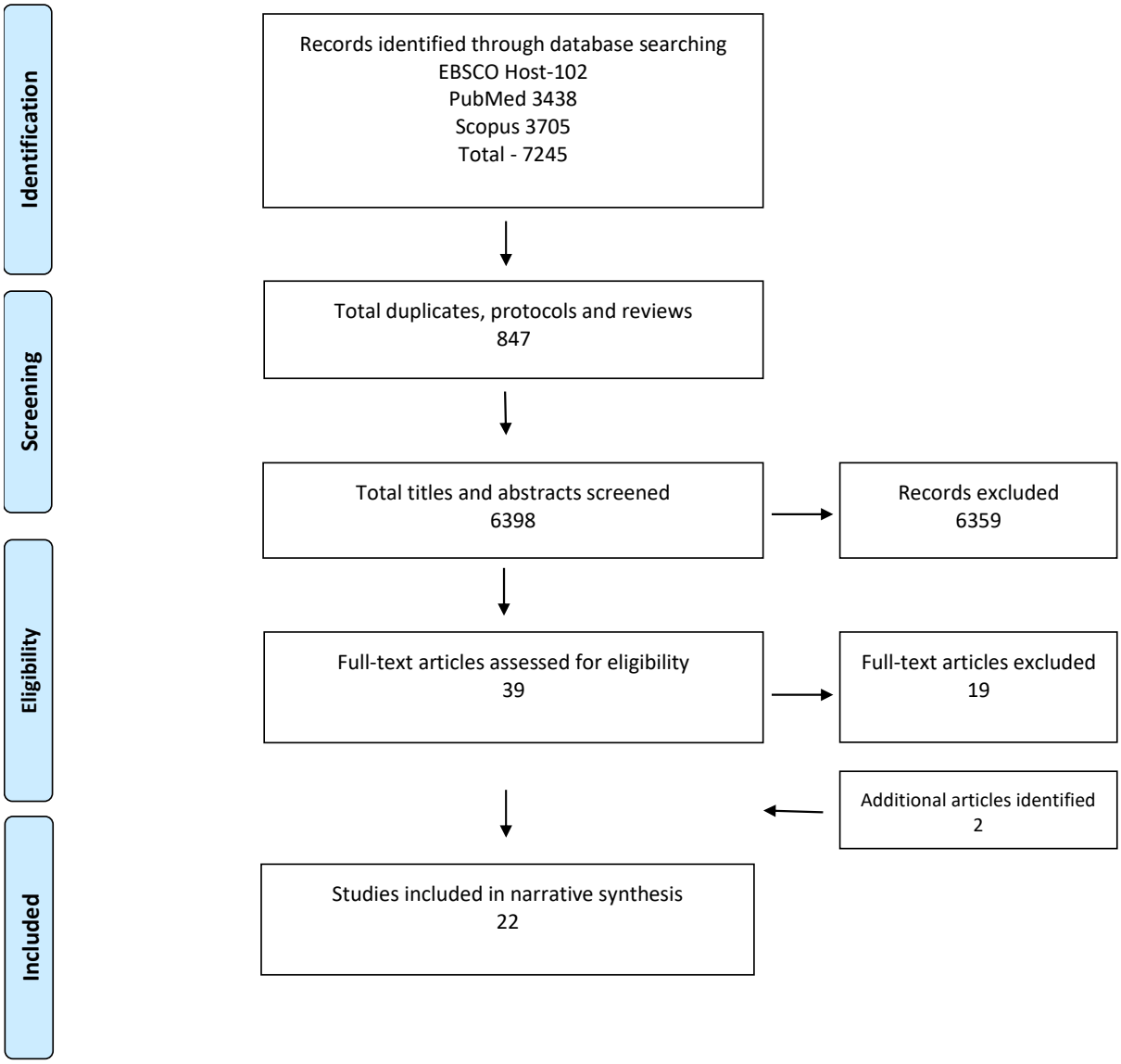


Figure 2. PRISMA flow diagram outlining the paper selection process

3.3.2 Key aspects of included studies

Table 3 provides an overview of the included studies. Although our search started in 2002, no articles were found that were published before 2006. We also found no studies published between 2021 and 2023. Most studies (12; 55%) were published between 2016 and 2019. The most common country setting was the United Kingdom (6; 27%), followed by the United States (5; 23%), and the only LMIC study was based in India. Most studies focused on adults (12; 55%) compared to children and adolescents. Included studies focused on various health promotion topics such as obesity prevention, physical activity promotion, smoking cessation, and sexual and reproductive health.

Not all the studies explicitly reported the type of economic evaluation performed. We categorised these ourselves based on an assessment of the reported methods and results. The most common approach was cost-utility analysis (CUA) (15, 68%). Four studies conducted a cost-effectiveness analysis (4, 18%), and two studies conducted a cost-benefit analysis (CBA). One study explicitly reported conducting two analyses: a CUA and a CBA. Half of the studies (11, 50%) were done from the societal and the other from the provider perspective.

Table 3. Key aspects of included studies

Key aspects of included studies	No. (%) n=22
Year of publication	
2006-2009	5 (23)
2010-2014	3 (14)
2016-2019	12 (55)
2020 & 2021	2 (9)

Country of origin	
United States	6 (27)
United Kingdom	5 (23)
Australia	3 (14)
New Zealand	2 (9)
Netherlands	2 (9)
Sweden	2 (9)
India	1 (4.5)
Ireland	1 (4.5)
Setting	
Community	14 (64)
School	4 (18)
Community/school	2 (9)
Workplace	2 (9)
Target age group	
Adults	12 (55)
Children/adolescents	10 (45)
Health promotion topic	
Obesity prevention/reduction	7 (32)
Physical activity promotion	3 (14)
Cardiovascular disease prevention	3 (14)
Smoking prevention/cessation	3 (14)
Diabetes prevention	4 (18)
Sexual and reproductive health promotion	1 (4)
Falls prevention	1 (4)
Type of economic evaluation	
CEA	4 (18)
CUA (including studies that reported both CEA and CUA)	15 (68)
CBA	2 (9)
CUA + CBA	1 (5)
Study Perspective	
Decision maker/ healthcare payer/ provider	11 (50)
Societal	11 (50)

Notes: CBA = Cost-benefit analysis, CEA = Cost-effectiveness analysis, CUA = Cost-utility analysis

The reporting quality of the included studies was assessed using the Consolidated Health Economics Evaluation Reporting Standards (CHEERS) checklist (Husereau et al., 2022). Data related to the 28-item checklist were extracted on Excel, indicating with a "yes" when the criteria were met "no" when they were not satisfied, and "not applicable" when they were considered irrelevant for a particular study. The results of the quality assessment are presented in Appendix 1. The items that were less frequently reported included the "health economic analysis plan" and "characterising heterogenicity and distributional effects". Figure 3 illustrates the overall quality of reporting by CHEERS item. All included studies reported on at least 74% of the items, and the majority (19 studies) reported on more than 80%.

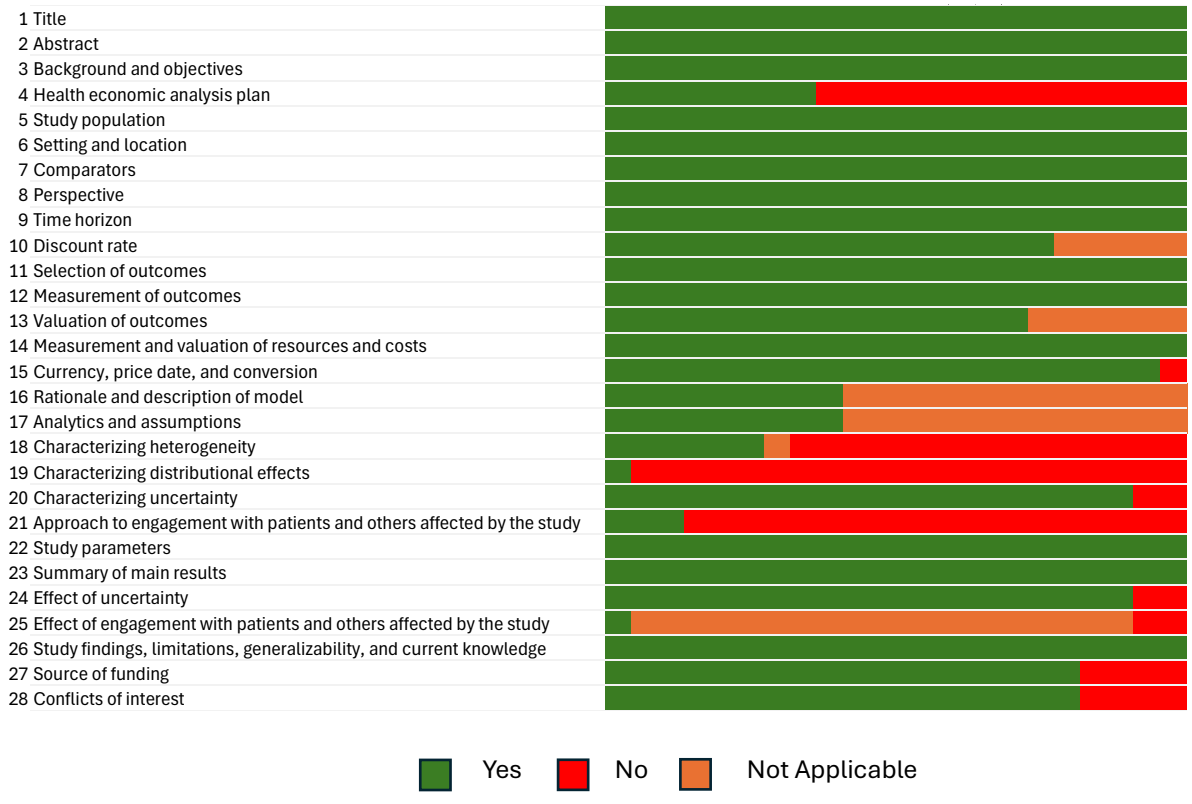


Figure 3. Quality assessment following the CHEERS checklist

3.3.3 Appraisal of economic evaluation methods in included studies

We assessed the methodological characteristics of the included studies, focusing on the perspective (provider/societal), the approach taken towards the inclusion of health care and non-health care provider costs, the measure(s) of health and non-health outcomes, the calculation of summary measures and the nature of the interpretation of value for money. The findings are presented in Table 4.

The CBHP interventions were provided in diverse settings, including schools, workplaces, and the community, by a range of providers. While all studies reported including direct programme costs, only nine studies reported the healthcare costs that are likely to change in the face of an effective health promotion intervention. Of the eleven studies that reported a societal perspective, two studies explicitly mentioned including costs from different sectors (Johansson et al., 2009; Moodie et al., 2013). Three studies conducted from a societal perspective did not include any patient/participant costs (McAuley et al., 2010; Sutherland et al., 2016; Akanni, Smith & Ory, 2017), while two of the eleven studies that adopted a provider perspective included non-medical direct costs, including family expenditures, transport and childcare costs (Robertson et al., 2017; Gilmer et al., 2018). One of the studies done from a provider perspective also included productivity losses (Robertson et al., 2017).

The scope of measured outcomes was mainly focused on health or proxies of health gain. Of the eight studies that conducted a CUA from the societal perspective, all presented standard measures of health outcomes and did not report any non-health

outcomes. In the CEAs, natural units included kilograms of weight gain prevented, timed up-and-go test scores, and minutes of moderate-to-vigorous physical activity per day gained. The two studies which conducted a CBA used the human capital approach (Rosenthal et al., 2009) and monetisation of DALYs, respectively (Beard et al., 2006). Another study that conducted a CBA in addition to a CUA monetised reductions in absenteeism (Fitzgerald et al., 2018).

All except for one CEA or CUA study presented ICERs as summary measures. A number of CUA studies included both health care and non-health care costs and/or societal costs in the ICER. In addition, value for money in all the CUA studies was assessed by comparing this ICER to a supply-side cost-effectiveness threshold. This included all the studies that included non-healthcare costs

One study conducted a CUA (health system perspective) and a CBA (provider perspective) presented QALYs as outcomes for the CUA, presenting an ICER and comparing it to a supply-side threshold. The study also conducted a CBA to accommodate the broader costs and benefits. For this analysis, net benefits were presented as summary measures.

Table 4. Characteristics of included studies (arranged in alphabetical order)

First author & Year of publication	Country of Origin	Setting	HP topic	Target group	Type of EE	View-point	Type of provider	Scope of provider costs	Scope of patient costs	Outcomes	Summary measure	Interpretation of value for money
Akanni, O. 2017	USA	Community	Physical activity promotion	Adults	CUA	Societal	Department of Aging and Disability Services	Programme costs	Not included	QALY	ICER	ICER compared to the common cost-effectiveness threshold
Anderson, Y.C. 2018	New Zealand	School + community	Obesity prevention	Children and adolescents	CEA*	Provider	Multi-disciplinary team (healthcare)	Programme costs	Not included	Natural units	Incr. costs and effects	The intervention had similar effectiveness to the standard of care but was less costly
Anokye, N. 2018	UK	Community	Physical activity promotion	Adults	CUA	Provider	Cross-sector (Sport, public health and Health)	Programme costs	Not included	QALYs	ICER	The intervention was more costly but increased QALYs, and the ICER was more than the cost-effectiveness threshold.
Barton, R. 2011	UK	Community	CVD risk reduction	Adults	CUA	Provider	National Health Service and Personal Social Services	Programme costs, Healthcare costs	Not included	QALYs	ICER	The intervention was more costly and more effective, and the ICER was more favourable than the cost-effectiveness threshold.

First author & Year of publication	Country of Origin	Setting	HP topic	Target group	Type of EE	View-point	Type of provider	Scope of provider costs	Scope of patient costs	Outcomes	Summary measure	Interpretation of value for money
Beard, J. 2006	Australia	Community	Falls prevention	Adults	CBA	Provider	Unclear	Programme costs Averted healthcare costs	Fees for attendance Time lost due to illness, pain and suffering	DALYs monetised	Net present value	Benefit to cost ratios presented for 1. State govt - reflecting direct hospitalisation costs. 2. Aus govt - reflecting hosp. and other direct costs (nursing home and GP). 3. Community - govt and community costs and benefits. These results suggest that the Stay on Your Feet program was highly cost-effective in preventing falls among older people
Canaway, A. 2019	UK England	School	Obesity prevention	Children	CUA	Provider	Run by football club staff in school	Programme costs	Not included	QALYs	ICER Incremental net benefit	The intervention was more effective but also more expensive when compared to the control arm, and the ICER was

First author & Year of publication	Country of Origin	Setting	HP topic	Target group	Type of EE	View-point	Type of provider	Scope of provider costs	Scope of patient costs	Outcomes	Summary measure	Interpretation of value for money
												below the cost-effectiveness threshold
Fitzgerald, S. 2018	Ireland	Workplace	Obesity prevention	Adults	CUA + CBA	Provider	Employer	Programme costs	Not included	QALYs Net benefits	ICER Net benefit	The educational intervention delivered QALY improvements but was dominated by the system-level intervention as it was more costly. In addition, the education interventions had negative net benefits
Gilmer, T. 2018	USA	Community	Diabetes prevention	Adults	CUA	Provider	Health insurance provider	Programme costs Incremental healthcare costs	Transport and childcare	QALYs	ICER	The intervention was cost-effective over a time horizon of 40 years when the ICER was compared to the cost-effectiveness threshold
Hollingworth, W. 2011	UK	School	Smoking cessation	Adolescents	CEA	Provider	Schools	Programme costs	Not included	Natural units	ICER	The ICER was less than the conventional threshold

First author & Year of publication	Country of Origin	Setting	HP topic	Target group	Type of EE	View-point	Type of provider	Scope of provider costs	Scope of patient costs	Outcomes	Summary measure	Interpretation of value for money
Johansson, P. 2009	Sweden	Community	Diabetes prevention	Adults	CUA	Societal	Unclear	Societal program costs (different sectors)	Target groups' expenses and time spent	QALYs	ICER	The study showed conflicting results. Cost increases and QALY losses for women were favourable in only two female study groups.
McAuley, K.A. 2009	New Zealand	School + community	Obesity prevention	Children	CEA	Societal	Schools	Project marginal costs	Not included	Natural units	Cost per natural unit	While there was no difference in effectiveness between the intervention and control, the intervention was successful in significantly reducing the rate of excessive weight gain in children, and the costs of the intervention per child relating this to the prevented weight gain was reported
Moodie, M.L. 2013	Australia	Community	Obesity prevention	Children	CUA	Societal	Unclear	Programme costs (different sectors)	Student and parent time	DALYs	ICER	Measured against the CET, the ICER for the intervention was found cost-effective

First author & Year of publication	Country of Origin	Setting	HP topic	Target group	Type of EE	View-point	Type of provider	Scope of provider costs	Scope of patient costs	Outcomes	Summary measure	Interpretation of value for money
Neumann, A.2017	Sweden	Community	Diabetes prevention	Adults	CUA	Societal	Healthcare provider	Programme costs Healthcare costs	Included cost of sickness absence, early retirement, production loss due to mortality	QALYs	ICER	The intervention was more costly but also gained higher QALYs, and the ICER was less than the CET
Panca, M. 2017	UK	Community	Obesity prevention	Adolescents	CUA	Provider	Healthcare provider	Programme costs Healthcare costs	Not included	QALYs	ICER	No difference in outcomes between the alternatives and the intervention had higher costs compared to std care. The intervention was unlikely to be cost-effective.
Robertson, W. 2017	UK	Community	Obesity prevention	Children	CUA	Provider	Healthcare provider	Programme costs	Family expenditures and parental lost productivity attributable to the child's health status	QALYs	ICER	There was no significant difference in outcomes for the alternatives, and the intervention was significantly more costly than the standard of care.
Rosenthal, M.S. 2009	USA	Community	Pregnancy prevention	Adolescents	CBA	Societal	Public health provider	Total operating	Opportunity cost of participation was assumed to	Total costs averted	Net societal benefit	Social benefits outweigh total social costs

First author & Year of publication	Country of Origin	Setting	HP topic	Target group	Type of EE	View-point	Type of provider	Scope of provider costs	Scope of patient costs	Outcomes	Summary measure	Interpretation of value for money
								costs of the program	be $0 (few wage-earning and enrichment activities available)			
Shatish, T. 2020	India	Community	Diabetes prevention	Adults	CUA	Societal	Public health provider	Programme costs Healthcare utilisation costs	Time, transport, food, and accommodation	QALYs	ICER	The ICER was less than the CET
Smith, L. 2019	USA	Community	CVD risk reduction	Adults	CUA	Societal	Public health provider	Program costs and projected averted costs	Unclear (mentions indirect costs)	QALYs	Incr. costs and effects	The base-case scenario showed incremental cost savings associated with the intervention.
Sutherland, R. 2016	Australia	School	Physical activity promotion	Adolescents	CEA	Societal	Schools	Programme costs	Not included	Natural outcomes	ICER	The intervention had a statistically significant intervention effect at a low cost compared to the alternative.
Van den Brand. 2020	Netherlands	Workplace	Smoking cessation	Adults	CUA	Societal	Employer	Programme costs Healthcare costs	Patient and family costs (travel and time costs)	QALYs	ICER	The intervention was dominated by the comparator

First author & Year of publication	Country of Origin	Setting	HP topic	Target group	Type of EE	View-point	Type of provider	Scope of provider costs	Scope of patient costs	Outcomes	Summary measure	Interpretation of value for money
Vijgen, SMC. 2008	Netherlands	School	Tobacco use prevention	Adolescents	CUA	Provider	Schools	Programme costs Healthcare costs	Not included	QALYs	ICER	The cost per QALY gained from the intervention was below the CET
Wang, H. 2019	USA	Community	CVD risk reduction	Adults	CEA	Societal	Public health provider	Programme costs	Participants' direct and opportunity costs	QALYs	ICER	The cost per QALY gained from the intervention was higher than the CET

Note: CBA = Cost-benefit analysis, CEA = Cost-effectiveness analysis, CET = cost-effectiveness threshold , CUA = Cost-utility analysis, CVD = Cardiovascular disease, HP = health promotion,

ICER = Incremental cost-effectiveness ratio, QALY = Quality-adjusted life year, ROI = Return on Investment, , EE = economic evaluation

3.4 Discussion

This review aimed to describe the methods used in the economic evaluation of CBHP interventions based on a systematic search and appraisal of full economic evaluations published between 2002 and 2023. Although the role of economic evaluation towards interpreting the value of health care interventions (e.g. medicines, vaccines, psychological counselling) has gained considerable traction (Huter et al., 2018), the findings from this review suggest that challenges remain in applying such methods to CBHP. While the literature on complex evaluations has already identified difficulties in attributing outcomes to health promotion interventions, leading to misrepresentation of broader impact (Skivington et al., 2021), this review identifies additional conceptual challenges in applying economic evaluation methods.

These challenges include the scope of intersectoral costs and outcomes, how these are combined in summary measures and how value for money is determined. In line with the traditional literature, we recommend that the scope of costs and outcomes continues to be broad enough to capture changes that arise from intervention implementation. This recommendation has implications for each form of full economic evaluation.

Traditionally, the CEA is the most common form of economic evaluation despite its limited usefulness in value-for-money considerations. In CBHP, the CEA has additional limitations in that the use of a unitary health-related outcome measure is particularly narrow. In this review, the CUA was the most common type of economic evaluation. If CUA is used to

assess value for money in health-related interventions, standard recommendations are that the ICER is limited to health care costs and compared against a supply side CET measuring the marginal productivity of health system spending. In this review, studies that conducted a CUA and included non-medical costs still presented an ICER, which was compared to a supply-side threshold. This might not be appropriate in CUA of CBHP because the intervention costs are typically not health care costs (for example, because the provider in this instance might be a sports coach employed within a school). Instead, we recommend that the ICER is compared to a demand-side CET that is more reflective of the willingness to pay for improvements in health. However, this recommendation will not overcome the issue of the exclusion of non-health outcomes. Given these shortcomings, the CBA has many advantages for CBHP in that it can accommodate any costs or outcomes and can enable intersectoral value-for-money decision-making. In this review, very few studies conducted a CBA. A previous review reported that processes of monetising outcomes could be challenging in health promotion as these interventions can have features of public goods, for which individuals report a very low willingness to pay (Huter et al., 2018). In addition, using the human capital approach can underestimate or overestimate productivity costs, leading to inaccurate conclusions and affecting decision-making (Rissanen et al., 2021).

Finally, this review did not find any CCA studies. Despite this, we recommend that further thought be given to the application of CCA in CBHP, which would entail measuring costs and outcomes broadly and presenting them in a disaggregated manner. It may also be possible to nest aspects of CUA within a broader CCA framework, where costs and multidimensional

health outcomes (QALYs or DALYs) are combined in an ICER that is compared to a demand-side CET, which is presented alongside non-health outcomes, e.g. educational attainment.

3.5 Strengths and limitations

We have not seen another systematic review focusing on the economic evaluation methods of community-based health promotion interventions using individual-level strategies without disease or age restrictions. While we followed systematic procedures in conducting the review, our focus was to describe and critique the specific economic evaluation methods. One of the study limitations is that we did not conduct an extensive search of the literature, including a limited number of databases, and only included articles written in English. We did not focus on how best to attribute the impact of intervention outcomes in complex interventions, as these have previously been described (Bates, 2022).

3.6 Conclusion

While CBHP remains firmly on the global health agenda, there is limited economic evaluation evidence, and there are challenges in the application of standard methods. In reviewing the existing literature, this study aimed to provide conceptual and methodological clarity and thereby improve the evidence base that is needed to conduct economic evaluation studies that will support decision-making.

Chapter 4

4 Chapter 4: A cost analysis of a sports-based sexual health education programme for adolescent girls in South African schools

Abstract

Studies have shown that school-based sexual health education interventions can improve adolescent sexual and reproductive health outcomes. However, there is little evidence on the cost and cost-effectiveness of such programmes, limiting investment and priority-setting decisions. This paper analyses the costs of the SKILLZ Health for Girls programme, a sports-based sexual health education intervention targeted at adolescent girls in the secondary school environment. Costs were collected within a cluster-randomized trial conducted in Cape Town, South Africa. The analysis was conducted from a provider perspective, and a mixed-method costing approach was used. A cost data collection tool was developed to compile cost information from one-on-one interviews, trial administrative data and non-participant observations of the intervention. Costs were analysed for 2019, representing a full school year of programme implementation. The intention-to-treat analysis revealed an average cost per learner per session of $9.92 and an average cost per learner graduating of $69.43. Sensitivity analysis indicated that these costs were sensitive to learner participation rates. Using the base-case analysis for the Western Cape province (maximising coverage of schools but only including 30% of eligible learners), total costs were estimated at $4,817,217 for a 3-year period, which is equivalent to the government budget dedicated to school-based HIV and AIDS Life Skills Education. Results from this study can

inform investment decisions for health promotion interventions in schools in South Africa and similar contexts.

4.1 Introduction

Investing in the sexual and reproductive health (SRH) and development of adolescent girls and young women is a key aspect of the Sustainable Development Goals (Inter-Agency and Expert Group on Sustainable Development Goal Indicators, 2016; United Nations Educational Scientific and Cultural Organization (UNESCO), 2018). Despite this, unintended pregnancies, sexually transmitted infections (STIs), including HIV and harmful gender norms remain prevalent, particularly in low and middle-income countries (LMICs) (World Health Organization (WHO), 2019). This, in turn, contributes to incomplete education, unemployment and health risks (UNESCO, 2017), with complications of pregnancy or abortion being the leading causes of death in late adolescence (WHO, 2019).

In South Africa, adolescent girls experience a disproportionately high burden of sexual ill-health (Baker et al., 2023). Adolescent girls aged 15-19 years have a high unmet need for contraceptives at 31% (Jonas, Lombard, et al., 2022). This contributes to the exceptionally high rate of adolescent pregnancy, with recent estimates indicating that nearly 20% of women have begun childbearing by 18 (National Department of Health South Africa, Statistics South Africa & South African Medical Research Council (SAMRC), 2019). The rate of termination of pregnancy in adolescent females is reported at 9% (Barron et al., 2022). In addition, while overall HIV prevalence has decreased, adolescent girls continue to be

disproportionately affected. The high rates of pregnancy exacerbate the risk of HIV in this population, with a prevalence of 6.9% in adolescent girls and young women (AGYW) aged 15–24, which is double that of their male counterparts (Naidoo & Zungu, 2023). Other STIs have been found to be high in this population, including 11% for *Neisseria Gonorrhoea* and 42% for *Chlamydia Trachomatis* (Barnabas et al., 2018). Despite the provision of a range of sexual and reproductive health services free at the point of use in the public sector (including contraceptives, terminations of pregnancy, STI treatment and maternal health care), the implementation of adolescent-friendly health services (Baker et al., 2023), and the country's progressive rights-based framework of laws, policies, and guidelines, these worrying trends have persisted (Strode & Essack, 2017).

In an attempt to mitigate these concerns, school-based sexual and reproductive health education (SBSHE) interventions have been widely implemented worldwide (Langford et al., 2014; Pinto, Silva & Andrade, 2017). While the school environment implies that such interventions are inherently complex and require context-specific tailoring (Bergeron, Talbot & Gaboury, 2019), schools remain a key setting for adolescent SRH promotion (Mukamana & Johri, 2016; United Nations Educational Scientific and Cultural Organization (UNESCO), 2018).

In South Africa, the Department of Health (DOH) and the Department of Basic Education (DBE) have collaborated to produce *Life Orientation*, a life skills, sexuality and HIV/AIDS educational programme offered in schools to grade 4-12 learners as part of the National

Curriculum. Despite this, various challenges have persisted (Koch & Wehmeyer, 2021b). As an extension to Life Orientation, with NGO assistance and Global Fund financing, the DBE initiated the *Keeping Girls in School (KGIS)* programme, which focuses on female adolescent learners (14-18 years) in no-fee schools (i.e. schools in the poorest three socioeconomic quintiles) (Arends, Winnaar & Namome, 2021). In Cape Town (Western Cape province), KGIS was delivered by the Desmond Tutu Health Foundation (DTHF), a local non-governmental and health research organisation. In conjunction with KGIS, the foundation introduced a comprehensive sports-based SRH education programme called SKILLZ, which had been found to be effective in a different setting (Maleka, 2017; Grassroot Soccer, 2021). The feasibility, acceptability, impact and cost-effectiveness of SKILLZ plus KGIS versus KGIS alone was then evaluated within a cluster-randomized control trial called Goals for Girls (G4G). Details of the trial design and outcomes are available in published sources (Pike, Coakley, Ahmed, et al., 2023; Pike, Coakley, Lee, et al., 2023). The aim of this current paper is to estimate the incremental costs and budget impact of SKILLZ, assuming the perspective of the Western Cape Education Department.

4.2 Methods

4.2.1 Study design, setting and description of the intervention

The G4G study was a cluster randomised controlled trial run between January 2018 and December 2019 in 38 secondary schools in the Klipfontein/Mitchells Plain health sub-district, a poor peri-urban area located in Cape Town, Western Cape Province, South Africa.

Clustering was at the level of the school, with 18 intervention (KGIS plus SKILLZ) and 20 control (KGIS) schools. Within these schools, girls were eligible if they were in grades 8-10 (approximately 14-17 years old). A total of 2791 learners were included in two cohorts over two years (termed cohorts 1 and 2). As part of a dynamic implementation approach, the programme was adapted to improve impact for cohort 2.

The SKILLZ programme was adapted from an existing evidence-based, interactive life skills curriculum designed by the NGO Grassroots Soccer. The programme included ten sessions delivered over five months, equivalent to two school terms, with some schools implementing it during school and some after school. A maximum of 20 learners could participate per session, and only one session was given per school per day. To qualify for graduation from the programme, a learner had to complete at least seven of the ten sessions.

Trained female near-peer educators (age 18-30 years) called SKILLZ caring coaches (n=10) delivered the curriculum with oversight and support from one master coach, a former coach with at least three years of experience working within similar youth programmes. Before implementation, caring coaches received five days of training, with weekly facilitation meetings during implementation. For those schools opting to implement an after-school version, sessions were delivered directly after school, and free transport was offered to the learners from the school to their homes. Figure 4 illustrates the key themes covered during the 10 SKILLZ soccer sessions with further details provided in Table 5.

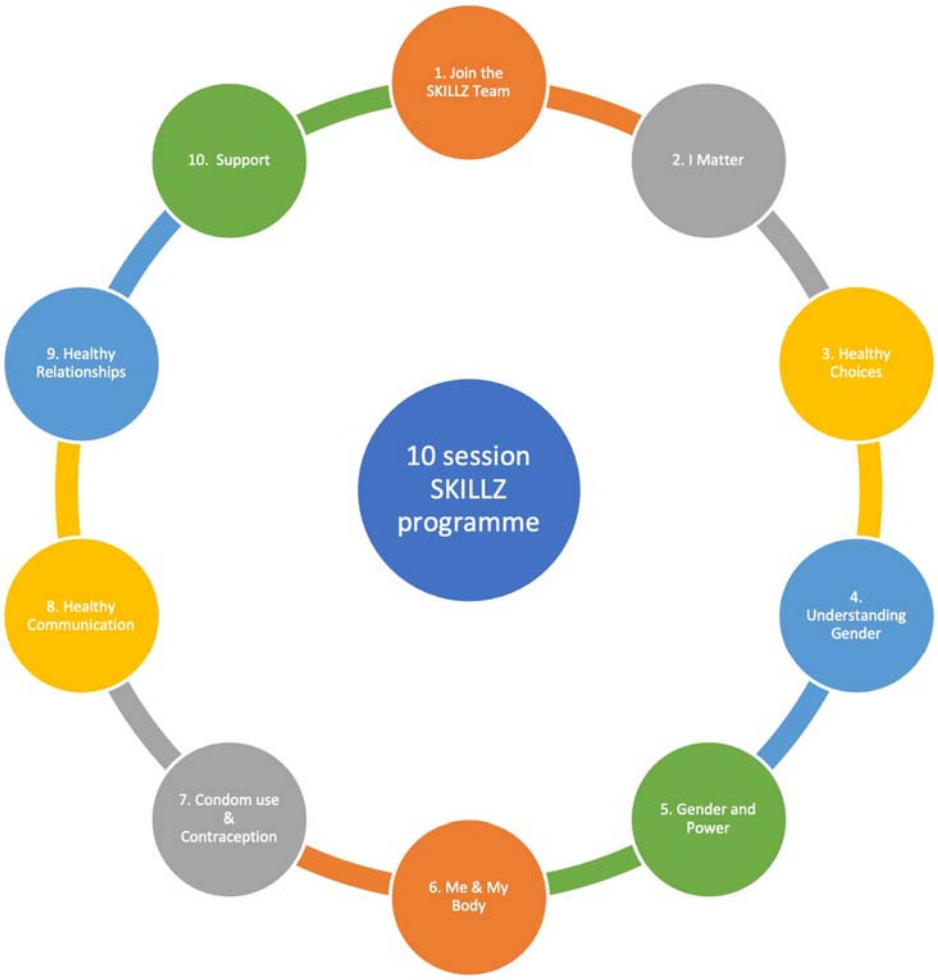


Figure 4. Topics covered in the SKILLZ curriculum

Table 5. Activities during a typical SKILLZ session

Opening Circle • Gather all girls to welcome them • Review the last SKILLZ practice and share the schedule • Start the session with an energizer • Warm-up stretches and exercises
Opening Team Time • Split players into teams to do a mindfulness and/or breathing activity • Players check in with their teammates
Life SKILLZ Activity • Bring 2 teams together and lead the players through the day's activity or game
Closing Team Time • Closing check-in for each team with their coach • The coach facilitates discussion on the activities of the day and players think about how they have/will apply what they learned to their lives
Closing Circle • Player teams come back together as a big group to sing, dance, and cheer together

4.2.2 Cost analysis

The within-trial cost analysis focused on the 761 learners receiving the after-school version of SKILLZ within the second cohort of the G4G trial. As mentioned, given implementation challenges, the trial modified its implementation approach to improve outputs in cohort 2; hence, this was the focus of the costing. Using a combined top-down and bottom-up costing approach and a provider perspective, the costs of SKILLZ were identified, measured, and valued in 2019 South African Rands (ZAR) before converting to United States Dollars (US$) at an average market exchange rate of R14.45 = US$1 ("US Dollar to South African Rand Spot

Exchange Rates for 2019", 2021). Where needed, costs were first inflated to 2019 levels using the South African consumer price index before conversion to US$.

We developed a costing framework based on standard costing methods, costing of social and behavioural change health interventions, and examples of costing complex public health interventions and, in particular, NGO-implemented programmes (Larson & Wambua, 2011). To understand the production process and implementation plan of the intervention, trial standard operating procedure documents were reviewed, one-on-one interviews were conducted with senior members of the G4G research team (n=2), and non-participant observation visits were randomly made to schools in October and November 2019 (n=2). Trial financial records were also accessed and analysed. Through this process, resources were organised into capital and recurrent cost categories and were then further categorised according to the phase of implementation (start-up vs post-start-up) and whether they were incurred at the site or at the above-site level, as shown in Table 6. The scope of costs excluded any resources used for research purposes.

Start-up costs included all costs incurred from 1 January 2018 to 30 April 2018, including personnel recruitment, equipment procurement, and community engagement, and were treated as capital costs in the analysis. In addition to start-up costs, capital costs in the post-start-up phase included initial staff training (trainers, trainees, venue and training materials) and additional equipment that was required. Recurrent post-start-up costs included personnel (caring coaches, master coach, project administrator, project coordinator) and

overheads (including administration and ongoing staff development). Return transport costs for staff were between the DTHF head office and the schools, while transport for after-school SKILLZ sessions was provided for the learners between their schools and homes. Finally, we categorised post-start-up non-personnel costs into site-level (community/school setting) and above-site-level (largely programme administration) costs. The costs of school infrastructure (e.g. school hall or sports field) were excluded.

Table 6. Cost categories and costing methodology

Cost categories	Cost sub-categories	Costing methodology
Start-up costs		
	Computers and laptops	Top-down
	Equipment	Top-down
	Furniture & fittings	Top-down
	Administration support	Top-down
	Community activities	Top-down
	Advertising	Top-down
Post-start-up costs		
Capital costs		
	Computers and laptops	Top-down
	Staff training	Bottom-up
	Other equipment	Top-down
Recurrent costs		
Above-site level costs		
	Programme administrator	Bottom-up
	Programme Coordinator	Bottom-up
	Computer Consumables	Top-down
	Administration & support	Top-down
	Network and costs	Top-down
	Meetings	Top-down

Cost categories	Cost sub-categories	Costing methodology
	Consultant fees	Top-down
	Continuous development	Top-down
Site-level costs		
	Master coach	Bottom-up
	Caring coaches	Bottom-up
	Maintenance activities	Top-down
	Community activities	Top-down
	Advertising & promotion	Top-down
	Transport costs	Top-down

Once the scope of costs was defined, we used a combination of the bottom-up and top-down methods to measure resource use. For the bottom-up method, a self-administered time and motion tool was completed by the programme coordinator (n=1) and caring coaches (n=5). Interviews with staff from Grassroot Soccer (n=2) enabled an estimate of the time and personnel needed for initial training. The top-down method was used to allocate the remaining costs, which entailed reviewing financial records and itemising expenditures into different categories, following an approach described in the literature (Larson & Wambua, 2011).

Once all resources were identified and measured, costs were valued. For capital costs (including start-up costs), we assumed a useful working life of 2 years (the trial duration) and annuitised using a 3% interest rate (i.e., an annuatisation factor of 1.914), following the practice of global health evaluations (Basu & Ganiats, 2016). The time of personnel (coaches, coordinator, administrator) was valued using de facto wages and fringe benefits

from financial records. Some community members participated in community sensitisation activities and were paid a stipend for their time.

Once all cost components were measured and valued, we estimated the total annual cost of implementing the intervention. Then, using an intention-to-treat approach, we calculated a cost per session, a cost per learner graduating (7 or more sessions attended) and a cost per learner completing (attendance at all ten sessions). This analysis estimates costs under optimal conditions, if all enrolled learners attended sessions according to plan.

4.2.3 Sensitivity analysis

As mentioned, the base case analysis calculated unit costs using an intention-to-treat approach, which could be considered an idealised scenario. Using deterministic sensitivity analyses, we assessed the variation in these unit costs (cost per learner, cost per learner graduating, cost per learner completing) using trial output data reflecting the attendance rates that were realised in the trial – using a 'per protocol analysis' (Tripepi et al., 2020). In addition, we further broke down the 'per protocol' unit costs into a best- and worst-case using output data from the best and worst-performing schools in terms of attendance and graduation rates. Finally, we modelled a 'public sector' scenario using the intention to treat analysis. In this scenario, we excluded both staff and learner transport costs and where it was assumed that the equipment to run the sessions was available at each school.

4.2.4 Costs of scaling up the SKILLZ programme

We assessed the financial implications of scaling up the SKILLZ programme to no-fee schools in the Western Cape Province using three scale-up scenarios over three years (2022-2024). In 2020, there were 384 WCED high schools, a further 80 combined intermediate/high schools, and a total of 385 454 high school pupils in grades 8 to 12 (Western Cape Education Department (WCED), 2021). Approximately 60% or 278 schools fall into the no-fee category, with an estimated 231,272 pupils, of whom 115,636 (50%) would be girls (Parliamentary Monitoring Group South Africa, 2020; World Bank Group, 2024).

The scale-up analysis was constructed using the results from the intention-to-treat analysis and based on the cost per learner graduating. Two variables were used to model the scenarios, i.e., 1) scale-up to reach a higher percentage of eligible schools and 2) scale-up to reach a higher percentage of eligible learners within these schools. Projections for future costs were made using 2019 prices.

Scenario 1

This scenario demonstrated the costs of including SKILLZ as a mandatory part of the school curriculum. It modelled a linear increase in coverage to reach 80% of WCED no-fee schools and 80% of adolescent girls within these schools by 2024. We assumed an equal distribution of adolescent girls per school.

Scenario 2

This scenario represented lower school coverage with high learner coverage within schools. We determined the cost impact if programme uptake increased to reach 80% of learners in 50% of the schools. The increase in school coverage would follow a linear process, with an additional nine schools per year (2022-2024).

Scenario 3

We determined the cost impact of high coverage of schools and low coverage of learners in this scenario. The focus is on expansion into new schools at a rate that would ensure 100% school coverage with 30% learner coverage within these schools to accommodate the most vulnerable adolescent girls.

4.2.5 Ethics approval

The G4G trial and accompanying economic evaluation obtained ethics approval from the Human Research Ethics Committee of the University of Cape Town (REF: 138/2018). Permissions were obtained from the Western Cape Education Department and the participating schools.

4.3 Results

A total of 761 learners from nine schools allocated to the after-school version of the intervention arm were enrolled in the programme in 2019, with 10 caring coaches and one

master coach delivering the sessions. Ten sessions were planned per learner, and up to 20 learners could be accommodated per session. Given some variations across schools, a total of 379 sessions were planned. Data from the self-administered time and motion tool are presented in Table 7. For the caring coaches, the total time per SKILLZ session, including travel time, set-up, clean-up, and the actual session, varied between 1 h 50 minutes and 3 h 50 minutes with a mean of 2 h 48 minutes. The time estimates fluctuated according to the specific attributes of each school, including the location and infrastructure configuration. The average contact time with the learners per SKILLZ session was 1 hour and 7 minutes, with the longest session lasting 90 minutes and the shortest 45 minutes. The average waiting time per school was 19 minutes. The average return travel time from the head office to the school varied from 30 to 40 minutes, depending on the distance to the particular school (an average of 34 minutes).

Table 7. Length of time spent on SKILLZ activities

Average school visits per day and time per SKILLZ school visit in minutes					
Travel to school and back	*Waiting time at school*	*Set-up*	*Session time*	*Clean up*	*Avg. schools visited per day*
34 minutes	20 minutes	17 minutes	1 h 7 minutes	16 minutes	1.8
Total time per session					
SKILLZ session per coach per school			*Actual time as % of maximum hours per coach per day*		
2 h 48 minutes			70%		

The total 1-year cost of the SKILLZ program was estimated to be $75 183.59, as shown in Table 8. Start-up and capital costs for 2019 accounted for 4% and 2%, respectively. The unit cost for the initial 5-day training course was $240.31 per SKILLZ coach and $2 643.38 for 11 coaches. The total recurrent costs for programme delivery and maintenance accounted for 94% of the overall costs, as shown in Table 8. Above-site delivery site costs accounted for 38% ($26,980.46) of these recurrent operational costs, and almost half of the above-service delivery site costs were administration and support costs. Site-level costs represented 62% of the total recurrent costs ($43,406). Transport costs for both staff and participants represented 29% and 11% of total recurrent costs, respectively, while personnel costs accounted for 7%.

Table 8. Breakdown of annual total costs (2019 US$) for the SKILLZ programme

Cost category		**Cost (US$)**	**Percent of total**
Start-up costs (annuitised)		3 029.56	4
Capital costs (annuitised)		1 767.58	2
Recurrent costs	Administration and support costs	22 951.82	94
	Staff transport costs	20 531.79	
	Learner transport costs	8 089.30	
	Other recurrent costs	9 868.96	
	Personnel costs		
	Master Coach	1 149.19	
	Caring coaches	3 766.76	
	Project Coordinator	2 404.45	
	Project Administrator	1 624.19	
Total costs per annum		75 183.59	

As mentioned, attendance at sessions was less than planned. The trial made adjustments for this, and as a result, only 172 of the 379 expected sessions took place. The number of participant learners per school determined the number of sessions. While the trial was able to make the necessary adjustments, the costs remained unchanged.

Table **9** presents total costs and a range of unit costs under the intention-to-treat (idealised) and per-protocol (realised) scenarios. As shown, of the 761 learners enrolled, 72% attended one or more sessions; 40% graduated (defined as attending seven or more sessions). Put together, attendance was 46% across all sessions for all schools, with 72% in the best-performing school and 26% in the worst-performing school.

Table 9. Unit costs (2019 US$) comparing intention to treat and per protocol analyses

	Intention to treat	**Per protocol**
Number of schools	9	9
Learners enrolled	761	761
Number of sessions	379	172
Number of learners per session	20	9
% learners attending 1 or more sessions	100%	72%
% learners graduating (7 or more sessions)	100%	40%
Annual total cost	75,184	
Cost per school	8,354	
Cost per session	198	409
Cost per learner per session	10	45
Cost per learner graduating	69	318
Cost per learner completing the curriculum	99	454

Given the above, the best-performing school had a 72% attendance rate across all sessions, at a unit cost of $29 per learner per session, while the worst-performing school had a unit cost of $82 per learner per session. In the public sector scenario – where both staff and learner transport costs were excluded and where it was assumed that the equipment to run the sessions was available at each school – the costs per learner per session and learner reached were $6.33 and $44.29, respectively, and the cost per school was estimated at $5 329.38. Figure 5 shows the difference in unit costs for each scenario.

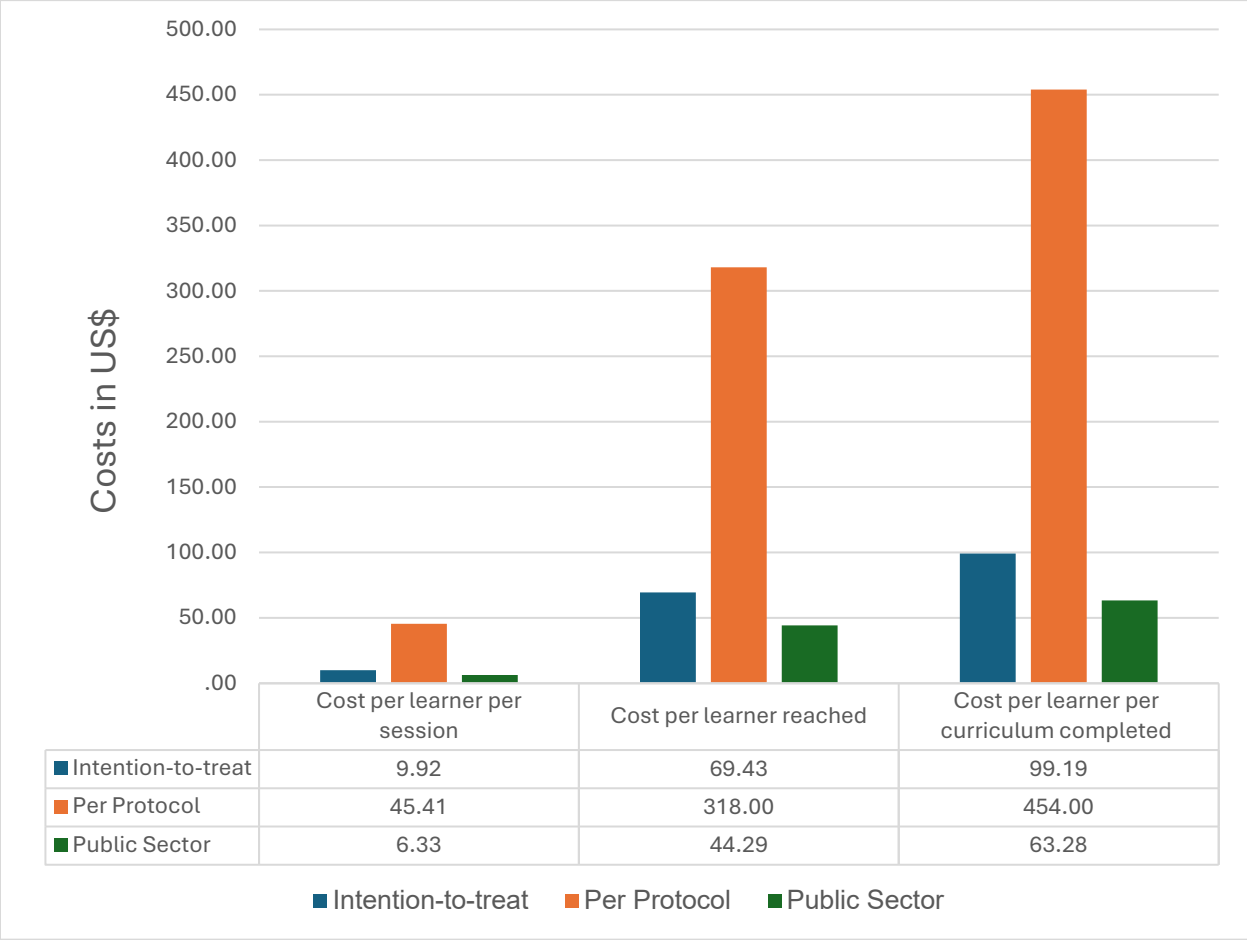


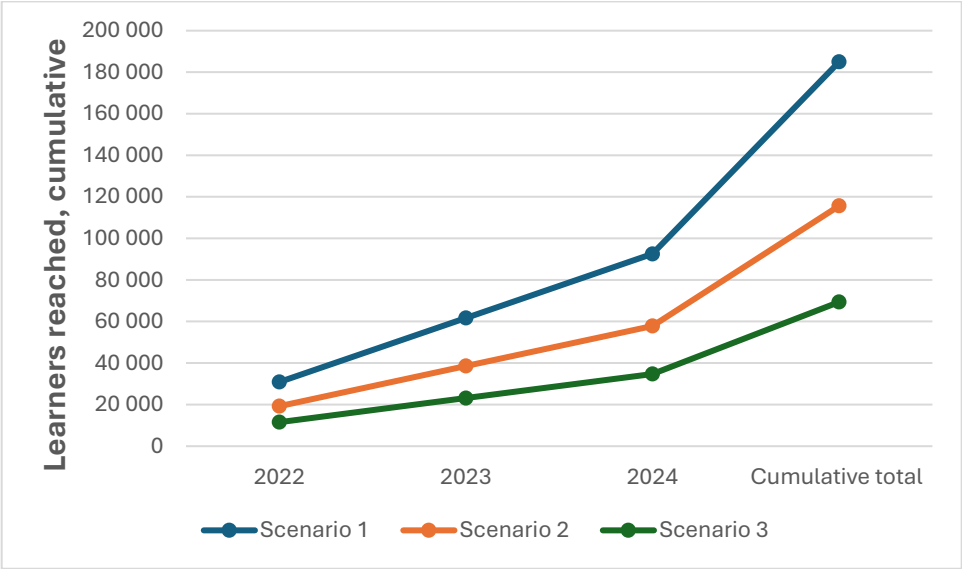
Figure 5. Comparison of unit costs (2019 US$) between scenarios

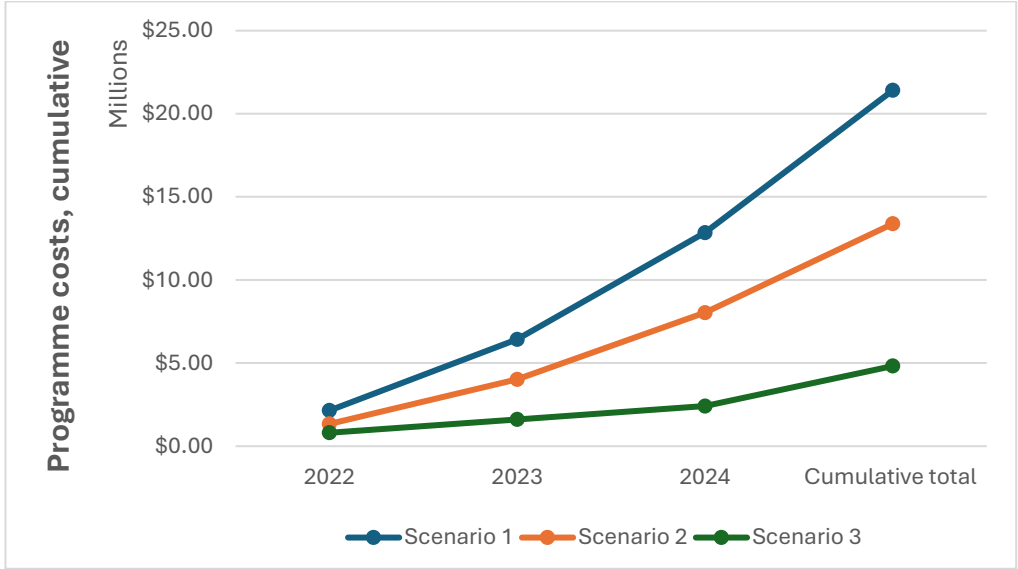
4.3.1 Scale-up analysis

For scenario 1, the total cumulative number of adolescent girls reached would be185 000. The total cost for learners who have completed the curriculum would have been $ 21,409,853. For scenario 2, the accumulated number of learners in the programme would be 115 536, and the total accumulated cost would be $13 381,158. In scenario 3, the total accumulated costs at the end of 2024 for an accumulative 69,382 learners reached would amount to $ 4,817 217. Figure 6 illustrates the cumulative learners reached and cumulative total costs for the three scenarios, adapted from another analysis (UNESCO, 2011).

4.3.2 Cost impact analysis of provincial scale-up

The estimated amount allocated to the conditional grant in the Western Cape Province towards the HIV and AIDS Life-Skills education programme amounted to $4 762 346.36 from 2019 to 2021 before COVID-19-related reductions (Government Communication and Information System (South Africa), 2020). Implementing the SKILLZ programme under scenario three would require 100% of the total allocated amount, while scenario one would require 4.5 times this amount.





Scenario 1: high coverage of schools and high coverage of learners

Scenario 2: low coverage of schools with high coverage of learners

Scenario 3: high coverage of schools and low coverage of learners

Note: Scale-up scenarios and associated costs. Adapted from UNESCO (2011). Sexuality Education Programmes in Six Countries Full Report.

http://unesdoc.unesco.org/images/0021/002116/211604e.pdf

Figure 6. Cumulative learners reached and cumulative total costs (2019 US$) for each of the scenarios

4.4 Discussion

This paper presents a cost analysis of an after-school sports-based sexual and reproductive health education intervention offered to adolescent girls in nine schools located in a poor area in Cape Town, South Africa. The analysis was conducted alongside the Goals 4 Girls cluster randomised control trial, with a specific focus on the implementation approach adopted in cohort 2 of the trial. To our knowledge, this is the first cost analysis evaluating a SBSHE intervention in the South African context.

In South Africa, unintended pregnancies, STIs and HIV are a significant challenge for adolescents, contributing to high levels of school drop-out and ill health (Hartnack, 2017). In this context, the school environment is an important setting for SRH promotion interventions (Francis, 2010; Ngabaza & Shefer, 2019). Notwithstanding this positioning, the goal of successfully implementing such interventions has been an ongoing challenge (Swanepoel & Beyers, 2019). The impact evaluation of the G4G trial highlighted challenges with implementation fidelity (the degree to which the intervention was implemented as intended) (Holliday et al., 2009). Programme attendance was poor, with only 72% of enrolled participants attending one or more sessions and 40% graduating (attending seven or more sessions). As shown by Pike et al. (2023), the trial could not detect a reduction in pregnancies. Still, some differences in STI prevalence and socio-behavioural outcomes were found between the intervention and control groups in cohort 2, but only for those learners who graduated. These disappointing trial outcomes are reflected in the comparison of unit costs between the intention to treat and per protocol analyses, with considerably higher unit

costs (e.g. cost per learner per session and cost per learner graduating) resulting from the diseconomies of scale associated with poor attendance. A third of the costs incurred above the site level could be incurred within the administrative structures of the schools if the intervention were implemented within the currently available structures, and other economies (e.g., economies of scope) might be realised. Nevertheless, in the intention to treat analysis, the cost of $69.43 was within the range of costs reported in similar programmes. A study of pilot sexuality education programmes in Kenya and Indonesia reported that costs per learner reached were $50 and $160, respectively (Kivela, Ketting & Baltussen, 2013).

While these findings suggest that due caution is needed before investing in similar interventions, this cost analysis is nevertheless of value to those seeking to understand the extent of investment and the extent of intervention fidelity that would be needed for an intervention of this nature to start delivering value. Indeed, irrespective of equivocal impact, SBSHE is likely to remain on the policy agenda globally, perhaps given the understanding that such interventions are one element within a range of initiatives which could yield substantial cumulative benefits (Chung, Kim & Lee, 2018).

The cost analysis reveals that transport costs were a key driver. These included transport for the coaches to and from the schools and for the learners travelling home. Cape Town is a city with exceptionally high levels of violence, and the schools included in the trial are located in areas where violence is particularly endemic (Mathews et al., 2015). A key strategy

for children is to walk home together in groups directly after school (called the 'walking bus'). Therefore, in the after-school version of the intervention, transport was provided to provide safe passage for the girls to encourage attendance. However, there is limited road access to the poorest parts of the city (called informal settlements), which could be one explanation for the poor attendance. Therefore, a key consideration in scaling up would be to assess whether a within-school-hours offering might be more acceptable to the learners. This would reduce the need for transport and ensure attendance. Personnel costs only accounted for 7% of total costs, representing a minor cost component. Considering the ongoing teacher-related challenges for implementing comprehensive SBSHE in South Africa (Swanepoel & Beyers, 2019), near-peer-led programmes present an opportunity to address barriers, including teacher conflicts in implementing SBSHE (Shibuya et al., 2023).

In scale-up analysis, the cumulative cost of maximising coverage to include all eligible schools and only 30% of eligible learners within those schools over three years would be equivalent to the government budget dedicated to school-based HIV and AIDS Life Skills Education. However, this cost would only represent a third of the budget for a grant-funded programme which covered the implementation of prevention programs for adolescent girls and young women in Cape Town. (Mathews, Lombard & Puren, 2020).

This analysis has some limitations. Firstly, we adopted a provider's perspective on costs and therefore excluded costs to the learners and their families. A typical 'patient' perspective in economic evaluation would include any direct costs incurred (e.g. user fees, transport) and

indirect costs (e.g. lost income and opportunity cost of time). For this intervention based in no-fee schools, no user fees would be incurred if it were mainstreamed in routine practice. In addition, transport costs were included in the provider's perspective, which could be considered a proxy for these learner transport costs. In terms of indirect costs, it is unlikely that participation in the intervention would generate lost income given that youth employment is rare in South African cities; indeed, retention in schools is a key strategy to overcome the devastating *unemployment* levels in young adults, estimated at 45% (Stats SA, 2024). That said, our time and motion tool indicates that each session with the girls took approximately 1 hour. The opportunity cost of this time may be one reason for the low attendance rates. In addition, if the intervention were to be offered during normal school hours, the opportunity cost in terms of missed curriculum would be an important question for further research.

4.5 Conclusion

Despite the disappointing trial results, SBSHE interventions are likely to remain on the policy agenda in South Africa and similar settings. This study provides new information on the cost and financial implications of a sports-based SRH promotion intervention in a school setting. It illustrates how diseconomies of scale associated with poor attendance influence unit costs. These results will be useful to those planning to implement similar interventions.

Chapter 5

5 Chapter 5: Assessing the costs of basic and emergency intrapartum care: findings from the South African public health sector

Abstract

Background: Sub-Saharan Africa accounts for two-thirds of maternal deaths globally. There is extensive evidence that optimising intrapartum care is the leading strategy for reducing maternal mortality. Despite significant efforts to improve maternal care in South Africa, the institutional maternal mortality rate remains a key concern. In striving toward reaching the Sustainable Development Goal of a maternal mortality ratio of fewer than 70 deaths per 100,000 live births, cost information to guide investment decisions is needed. This paper evaluates the costs of intrapartum care within a primary care midwife obstetric unit (MOU) and a secondary-level maternity hospital in Cape Town, South Africa.

Methods: Using a retrospective cost analysis from the provider's perspective, we calculated the cost per vaginal delivery and per caesarian section using 2020 prices. A combination of bottom-up and top-down costing was used to identify and value the cost items. We identified clinical, overhead, and capital costs through a clinical records audit, hospital utilisation data, financial records and key informant interviews. We used sub-group analysis to assess costs by age and by medical or obstetric complications. Sensitivity analysis was used to assess the influence of key parameters on costs.

Results: The average length of stay was 17 hours for vaginal delivery at the MOU, two days for vaginal delivery at the hospital obstetric unit and four days for caesarean section. Perinatal complications resulted in a longer length of stay. From a provider's

perspective, the mean cost per patient for vaginal delivery at the MOU and hospital was US$142.47 and US$557.49, respectively, compared to US$943.33 for a c-section. Clinical costs, including personnel, were the leading drivers of costs in both facilities.

Conclusion: Provider costs for vaginal delivery and c-section were higher than the mean costs in similar contexts but consistent with healthcare costs in South Africa. The study provides evidence on the costs of basic and emergency intrapartum care to inform the planning of maternal health services in South Africa and similar settings.

5.1 Background

Globally, there has been significant progress towards achieving the 2030 Sustainable Development Goals (SDGs) for maternal health (Khorrami et al., 2019; World Health Organization (WHO) et al., 2019). While maternal mortality rates have decreased in Sub-Saharan Africa (SSA), the region still accounts for two-thirds of the global burden of maternal deaths (WHO, 2019; Musarandega et al., 2021). Evidence shows that skilled attendance at birth ("an accredited health professional (doctor, midwife, or nurse) who has been educated and trained to proficiency in the skills needed to manage uncomplicated pregnancies, childbirth, and the immediate postnatal period, and in the identification, management, and referral of complications in women and newborns") (WHO, 2004) – as well as emergency obstetric care, particularly caesarean section (c-section), are the critical interventions needed to reduce maternal mortality (Kruk et al., 2007; Prata et al., 2011).

In South Africa, the institutional maternal mortality rate (iMMR) remains persistently above the SDG target of 70 per 100,000 live births by 2030. In 2019/2020, the iMMR fell below 100 for the first time, but this gain was reversed during the COVID-19 pandemic, with an iMMR of 120 per 100,000 live births in 2020/2021, close to double the SDG target. Using a tax-based pre-payment mechanism, the South African public healthcare sector serves approximately 80% of the population. Some hospital services require a means-tested user fee, but all other services, including all maternity and child health services, are free at the point of use. For obstetrics, the continuum of care includes primary care midwife obstetric units (MOUs) that provide antenatal, postnatal, and 24-hour intrapartum care for low-risk pregnant women (Maputle & Hiss, 2010). In addition, MOUs identify and refer high-risk patients to higher levels of care where more specialised providers are available to attend to vaginal deliveries or to provide c-sections. Within this context of access to obstetric services across the continuum, the high iMMR is attributed to issues with quality of care, including a shortage of health personnel, a lack of resources, and overcrowding in facilities (Hastings-Tolsma et al., 2021).

A recent systematic review of patient and health system costs of managing pregnancy and birth-related complications in sub-Saharan Africa estimated the provider cost of spontaneous vaginal delivery to be between $8 and $73 in comparison to $80 to $562 for c-section (Mori et al., 2020). These estimates were available from six countries for vaginal deliveries and eight countries for c-sections, but none were from South Africa. The only available South African study is more than 30 years old (Broomberg & Rees, 1993). Given that the high iMMR is in part attributed to issues of quality of care, the South African public sector requires concerted investments in obstetric services. More recent cost

data are therefore required to inform priority setting for maternity care and to deliver on key policy objectives (Republic of South Africa, 2019).

The aim of this study is to estimate the provider costs associated with intrapartum care at different levels based on primary data collection within one midwife obstetric unit and one referral obstetric hospital in the Western Cape province of South Africa.

5.2 Methods

5.2.1 Study area

The midwife-led unit is based in the Khayelitsha health sub-district, a large peri-urban township in Cape Town, South Africa. Khayelitsha is characterised by poverty and a high disease burden (Richards et al., 2018). Two MOUs serve an estimated female population (10 to 54 years of age) of 163 962 (Western Cape Government, 2020). The study site was the Khayelitsha Site B MOU, part of the Site B community health centre. The MOU provides low-risk antenatal, delivery, and postnatal services. The 24-hour labour ward is staffed by four advanced midwives and two enrolled nursing assistants for each 12-hour shift. The facility has seven beds, of which four are for postnatal care, and the remainder are for advanced labour and delivery. Patients in early labour mobilise in the waiting room. In 2020, 5957 pregnant women came through the labour ward. Of these, 2469 patients had vaginal deliveries at the MOU, and the remainder were assessed and either discharged or referred to a higher level of care.

The referral hospital is a level II dedicated maternity referral and teaching hospital based in Cape Town. With 205 beds (73 neonatal and 132 obstetric), it is the largest maternity hospital in the country. It offers 24-hour emergency obstetric care and provides a wide range of maternal and neonatal health services, care to high-risk pregnant women and care to those with intrapartum complications. The obstetric beds are divided between antenatal/pre-delivery, delivery, and postpartum wards. The labour ward suite accommodates patients in established labour and contains 18 beds. In addition, the hospital is equipped with two theatres for c-section deliveries and other surgeries. In 2020, the hospital served 43 394 outpatients and 13 224 inpatients. Of the latter, 82% (10 844) were maternity admissions, which accounted for 42 552 inpatient days. The c-section rate was 50% (5425).

5.2.2 Study design

We conducted a retrospective cost analysis from the provider's perspective. The scope of costs included the full costs per delivery from admission to discharge and included the resources used for labour, childbirth, and the immediate postnatal period. We estimated unit costs according to maternal health outcomes relevant to the level of care, including (1) mode of delivery, (2) interventions during delivery, (3) obstetric and medical complications (premature rupture of membranes, postpartum haemorrhage, pre-eclampsia) and (4) age at delivery (under or over 20 years of age). All costs were calculated for the financial year 2020 in South African Rand (ZAR) and converted to the US Dollar (US$) using average exchange rates for the same period (US$1 = R14.81) (United States Bureau of the Fiscal Service, 2021)

5.2.3 Costing approach

A resource use inventory was developed to capture resource utilisation and costs for the study guided by a disease-specific costing guideline for LMICs (Hendriks et al., 2014). The data collection process included four parts: (1) ad-hoc key informant interviews, (2) a clinical records audit, (3) a review of facility administrative data and (4) a review of facility financial records.

To understand the flow of patients, key activities from admission to discharge and clinical processes, interviews were conducted with key informants at each study site. These included the facility manager (n=1) and advanced midwives (n=2) at the MOU; and the labour ward operations manager (n=1), senior registrars (n=2), advanced midwife (n=1), accoucheur (n=1), theatre complex operations manager (n=1) and a theatre scrub nurse (n=1) at the hospital. Thereafter, costs were classified as patient-specific, clinical staff, overheads, and capital.

Patient-specific costs

Using a bottom-up approach, patient-specific costs were based on in-depth reviews of patient clinical records. These were entered into a bespoke database. Clinical records were selected for inclusion using two approaches. For the MOU, the record review was undertaken in December 2021 and included deliveries from the preceding six months. Using a random sampling method, patients were first identified from the inpatient registration book post-discharge, and their medical records were retrieved accordingly. For the hospital, data collection was undertaken from July to October 2021.

Disproportionate stratified sampling was used to select records for the different age groups (adolescents versus adults) in order to understand potential differences in cost by age group. Eligible patients included recently discharged patients between July and October 2021.

The extracted data from clinical records at both study sites included age at delivery (under 20 or over 20), gravidity, parity, gestational weeks at delivery, type of delivery, length of stay, quantities of medical services, as well as the kind and quantities of medical supplies used. These patient-specific resources were then valued using routine public sector prices for medicines (sourced from the hospital pharmacy), laboratory investigations (National Health Laboratory Service, 2020), and blood products (South African National Blood Service (SANBS), 2021)

Clinical staff costs

Clinical staff costs for the antenatal and postnatal wards, and the labour suite were assessed using a top-down approach at both facilities. Using information from key informant interviews, we estimated the full-time equivalent clinical staffing per ward for the 2020 cost year. Equivalents were then valued using the Department of Public Service and Administration salary scales, including the Occupational-Specific Dispensation salary scales for clinical staff. Thereafter, the resulting annual costs were allocated equally using routine activity data over the same time period. In the hospital, these costs were allocated per bed-day or per delivery using activity data from each ward. In the MOU, we allocated antenatal and postnatal ward costs per delivery. However, because

many women are examined and referred, we included half of the headcount of referred patients in the allocation factor.

We collected time data from medical records for clinical staff performing C-sections. We then allocated anaesthetic and obstetric care costs per minute spent in the operating theatre for caesarean section costs.

Overhead costs

We assessed overhead costs using routine expenditure data, including cleaning, laundry, electricity and water, waste management, security, communication, facility management, and administrative and support staff (clerks, porters, drivers). Staff that rendered services to the entire facility (central sterile services department, pharmacy staff) were also included under overhead costs for hospital care. We then allocated these costs using the patient-day equivalent method. This entails summing inpatient days and one-third of outpatient visits to estimate an overhead cost per patient day equivalent. In combination with record review data on the ALOS, this allows for a calculation of overhead costs per delivery.

Capital costs

Lists of furniture and equipment used in the relevant wards in the facilities were obtained through observation and key informant interviews. For hospital care, the lists of theatre and central sterile services department equipment and surgical instruments were sourced from the surgical stores at the hospital. Replacement values - assumed to be

the current purchase price - were sourced from medical equipment suppliers in South Africa (“Medical Equipment Supplier - South Africa”, 2022). We allocated building costs per patient per ward, depending on the time spent in the different wards during the inpatient stay (antenatal, intrapartum, and postnatal care). Costs per square metre of space were estimated per ward based on assumptions for spatial needs for a level I and II bed, including support areas (100m2 per bed). These costs per square metre were sourced from the Department of Health Infrastructure Unit ($ 1,635.65). The floor area estimates for the theatre were obtained from another study, which estimated surgical costs for a similar level of care. (Samuel & Reed, 2021).

All capital costs were annuitised using a 3% interest rate. Useful life-years for hospital furniture and equipment included in the study were found from the International Public Sector Accounting Standards useful lives tables (IPSAS United Nations, 2022). Following this guidance, buildings were estimated to have a lifetime of 30 years, seven years for equipment, five years for electronics, and three years for linen.

5.2.4 Unit cost analysis

Once all the above components were estimated and valued, they were then used to calculate a unit cost per delivery. This entailed adding patient-specific costs per delivery (from patient-specific resources collected in the record review), clinical staff, overheads and capital costs per delivery (depending on the ALOS from the record review). Costs were then categorised according to the site, delivery method (vaginal or c-section),

maternal age (below or above 20 years), as well as by obstetric or medical complication (Table 10).

5.2.5 Sensitivity analysis

Reducing the average length of stay is recognised as a way to achieve efficiency. We expected the costs of intrapartum care per patient to be highly dependent on the length of stay. Thus, we performed deterministic sensitivity analyses to examine the implications of the length of stay on average costs. Average costs were computed for each LOS scenario for the different modes of delivery. Sensitivity analysis was focused on the mode of delivery, including all the patients in each sample (ALL). In addition, we included all the variations where the LOS was different to the ALOS for the base case (ALL). We used the upper and lower bounds based on confidence intervals from utilisation data.

5.2.6 Ethics

This study received ethical approval from the University of Cape Town Human Research Ethics Committee (REF Number 045/2020), and permission to conduct the research was obtained from both the provincial (Western Cape Department of Health and Wellness) and facility (Mowbray Maternity Hospital and Site B Community Health Centre) levels.

5.3 Results

5.3.1 Demographic and clinical characteristics

The baseline characteristics of the sample are presented in Table 10 and are further described below.

MOU vaginal deliveries. After excluding three patients who were referred, the analysis included 148 medical records of patients who delivered and were discharged from Site B MOU. Adolescent mothers represented 11% (n=17) of the sample. Almost a quarter of the patients were HIV positive (n=36; 24%). Nearly a third of the patients in the sample (n=52; 35%) were primigravida (pregnant for the first time). The average gestational age was 39 weeks four days, and the most common presentation was between 40 and 41 weeks (n=46; 31%). Two patients in the sample did not have antenatal care. The average length of stay (ALOS) was 17 hours. Patients spent an average of seven hours in the labour and delivery section and 10 hours in the postnatal ward.

Obstetric hospital vaginal deliveries. Of the 152 medical records that were reviewed, 61% were referred from another healthcare facility. Just over twelve per cent (n=19) were HIV positive. A small percentage of mothers were unbooked; 99% of mothers had antenatal care. Most mothers presented in the latent stage of labour (41%). The average gestational age at admission was 38 weeks seven days, and most women (42%) were between 39 weeks six days and 41 weeks four days at admission. The majority of patients had spontaneous vaginal delivery, and 15% of patients had induction of labour. In almost all the patients (97%), the fetal presentation was cephalic. Over half of the patients had an

episiotomy or a perineal tear. A small percentage of patients (8%) required assisted delivery. A quarter of the patients had obstetric complications, the most common diagnosis being premature or prolonged rupture of membranes (PROM), including those with preterm premature rupture of membranes (n=13), followed by postpartum haemorrhage (PPH) (n=9). Other obstetric complications included oligohydramnios, intrauterine growth retardation, and threatening preterm labour. Pre-eclampsia was the most common medical problem (n=15). The ALOS for vaginal delivery was two days, with an average of 0.6 days length of stay in the antenatal and labour wards and 1.4 days in the postnatal ward. Our data showed that the ALOS was longer after induction of labour, PROM and PPH, as presented in Table 12.

Caesarean section. Seventy-three medical records of women who had a caesarean section birth were reviewed. Two patients were referred to another hospital and were excluded from the analysis. Adolescent mothers represented 41% (n=30) of the sample, and the average age was 24 years (SD 7). Most patients had antenatal care (96%) (Table 10), and six patients (8%) were HIV-positive status. Of all the records reviewed, 62% were emergency caesarean sections, and fetal distress/ CTG non-reassuring was the most common indication, accounting for 49% of all non-elective surgeries. Other frequent indications included failed induction of labour and failure to progress. The most common indication for elective surgery was a previous c-section (75%). The average gestational age at admission was 39 weeks eight days, and most women (49%) were between 40 weeks two days and 41 weeks 5 days at admission. All patients received spinal anaesthesia. The average total time spent in the operating theatre per patient was 40 minutes (SD 12 min). The ALOS was four days, with an average of three days stay in the

postnatal ward. Nine patients had medical complications, five of which had a diagnosis of preeclampsia. Only 14% of patients had obstetric complications, including fetal macrosomia, premature rupture of membranes and adherent placenta. Five patients had other post-c-section complications, three of which had asymptomatic anaemia and were treated with haematinics. The other two patients had post-c-section tachycardia, which resolved spontaneously. There was no difference in the average length of stay between elective and emergency c-sections (4 days).

Table 10. Baseline characteristics of the study samples

	MOU vaginal delivery N=148		**Obstetric hospital vaginal delivery N=152**		**Caesarean section N=71**	
	n	**%**	**n**	**%**	**n**	**%**
Age						
< 20	17	11%	81	53%	30	41%
≥ 20	131	81%	71	47%	40	59%
HIV status						
Positive	36	24%	19	12.5%	6	8%
Negative	112	76%	133	87.5%	65	92%
Antenatal care						
Booked	146	99%	150	99%	68	96%
Unbooked	2	1%	2	1%	3	4%
Complications						
Obstetric complications		N/A	38	25%	10	14%
Medical complications		N/A	24	16%	9	13%

5.3.2 Unit cost per delivery

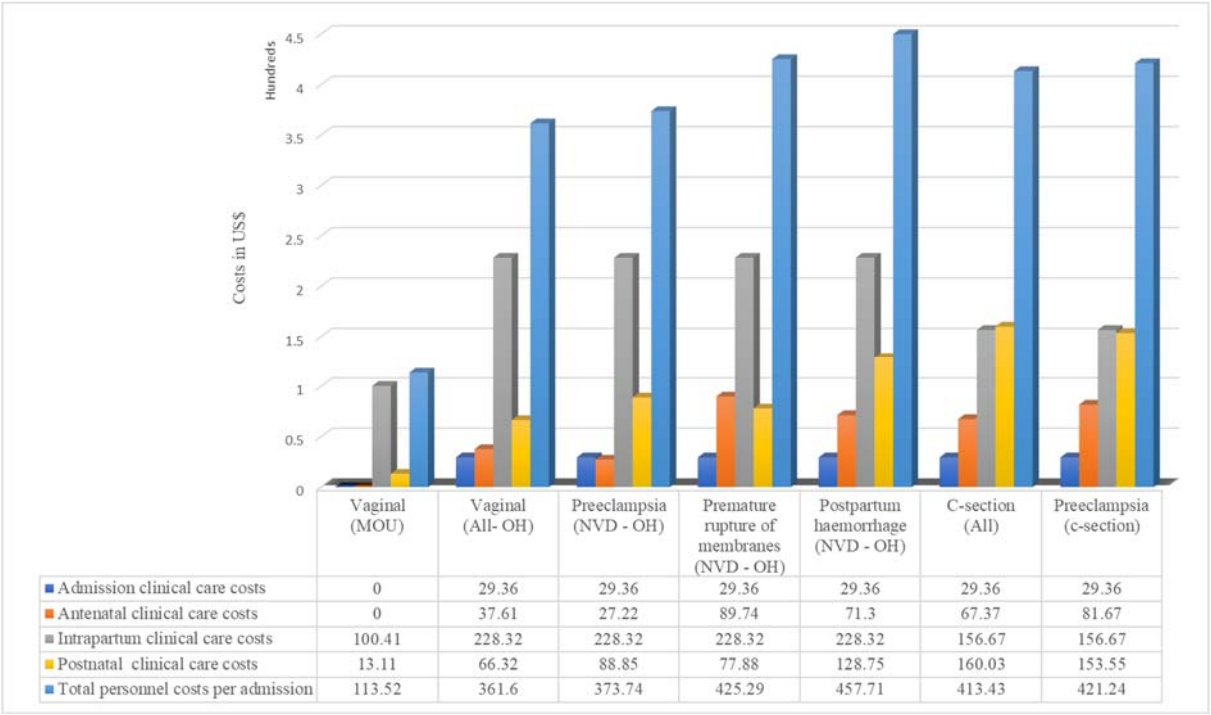
MOU vaginal delivery. The unit cost per spontaneous vaginal delivery was $142.47. Clinical staff costs contributed 80% of the cost, with a mean cost of $113.52 per patient (Table 11). Of these costs, 88% ($100.41) were nursing costs for labour and delivery, and 12% ($13,11) were postnatal costs. Capital costs accounted for 13% of total costs at a mean cost of $19.03 per patient. The mean overhead cost per patient was $8.87. Drug costs were low at an average of $1.02 per patient. There was a small difference between the unit cost in adults ($142.22) versus adolescent mothers at $144.40.

Obstetric hospital delivery. The mean cost for vaginal delivery was $557.49 per patient (SD $200.47) compared to $943.33 (SD $213.19) for a c-section. On average, clinical staff costs accounted for 65% of costs for vaginal delivery and 44% for caesarean section (Table 11). Medicines, consumables, laboratory tests and blood transfusions accounted for 18% of total costs in caesarean section patients and only 3% for vaginal delivery. Overhead costs accounted for 18% of total costs for vaginal delivery and 21% for c-section, while capital costs accounted for approximately one-sixth of the total costs, 14% for vaginal delivery and 16% for c-section.

The cost of vaginal delivery after induction of labour at $631.40 was higher than that of spontaneous vaginal delivery at $544.31. Correspondingly, the mean cost for patients with PPH after vaginal delivery was the highest for all patients with complications following a vaginal delivery, at $869.94. The mean cost for patients with PROM and subsequent vaginal delivery was $615.48. The mean cost for patients who had a vaginal delivery and a diagnosis of preeclampsia was $606.65. The delivery costs for adolescent

mothers in both vaginal delivery and c-section were moderately higher than the mean costs at $565.95 and $1 004.89, respectively. In contrast, the related delivery costs by adult mothers were below the average at $543.13 and $898.29, respectively. Emergency c-section costs were above the total mean cost at $971.86 compared to the cost of elective c-section ($896.84).

As mentioned, the most significant component of total costs was clinical staff, which accounted for 65% of vaginal delivery costs and 44% of caesarean section costs. The mean personnel costs per woman per ward for each delivery method and complication are presented in Figure 7. As shown, total personnel costs for c-section were slightly higher than for all vaginal deliveries but were lower than in complicated vaginal deliveries, with the highest costs in postpartum haemorrhage. Postnatal care costs accounted for the most significant portion of personnel costs for c-section at 39% ($160.03). For c-sections, personnel costs for intrapartum care accounted for 38% of total personnel costs. Mothers who had PPH after a vaginal delivery had a similar postnatal stay to patients with a c-section. Their mean postnatal personnel costs were 50% more than the average for all vaginal deliveries at $128.75.



	Vaginal (MOU)	Vaginal (All- OH)	Preeclampsia (NVD - OH)	Premature rupture of membranes (NVD - OH)	Postpartum haemorrhage (NVD - OH)	C-section (All)	Preeclampsia (c-section)
Admission clinical care costs	0	29.36	29.36	29.36	29.36	29.36	29.36
Antenatal clinical care costs	0	37.61	27.22	89.74	71.3	67.37	81.67
Intrapartum clinical care costs	100.41	228.32	228.32	228.32	228.32	156.67	156.67
Postnatal clinical care costs	13.11	66.32	88.85	77.88	128.75	160.03	153.55
Total personnel costs per admission	113.52	361.6	373.74	425.29	457.71	413.43	421.24

Figure 7. Mean clinical care costs per delivery method and complication (costs in US$)

Note MOU = midwife obstetric unit, NVD = Normal vaginal delivery, OH = obstetric hospital

Table 11. Unit cost by mode of delivery

					Amount and percentage of total costs			
Delivery method	**n**	**ALOS in days**	**Total costs per patient stay $ (SD)**	**Cost per PDE $**	**Capital costs**	**Personnel**	**Medicines, consumables, laboratory tests and blood transfusions**	**Overhead costs**
MOU spontaneous vaginal delivery								
Vaginal delivery (ALL)	148	0.7	142.47 (8.40)		**$19.03** 13%	113.52 80%	**$1.02** 0.7%	**$8.87** 6.2%
Vaginal delivery to adolescent mother	17	0.7	144.40 (8.30)		$17.68 12	$113.52 79	**$1.02** 0.7	$10.77 7
Vaginal delivery to adult mother	131	0.7	142.22 (8.41)		$18.89 13	$113.52 80	**$1.02** 0.7	$8.62 6
Obstetric hospital vaginal delivery								
Vaginal delivery (All)	152	2	557.49 (200.47)	269.01	77.41 14%	361.60 65%	$30.11 3%	$98.62 18%
Spontaneous vaginal delivery	129	2	544.31 (203.02)	276.44	74.75 14%	355.82 65%	19.86 3%	93.88 17%
Vaginal delivery after induction	23	2.7 (3)	631.40 (171.20)	238.07	92.30 15%	394.02 62%	19.88 3%	125.20 20%
Vaginal delivery to adolescent mother	81	2.2 (2)	565.95 (188.79)	258.99	80.82 14%	367.30 65%	14.67 3%	103.15 18%
Vaginal delivery to adult mother	71	1.9 (2)	543.13 (212.56)	279.44	73.52 14%	355.09 66%	22.77 4%	91.75 17%

					Amount and percentage of total costs			
Delivery method	**n**	**ALOS in days**	**Total costs per patient stay $ (SD)**	**Cost per PDE $**	**Capital costs**	**Personnel**	**Medicines, consumables, laboratory tests and blood transfusions**	**Overhead costs**
Vaginal delivery with preeclampsia	15	2.5 (2)	606.65 (133.82)	245.94	85.41 15%	373.74 62%	31.06 6%	116.44 19%
Premature rupture of membranes	13	3.2 (3)	702.30 (346.86)	222.68	108.09 15%	425.29 61%	18.99 2%	149.94 21%
Postpartum haemorrhage	9	4	869.94 (242.92)	217.48	128.47 15%	457.71 52%	94.93 11%	188.82 22%
Caesarean section								
Caesarean section (All)	71	4.3 (4)	943.33 (213.19)	221.78	154.52 16%	413.4h3 44%	174.59 18%	200.79 21%
Elective c-section	27	3.9(4)	896.84 (81,11)	228,44	144.92 16%	393.32 44%	173.28 19%	185.32 21%
Emergency c-section	44	4.5 (4)	971.86 (260,42)	218,17	160.41 17%	425.77 44%	175.40 18%	210.28 22%
Caesarean section to adolescent mother	30	4.7 (5)	1 004.89 (294.05)	213,81	167.60 17%	440.96 44%	174.47 17%	221.86 22%
Caesarean section to adult mother	41	3.9 (4)	898.29 (109.21)	228.76	144.95 16%	393.29 44%	174.68 20%	$185.37 21%
Caesarean section with Preeclampsia	5	4 .4 (4)	977.58 (200.49)	222,18	157.71 16%	421.24 43%	190.92 20%	207.70 21%

Note: ALOS = Average length of stay, *SD* = Standard Deviation

5.3.3 Sensitivity analysis

Using confidence intervals, we constructed high and low ALOS values for the different modes of delivery stratified by age or complication, which had longer lengths of stay than the base case scenario, which included all patients for a specific mode of delivery, as presented in Table 12. As expected, the length of stay had an impact on average costs. This was more evident in hospital-based intrapartum care.

Table 12. Average length of stay stratified by age or complication

Cost categories	Baseline estimate (mean)	Lower Bound	Upper Bound	Source of data
MOU vaginal (ALL*)	0.7 days	0.65 days	0.78 days	‡
OH vaginal (ALL)	2.1 days	1.8 days	2.3 days	‡
OH vaginal (PPH)	4 days	2.4 days	5.6 days	‡
OH vaginal (Preeclampsia)	2.5 days	1,9 days	3.1days	‡
OH vaginal (PROM)	3.5 days	1.5 days	5.5 days	‡
C-section (ALL)	4.25 days	3.9 days	4.6 days	‡
C-section (Adolescent mother)	4.7 days	3.9 days	5.5 days	‡

Notes: MOU = Midwife Obstetric Unit, OH = obstetric hospital‡ based on data obtained from patient clinical records, * based on all patients in each mode of delivery sample

MOU Vaginal delivery

Sensitivity analysis for MOU vaginal delivery revealed that average costs were robust to changes in length of stay (Figure 8)

Obstetric hospital vaginal delivery

The varying lengths of stay had the most impact on the cost in patients diagnosed with postpartum haemorrhage. This was driven by the extended length of stay in the postnatal ward. A tornado diagram depicts the effect of the different lengths of stay on average cost per delivery (Figure 8).

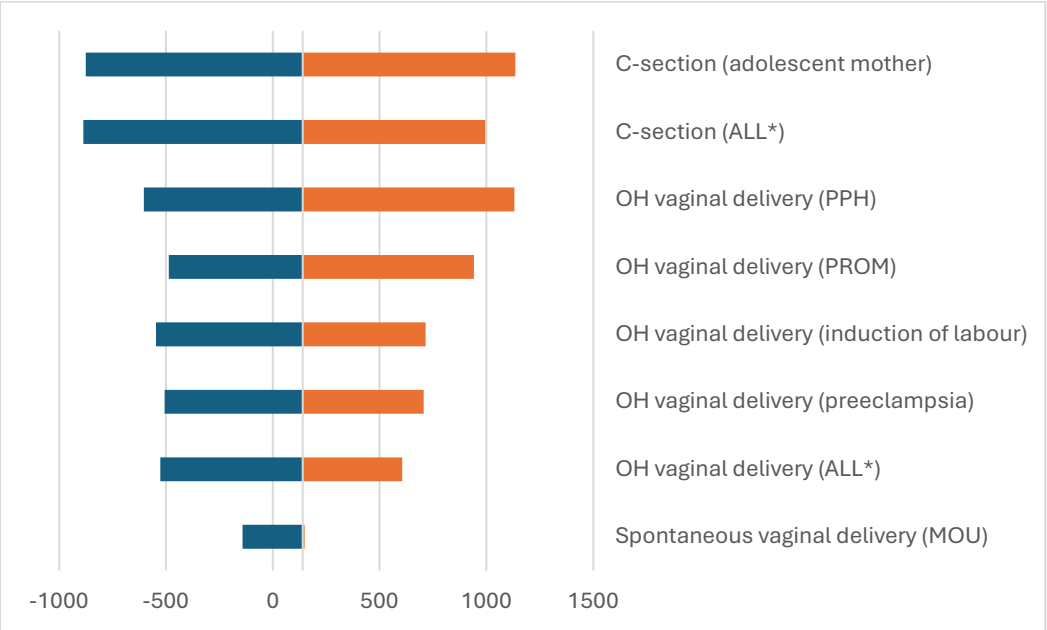


Figure 8. Tornado diagram

Note: MOU = midwife obstetric unit, OH = obstetric hospital, PPH = postpartum haemorrhage, PROM = premature rupture of membranes

Caesarean section

Average costs were more sensitive to the length of stay in patients diagnosed with preeclampsia (*Figure 8*). This was driven by extended length of stay in the antenatal ward.

5.4 Discussion

The aim of this study was to estimate the unit costs of childbirth care at the primary and secondary levels in the South African public health sector, which serves 80% of the population with services that are free at the point of use. In this setting, routine costing data are lacking, and electronic information systems are still in development. Primary research based on record reviews is therefore required to estimate the investment needed to improve the quality of maternity care. While the facilities included in this analysis are currently funded via historical budgeting approaches, the cost estimates presented in this paper can also be used to inform the planned introduction of alternative provider payment mechanisms such as capitation (for primary care) and diagnostic-related groups (for hospital care) (Republic of South Africa, 2024).

Our results indicate that the cost of vaginal delivery at a midwife-led unit was $142.47 compared to $557.49 at an obstetric hospital, and a c-section was $943.33 per patient. Personnel costs, including salaries for obstetricians, midwives, nurses, and anaesthetists, formed a substantial portion of the unit costs. The length of stay and the type of delivery (vaginal birth vs. cesarean section) significantly influenced these costs. Medicine costs

were generally low and depended on the specific needs of each patient for each type of delivery. It is generally understood that a c-section is more expensive than spontaneous vaginal delivery (Sarmiento et al., 2023). In our analysis, the mean c-section cost was 1.7 times higher than vaginal delivery within a hospital setting. The additional costs were attributable to medicines, consumables, personnel costs accrued over the extended inpatient stay, and overhead costs.

The direct provider costs (excluding overhead and capital costs) for vaginal and c-section delivery in South Africa are higher than the costs reported from a recent systematic review, which were between $14.50 and $281.65 for vaginal and between $73.00 and $383.62 for c-section [2020 prices] (Banke-Thomas et al., 2020). While the costs in our study are higher, they are comparable to estimates of the cost per inpatient day in public sector district hospitals in South Africa. Comparable to this study, however, the review found that personnel costs were the primary cost driver for vaginal delivery and c-section. Obstetric complications - mainly seen in the vaginal delivery sample - required additional observation, extending the inpatient stay and resulting in higher mean costs. Patients diagnosed with PPH after vaginal delivery had a similar ALOS and similar costs to patients who had a c-section. Comparable to other studies, our study also revealed the mean cost of an emergency c-section was higher than that of an elective c-section (Petrou & Khan, 2013).

Study limitations

This analysis has a number of shortcomings. While the aim of this study was to assess provider costs as an input towards investment decisions to improve the quality of maternal health care, the exclusion of patient costs is a limitation. As mentioned, the public sector serves the majority of the population with services that are largely free at the point of use. Patient costs would, therefore, include direct non-medical costs (e.g. transport to the facility), the opportunity cost of time and potentially indirect costs (e.g. lost income). Previous research in South Africa has assessed the patient costs of comprehensive and emergency obstetric care based on patient exit interviews conducted in several facilities, including the obstetric hospital that is the subject of this current paper. This research indicated that the majority of patient costs were incurred for supplies (e.g. nappies, sanitary towels), with transport costs being the second largest category of cost (Cleary et al., 2013)

A further limitation is that we used interviews to establish full-time equivalent clinical staffing per ward and allocated these using a top-down approach. For vaginal deliveries, this means that the overall unit cost is accurate. Still, we may have underestimated or overestimated the intensity of staffing needed to manage complications in the labour ward. In contrast, for c-sections, we were able to ascertain the time spent in surgery directly from patient records.

5.5 Conclusion

This cost analysis underscores the multifaceted nature of childbirth care costs in public healthcare facilities in South Africa. By understanding these costs from a provider's perspective, healthcare administrators and policymakers can gain insights for decision-making to enhance efficiency, optimise resource allocation, and ensure sustainable delivery of high-quality maternal care.

Chapter 6

6 Chapter 6: Understanding the potential value of adolescent sexual and reproductive health education: a cost consequence analysis

Abstract

Background: Promoting the sexual and reproductive health (SRH) of adolescent girls remains central to enabling their health, education, and economic prospects. Comprehensive school-based SRH education (SBSHE) is a priority in many low and middle-income countries, yet little is known about the economic value of these interventions. The objectives of this study were to estimate the costs and consequences of a comprehensive SBSHE intervention in terms of changes in SRH service costs as well as a range of intermediate and final outcomes.

Methods: We conducted a within-trial cost analysis and a modelled cost consequence analysis from a multisectoral provider and learner perspective. Our time horizon was the period of high school (5 years). Because the intervention within the trial did not show an impact on primary biological outcomes, we conducted multiple one-way sensitivity analyses and constructed scenario analyses to explore drivers of impact and potential value for money.

Results: Girls enrolled in the trial had a high need for sexual and reproductive health services. In our base case analysis, 24.3% were STI positive, 20.9% were using contraceptives, and 22.9% were modelled to fall pregnant over the course of high school, generating further need for maternal health services. The estimated undiscounted cost per learner over a five-year period was $289.66, with contraceptives and obstetric services accounting for 48% and 47%, respectively. The total societal costs of the SRH

intervention were $447.07, while the life years and QALYs were estimated at 4.9 and 4.4, respectively. In scenario analysis, increasing levels of abstinence or contraceptives both improved biological outcomes, although the latter generated significantly higher contraceptive costs. One-way sensitivity analyses revealed that changes in the discount rate and the utilisation of the intervention had the most impact on societal costs.

Conclusion: The results of this study highlight the need for further research to evaluate and optimise interventions for promoting adolescent SRH, especially in high-burden settings with constrained resources.

6.1 Introduction

Promoting adolescent sexual and reproductive health (SRH) is a global priority, integral to the attainment of the Sustainable Development Goals (SDGs) (Otu, Danhoundo & Yaya, 2021; United Nations, 2023). Adolescence (10 to 19 years) is a distinct phase of life (WHO, 2021) characterised by rapid biological, emotional and social development, which presents unique social and physical vulnerabilities for SRH (Laski, 2015; Odebode & Kolapo, 2016). Sub-Saharan Africa (SSA) has the highest burden of sexual and reproductive ill-health, with 40% of the global burden of STIs (Wang et al., 2023), 70% of the global HIV burden (WHO, 2023b), and the highest global rates of unintended pregnancies (UNFPA ESARO, 2021). Adolescent girls remain disproportionately affected by poor SRH outcomes in this region. In 2023, approximately six times as many adolescent girls were newly infected with HIV than adolescent boys (UNICEF, 2024). More than 20% of adolescent girls and young women (15 to 24) in SSA have an unmet contraceptive need (Sidibé et al., 2022), and approximately 50% of adolescent

pregnancies are unintended (Sully et al., 2020). More than 50% of unintended pregnancies result in termination of pregnancy (Mohamed et al., 2023), of which a high proportion (97%) is unsafe (Singh et al., 2018; World Health Organization (WHO), 2019). Ninety-nine per cent of maternal deaths of women aged 15 to 19 years occur in low- and middle-income countries (LMICs), particularly in sub-Saharan African countries (Kassa et al., 2018).

In South Africa, the highest curable STI incidence is detected in adolescent girls and young women (Frank et al., 2023). This, among other factors, predisposes them to a higher risk of HIV acquisition (Kharsany et al., 2020). In a country that bears the largest global HIV burden, an estimated third of all new HIV infections are seen in this population (Simbayi et al., 2019). Thirty-one per cent of adolescent girls have an unmet need for contraception (Jonas, Mathews, et al., 2022). South Africa has one of the highest adolescent pregnancy rates globally, and nearly 20% of women have given birth by age 18 (National Department of Health South Africa, Statistics South Africa & South African Medical Research Council (SAMRC), 2019).

South Africa's burden of sexual and reproductive ill-health manifests despite the country's progressive legislative framework, the provision of comprehensive SRH services that are relatively widely accessible and free at the point of use and the implementation of multiple interventions by government and non-governmental agencies to promote sexual and reproductive health (Strode & Essack, 2017). This includes two decades of comprehensive sexual education (CSE) in schools [also referred to as school-based sexual and reproductive health education (SHSHE)], community

awareness campaigns, adolescent-friendly health services, and improved access to contraceptives, including condoms (Reddy, Sewpaul & Jonas, 2016; Republic of South Africa, 2017; Adeniyi et al., 2018).

A recent review of reviews shows that the evidence regarding the effectiveness of health promotion interventions aimed at preventing adolescent pregnancy is mixed; interventions such as skill-building, peer-led programs, and abstinence initiatives have shown general effectiveness in reducing adolescent pregnancy rates and improving contraceptive use, while interventions focusing only on information provision, counselling, and those based on learner and teacher engagement have yielded mixed results (Mohamed et al., 2023). These findings suggest a complex landscape where some approaches and strategies show promise while others may need further refinement or evaluation to enhance their effectiveness in preventing adolescent pregnancies. In addition to mixed findings on effectiveness, the economic aspects of school-based SRH interventions are underexplored (Hawkins, 2024), which further limits policymaking in this area.

In response to the ongoing need to develop effective SRH promotion programmes in South Africa, the Goals for Girls (G4G) cluster randomised trial tested the impact of adapting an existing evidence-based sports comprehensive SBSHE intervention (Grassroot Soccer, 2021) to the school environment, given that 98% of children between 7- and 17 years old attend school in South Africa (Hall, 2024). The SKILLZ Health for Girls intervention was mainly implemented as an afterschool programme and included a 10-session near peer-led sports-based curriculum delivered over two school terms. The

curriculum focused on gender equality and building agency in adolescent girls through various sports-based health-promoting activities. Primary trial outcomes included the prevalence of two curable STIs (*Chlamydia trachomatis* and *Neisseria gonorrhoea*), pregnancy incidence and HIV incidence (Pike, Coakley, Ahmed, et al., 2023). The intervention was not effective across these outcomes. While the intervention was highly accepted by the target population, the study did not retain engagement, and attendance was less than 50%. This was related to several barriers, including after-school household responsibilities for adolescent girls and security concerns. Further details are available in published sources (Pike, Coakley, Ahmed, et al., 2023; Pike, Coakley, Lee, et al., 2023). While the trial was not effective, it collected a rich variety of data which can be combined to provide a further understanding of the cost burden of sexual and reproductive ill health in this vulnerable population as well as the potential impact of variations in key sexual and reproductive health outcomes on both costs and consequences. This, in turn, can further clarify the level of investment required and the potential value for money of similar interventions.

Using a healthcare provider perspective, this paper estimates the costs of adolescent SRH services over the period of secondary school (grades 8-12). Then, using a multisectoral provider (Departments of Health and Education) and learner perspective, it models the costs and consequences of a comprehensive SBSHE intervention in order to understand the potential changes in costs across perspectives as well as changes in outcomes, including the percentage of time spent in school, pregnancies, births, life years, and quality-adjusted life years (QALYs).

6.2 Methods

6.2.1 Study population

The Goals for Girls (G4G) cluster randomised trial was conducted in 38 'no fee' secondary schools in the Klipfontein/ Mitchells Plain health sub-district of Cape Town, South Africa, between 2018 and 2019. The eligible population for the trial included non-pregnant female learners (approximate age 14 to 17 years) in grades 8 to 10. Cluster randomisation was done by the school, and schools were randomly assigned to the intervention arm (the 'SKILLZ' intervention in addition to the existing classroom-based CSE curriculum) or the control group (only classroom-based CSE curriculum). Primary trial outcomes included changes in the prevalence of two curable STIs (*Chlamydia trachomatis* and *Neisseria gonorrhoea*), HIV and pregnancy. In addition, the trial collected information on contraceptive uptake. Trial details have previously been published (Pike, Coakley, Ahmed, et al., 2023).

6.2.2 Study design

We conducted a within-trial cost analysis and a modelled cost consequence analysis using a societal perspective (multi-sectoral provider and learner perspective). The time horizon of the analysis was restricted to the 5-year period of secondary school in the South African system (grades 8-12). The scope of costs was defined to include any changes in direct provider and direct learner costs that could result from the implementation of a comprehensive SBSHE intervention. These included the costs of the SKILLZ intervention (Department of Education perspective) and the costs of associated SR health services (Department of Health perspective), including contraception, STI

treatment, HIV treatment, termination of pregnancy, antenatal care, and intrapartum care. Learner costs were limited to the transport costs associated with accessing the SKILLZ intervention. Modelled intermediate outcomes included % pregnant, % giving birth and % time spent in school, and final outcomes included life years and quality-adjusted life years (QALYs). Given the focus on the secondary school period, our analysis excluded longer-term economic benefits such as productivity changes as well as the health care, social development and education costs associated with any babies born to adolescent mothers. We also excluded the opportunity costs of learner's time in an afterschool activity. All costs were expressed in 2020/21 prices converted to United States Dollars ($).

6.2.3 Modelling overview

We adopted a Markov modelling approach using TreeAge Pro Healthcare 2024, as depicted in Figure 9, with parameter values presented in Table 13. A hypothetical population of adolescent girls enters the model at the start of secondary school (age 13-14, grade 8) and is followed over a 5-year horizon using a three-month cycle length (equivalent to a school term). As is shown, the first two terms of school are modelled separately in order to capture intervention costs; thereafter, the model is structured around Markov states associated with being 'in school', 'out of school', 'pregnant first/second/third trimester' and 'postnatal' with 'dead' as the absorbing state. Various transition probabilities are used to move between these states. Probabilities of falling pregnant are mediated via contraceptive uptake, with those taking contraceptives assumed not to fall pregnant. Those falling pregnant have the option of terminating; if

not, they are assumed to carry to term, moving through Markov states associated with each successive trimester. They then move into the postnatal state for one cycle. Thereafter, a proportion will return to school, and the remainder will remain out of school.

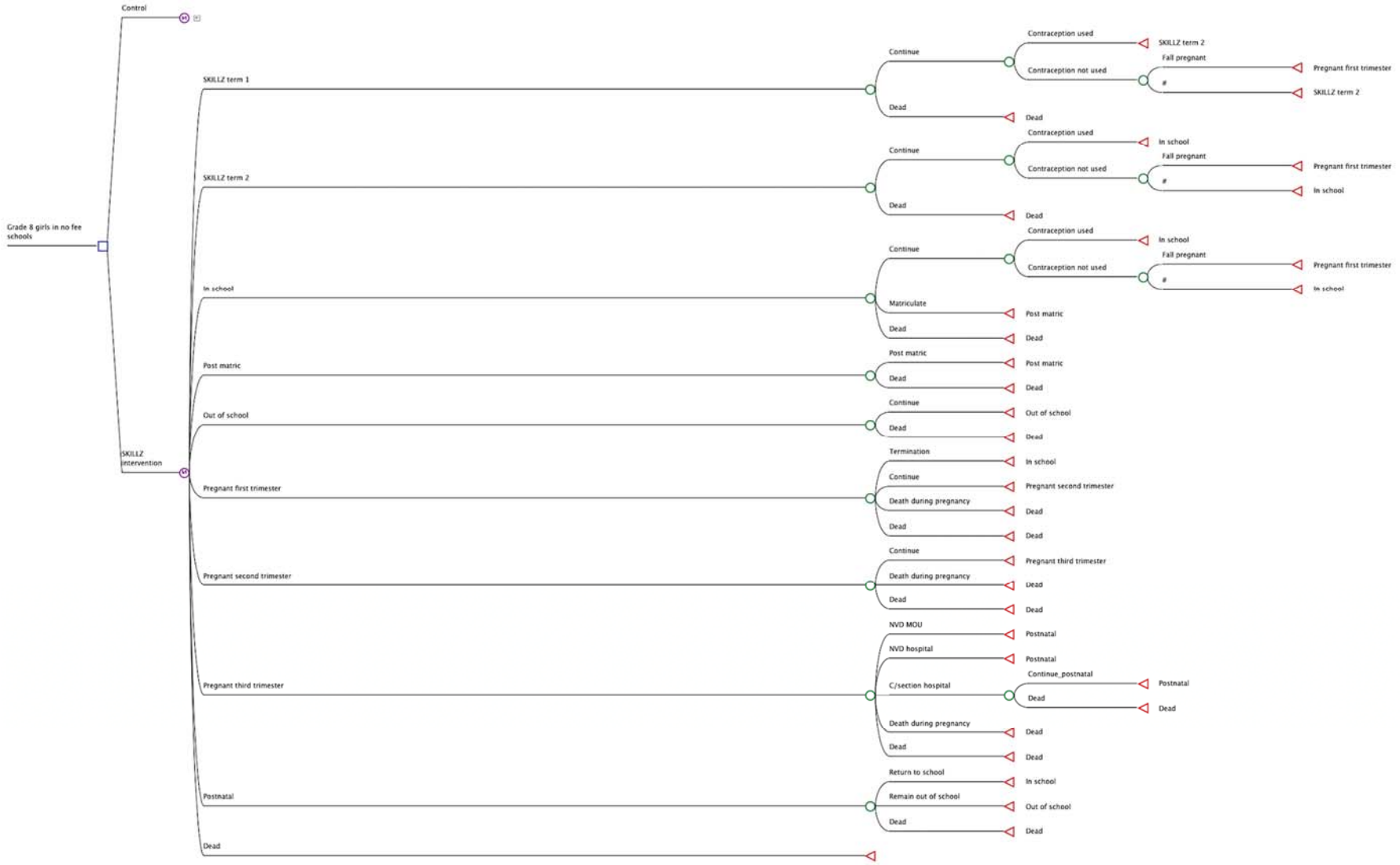


Figure 9. Simplified structure of the Markov model

6.2.4 Model variables

Table 13 summarises the values of parameters used in the model, ranges for sensitivity analyses, and sources of data. These include proportions and probabilities, unit costs and associated utilisation estimates, and quality of life values. For input parameters not found in the trial, we performed a systematic search for relevant literature and used official government sources for other country-related variables.

Given substantial loss to follow-up as well as largely non-significant changes in outcomes within the intervention arm of the G4G trial (including STIs, HIV, contraceptive uptake and pregnancy), the model is parameterised with baseline estimates drawn from the control group for prevalence of STIs and HIV and proportion on contraceptives. As mentioned, a high proportion of girls enrolled in the trial were lost to follow-up (uncontactable across multiple attempts), and it was not possible to estimate the incidence of pregnancy using these data (Pike, Coakley, Ahmed, et al., 2023). Instead, we calibrated the model against secondary data indicating that 20% of South African girls have begun childbearing by age 18 (roughly the age at which secondary school is completed). Based on the baseline estimates of the uptake of contraceptives in the trial as well as the uptake of abortion services in South Africa, we then estimate probabilities of falling pregnant per cycle. We included probabilities of dying during pregnancy and an age-specific all-cause probability of dying using WHO life tables for girls/women in South Africa (WHO, 2020).

Health provider unit costs related to contraception and treating STIs, including HIV, abortion, and antenatal care, were sourced from the literature using systematic methods. The costs for labour and delivery, including normal vaginal delivery and caesarean section, were estimated from a primary cost analysis including direct, overhead and capital costs for two different levels of care (a midwife-led obstetric unit and a regional hospital) consistent with current practice in South Africa (Chapter 5).

Costs for the intervention have been previously described (Chapter 4). Briefly, we have modelled these costs based on the 'intention to treat' analysis but have adjusted these costs based on the realised attendance rates as seen in the trial. The results, therefore, incorporate considerable diseconomies of scale and can be considered conservative. Learner costs comprise transport costs, which were estimated in the previous cost analysis as transport was provided to the learners within the G4G trial. All costs were adjusted for the 2020/21 financial year.

Values related to quality of life were sourced from the literature. We searched for studies conducted in LMICs using the EQ5D instrument, which presented utility values.

6.2.5 Cost-consequence analysis

We present our base case findings per learner over the 5-year time frame, providing both undiscounted (0%) and discounted (3%) results. Health provider costs are summarised by the type of SRH service. Multisector provider costs are estimated to include health provider and education provider costs. Societal costs are the summation of all provider

costs with learner transport costs associated with the intervention. Estimated consequences are also presented in a disaggregated fashion, including intermediate outcomes of % time in school, % pregnant and % giving birth by 5 years. We also present the final outcomes of life years and QALYs.

Table 13. Model input parameters for the base case and sensitivity analysis

Input variables	Values			Reference or source
	Base	Minimum	Maximum	
Probabilities and proportions				
Proportion on contraceptives (control group)	0.2086	0.1043	0.3129	(Pike, Coakley, Ahmed, et al., 2023)
Proportion STI positive (control group)	0.2433	0.12165	0.36495	(Pike, Coakley, Ahmed, et al., 2023)
Proportion HIV-positive (control group)	0.0097	0.00485	0.01455	(Pike, Coakley, Ahmed, et al., 2023)
Proportion aware of HIV-positive status assumed on treatment	0.8	0.4	1	(Pike, Coakley, Ahmed, et al., 2023)
Proportion STIs treated	1	0.5	1	Assumption
Probability of falling pregnant per cycle (calibrated)	0.0192	0.0096	0.02886	(National Department of Health South Africa, Statistics South Africa & South African Medical Research Council (SAMRC), 2019)
Proportion pregnancies terminated	0.09	0.045	0.135	(Barron et al., 2022)
Proportion deliveries c/section	0.283	0.1415	0.4245	(South African National Department of Health, 2019)
Proportion deliveries normal vaginal delivery MOU	0.4	0.2	0.6	(Pattinson et al., 2015)
Proportion dying post c/section	0.001	0.0005	0.0015	(South African National Department of Health, 2019)
Probability of death during pregnancy in those aged 15-19 years	0.0015	0.00075	0.00225	(South African National Department of Health, 2019)
Proportion returning to school after postnatal period	0.7	0.35	0.99	(Jochim et al., 2023)

Input variables	Values			Reference or source
	Base	Minimum	Maximum	
Unit costs				
Cost per contraceptive visit	37.78	18.89	56.67	(Massyn et al., 2020; South Africa National Department of Health, 2024)
Cost of HIV treatment per cycle	65.77	32.885	98.655	(Meyer-Rath et al., 2019)
Cost of syndromic STI treatment	14.01	7.005	21.015	(Smith, Leach & Rossouw, 2023)
Cost per medical termination of pregnancy	76.00	38	114	(Lince-Deroche et al., 2017)
Cost per antenatal visit	37.5	18.75	56.25	(Massyn et al., 2020)
Cost per c/section delivery	943.33	471.665	1414.995	Chapter 5
Cost per normal vaginal delivery in hospital	557.49	278.745	836.235	Chapter 5
Cost per normal vaginal delivery in MOU	142.47	71.235	213.705	Chapter 5
Cost per SKILLZ session - intention to treat	128.09	64.045	192.135	Chapter 4
Cost of SKILLZ transport per session - intention to treat	21.60	10.8	32.4	Chapter 4
Utilisation				
Utilisation of ANC visits Trimester 1	0.5	0.25	0.75	(Pattinson & Buchmann, 2017)
Utilisation of ANC visits Trimester 2	1.3	0.65	1.95	(Pattinson & Buchmann, 2017)
Utilisation of ANC visits Trimester 3	2.2	1.1	3.3	(Pattinson & Buchmann, 2017)
Number of participants per SKILLZ session - intention to treat	20	10	30	(Pike, Coakley, Ahmed, et al., 2023)
Realised attendance at SKILLZ sessions - cohort 2	0.4717	0.23585	0.70755	(Pike, Coakley, Ahmed, et al., 2023)
Utilisation of SKILLZ sessions per term - intention to treat	5	2.5	7.5	(Pike, Coakley, Ahmed, et al., 2023)

Input variables	Values			Reference or source
	Base	Minimum	Maximum	
Quality of life				
Quality of life of adolescents in school	0.897	0.8073	0.9867	(Mahumud et al., 2019)
Quality of life of adolescents out of school	0.833	0.7497	0.9163	(Jyani et al., 2023)
Quality of life of adolescents after matriculation	0.852	0.7668	0.9372	(Jyani et al., 2023)
Quality of life of pregnant adolescents trimester 1	0.86	0.774	0.946	(Boutib et al., 2023)
Quality of life of pregnant adolescents trimester 2	0.84	0.756	0.924	(Boutib et al., 2023)
Quality of life of pregnant adolescents trimester 3	0.64	0.576	0.704	(Boutib et al., 2023)
Quality of life of postnatal adolescents	0.70	0.63	0.77	(Jyani et al., 2023)
Discounting				
Annual discount rate	0.03	0	0.05	(Haacker, Hallett & Atun, 2020)

6.2.6 Sensitivity analyses

To assess the impact of an effective, comprehensive SBSHE intervention on costs and consequences, we performed extreme scenario analyses focused on three SRH outcomes: 1) the probability of falling pregnant (independent of the use of contraceptives), 2) the proportion using contraceptives, and 3) prevalence of STIs, including HIV. We present these findings as part of our cost-consequence analysis to illustrate the potential shifts in costs and consequences that could result from a successful intervention. While the majority of our findings are presented in a disaggregated fashion, we calculate an incremental cost per QALY gained summarising changes in (1) health provider costs and (2) multisector provider costs comparing each of the extreme scenarios to the base case (discounted at 3%). We interpret these findings in relation to a supply-side indicative cost-effectiveness threshold for South Africa (Edoka & Stacey, 2020). Given the lack of a demand-side threshold, we do not estimate an incremental cost per QALY gained from a societal perspective.

In addition to the scenario analysis, we ran one-way sensitivity analyses on all parameters using the ranges presented in Table 13 and summarise these findings in a tornado plot. We varied the base case values by ±50% except where this would move the variable out of the feasible range.

6.3 Results

Our modelled cost consequence results are provided in Table 14. We summarise cost results from a healthcare provider perspective, from a multisectoral provider perspective

(including the comprehensive SBSHE intervention costs) and from a societal perspective (including learner transport costs). When undiscounted, the health provider cost per learner over a five-year period is $289.66, with contraceptives accounting for just under half of these costs (48%). Obstetric services, which included antenatal, intrapartum, and immediate postnatal care, accounted for 47% of healthcare costs. Abortions and STIs, including HIV, accounted for 1% and 5%, respectively. The addition of a potential comprehensive SBSHE intervention adds $134.70 to costs, and learner transport costs are estimated at $22.71. The resultant total societal costs are $447.07. The intervention costs account for 30% of the societal costs, while learner costs (transport) account for 5%.

In terms of consequences, undiscounted outcomes indicate that girls had the opportunity to be in school up to 97% of the time during the 5-year period. In effect, this is because we assumed that they missed school in the three-month postnatal period, and based on the literature, we modelled that 70% would return to school thereafter. With our model calibrated to estimate 20% giving birth by the end of the projection, our estimates suggest that 23% would have fallen pregnant. Life years and QALYs were estimated at 4.9 and 4.4, respectively.

The three extreme scenario analyses illustrate that key shifts in costs would result from the implementation of an effective, comprehensive SBSHE intervention, particularly from the health provider perspective. If an intervention worked via abstinence such that the probability of pregnancy fell to zero, obstetric and termination costs would also fall to zero. This results in cost savings across all perspectives. When compared to the base

case (3% discounted), these savings, together with improved QALYs, generate absolute dominance, as shown by the negative signs on the incremental cost per QALY gained from either health or multisector provider perspectives. In contrast, if the intervention worked via encouraging the uptake of contraceptives (assumed for illustrative purposes to increase to 100%), the marked increase in contraceptive costs would outweigh the decrease in obstetric and termination costs, generating large net cost increases across all perspectives. Resulting ratios are estimated at $11,295 and $11,323 per QALY gained from the perspectives of health providers and multisector providers, respectively. These are considerably higher than a supply-side indicative cost-effectiveness threshold for South Africa. Finally, if the prevalence of STIs and HIV were to fall to zero, costs would also reduce, but by a much smaller margin. Given the high life expectancy and high quality of life of those treated for HIV (and STIs), we did not model outcome changes and hence do not calculate an incremental cost per QALY gained for this scenario.

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Table 14. Cost consequence and extreme scenario analysis (Costs in US$)

	0% discount rate	3% discount rate	If prob pregnancy is 0%; 3% discount rate	If uptake of contraceptives is 100%; 3% discount rate	If prop STIs and HIV is 0%; 3% discount rate
COSTS					
Contraceptives	137.86	129.30	138.57	664.30	129.30
STIs and HIV	14.11	13.38	12.80	12.80	-
Obstetrics	135.96	126.00	-	-	126.00
Termination of pregnancy	1.73	1.61	-	-	1.61
Total health provider costs (a)	**289.66**	**270.28**	**151.37**	**677.10**	**256.90**
SRHP intervention (b)	134.70	134.21	135.23	135.23	134.21
SRHP learner transport (c)	22.71	22.63	22.80	22.80	22.63
Total multisectoral provider costs (a+b)	**424.36**	**404.49**	**286.60**	**812.33**	**391.11**
Total societal costs (a+b+c)	**447.07**	**427.12**	**309.41**	**835.13**	**413.74**
CONSEQUENCES					
% time in school	96.6%	96.7%	100.0%	100.0%	96.7%
% pregnant	22.9%	22.9%	0.0%	0.0%	22.9%
% giving birth	20%	20%	0%	0%	20%
Life years	4.940	4.611	4.613	4.613	4.611
QALYs	4.394	4.102	4.138	4.138	4.102
Incr Cost per QALY gained					
Health provider			(3,301.42)	11,295.02	N/A
Multisectoral provider			(3,273.01)	11,323.44	N/A

As explained, we ran one-way sensitivity analyses across all parameters using the low and high values presented in Table 13. The majority of the parameter changes had no impact on either costs or consequences. In Figure 10, we present the findings for the parameters that were influential on societal costs. In addition to the influence of the discount rate, influential parameters included a variety of parameters related to uptake of the intervention, where costs would decrease if a higher number of participants participated per session if attendance at sessions were higher, if fewer sessions were offered per term or if the cost per session were to decrease (for example if offered by a less expensive cadre of staff). Beyond this, cost changes are mediated via contraceptive costs, proportions using contraception and the probability of falling pregnant, as expected given the results in the extreme scenario analysis. Changes in other variables had minimal impact on costs, and few variables influenced QALYs (results not shown).

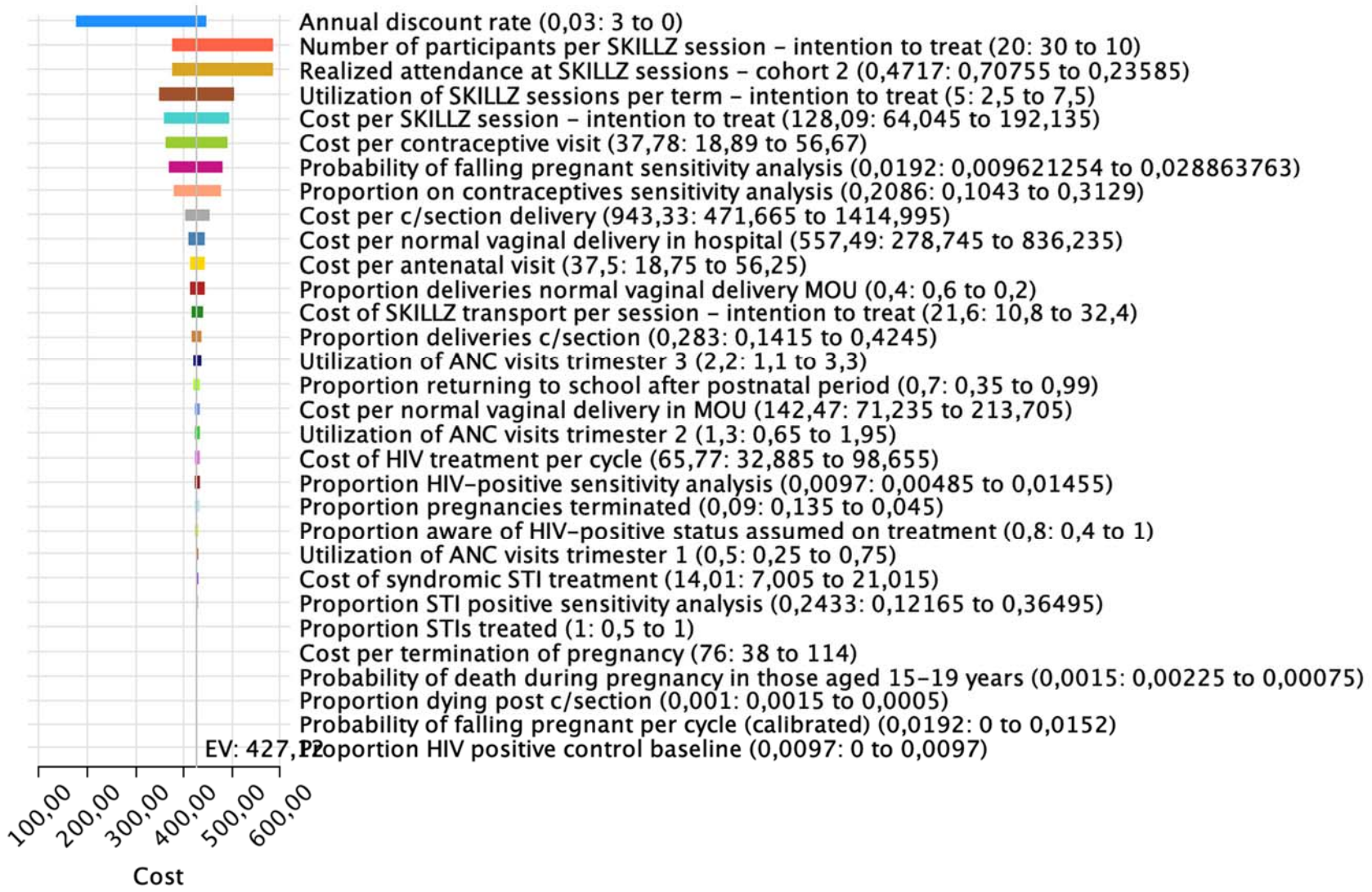

Figure 10. Tornado diagram societal costs (Costs in US$)

6.4 Discussion

Promoting the SRH of adolescent girls remains critical for a number of Sustainable Development Goals. This cost consequence analysis explored the costs and potential consequences of a comprehensive SBSHE intervention using a multisectoral provider and learner perspective across a range of intermediate and final outcomes. We combined a within-trial economic evaluation with a modelling approach in order to understand how costs and consequences might change if a successful intervention were to be implemented for this population of secondary school girls.

While it is logical for economic evaluation to be conducted alongside an effective intervention, there are challenges in implementing comprehensive SBSHE interventions in SSA, resulting in an extremely limited economic evidence base (Kaiser et al., 2021; Meherali et al., 2021). We therefore used baseline/control group data from the trial to understand the cost of needed SRH services given observed levels of STIs, HIV and uptake of contraceptives. While high levels of loss to follow-up and drop out from school meant that we were unable to estimate pregnancy incidence from the trial, we calibrated our model against secondary data indicating that up to 20% of girls have begun childbearing by age 18. This allowed us to use scenario analysis to understand how costs and outcomes might change depending on the effectiveness of any similar intervention.

Using a 3% discount rate and a five-year time horizon, if nothing changes, the study estimates that providing sexual and reproductive health services to adolescent girls costs

approximately $270 per learner from a Department of Health perspective. In this base case analysis, 22.9% would fall pregnant, 20% would give birth, there would be 4.6 life years and 4.1 QALYs, and 96.7% of the time would be available for school. The SRH intervention would cost $134, and learner transport costs would be $23. Total multisectoral provider and learner costs would be $427. Our scenario analyses then illustrate what would happen if a comprehensive SBSHE intervention worked either via an abstinence route (assuming a probability of pregnancy of 0%) or via a contraceptive route (assuming an uptake of contraceptives of 100%). For these two scenarios, we present an incremental cost per QALY gained from the perspectives of both a health provider and a multisectoral provider. These results indicate that incremental cost-effectiveness ratios range from negative (absolute dominance; highly cost-effective) to positive (higher than South Africa's indicative cost-effectiveness threshold; unlikely to be cost-effective). While both of these scenarios generate improved outcomes, the contraceptive route is costly, with the increased uptake of contraceptives considerably outweighing reductions in obstetric costs. Put together, these findings suggest that emphasis should be placed on interventions that work via both mechanisms (abstinence and contraceptives) and that reducing the costs of contraceptive services is a key priority to drive value for money. Continuing to provide accessible termination of pregnancy services would also be needed. Although this analysis shows that increasing contraceptive costs would outweigh the averted demand for short-term maternal healthcare services and associated costs, increasing the use of contraceptives would have positive impacts on long-term mother and child health and maternal mortality, avoiding broader societal costs (Kelly et al., 2023). In addition to modelling changes in pregnancy, we

also modelled changes in STIs and HIV. An interesting finding from this work is that contraceptive and obstetric costs for this population considerably outweigh STI and HIV costs from a healthcare provider's perspective. This is partly driven by the relatively low HIV prevalence in this population (<1%). That said, STIs were highly prevalent (>20%), indicating a risk of HIV acquisition in future years.

Even though promoting adolescent SRH through CSE has been identified as a priority, many LMICs experience challenges with implementing CSE programmes for several reasons, including the unavailability of resources and a lack of formalised multisectoral collaboration (Chavula, Zulu & Hurtig, 2022). Multisectoral collaboration is essential for improving adolescent SRH outcomes, especially in SSA. In South Africa, the value and role of multisectoral collaboration for adolescent SRH is acknowledged. However, the persistent disease burden requires a better understanding of the SRH needs of adolescents to inform the design of multisectoral policies and programmes (Ndlazi & Masango, 2022). By presenting disaggregated costs and outcomes, our study intends to support better interpretation of the evidence by helping different sectors gain insights from their perspectives (Ramponi et al., 2024).

This study has some limitations. We restricted our analysis to the five-year period of secondary school, excluding any longer-term indirect benefits (such as changes in productivity) that are argued to be an important outcome of such interventions (Jakubowski, Roos & Wall-Wieler, 2023). We also excluded the costs associated with supporting children

born to adolescent mothers. While we included transport costs for learners participating in the afterschool intervention, we excluded other opportunity costs of their time and therefore present only a limited learner perspective. We also excluded patient costs. While the South African public health care sector offers services free at the point of use and primary care services are widely accessible in communities, our exclusion of patient direct non-health care costs is a limitation, particularly for birth services where these costs have previously been shown to be higher than in other primary healthcare services (Cleary et al., 2013).

Despite the limitations of the study, we have provided new evidence on the potential value of a comprehensive SBSHE intervention. While the effectiveness of adolescent SRH has been investigated in South Africa, the economic value of such interventions has not been explored. Our results help to clarify how multisectoral provider costs change in response to a health promotion intervention. We also clarify how results change depending on whether the intervention works via an abstinence mechanism or via a contraceptive mechanism. This is intended to assist priority setting and resource allocation for similar multisectoral approaches.

6.5 Conclusion

This economic evaluation highlights the cost burden of sexual and reproductive ill-health in adolescent girls in South Africa. The study further presents the costs and consequences of a comprehensive SBSHE intervention, estimating a range of intermediate and final outcomes. Further research is needed to explore ways to optimise school-based SRH-

promoting interventions and to assess their cost-effectiveness. This would potentially allow the assessment of wider costs and benefits, which will inform decision-making on the interventions that represent the best value for money in high-burden and resource-constrained settings.

Chapter 7

7 Chapter 7: Discussion

7.1 Overview

While adolescent sexual and reproductive health has been recognised as a priority for three decades (UNFPA, 2004), adolescents in sub-Saharan Africa (SSA) bear the highest global burden of poor sexual and reproductive health (SRH) outcomes (Bearak et al., 2020). While progress has been made, this challenge persists, disproportionately affecting adolescent girls. Investing in adolescent sexual and reproductive health (ASRH) is critical due to the profound impact of poor ASRH outcomes on social and economic development (WHO, 2023c).

Comprehensive sexuality education (CSE) is a key component of the global strategy to promote ASRH (UNESCO, 2021). While many countries in SSA have developed policies to support CSE implementation, full integration has been limited (Wangamati, 2020; Chavula, Zulu & Hurtig, 2022). Effective implementation of CSE, referred to herein as comprehensive school-based sexual health education (SBSHE), has faced several challenges in many SSA countries. These include programme planning and implementation challenges. The former includes challenges related to funding, coordination, and monitoring, while the latter includes weaknesses in the adaptation of national curriculums to integrate SBSHE (Keogh et al., 2018). Even countries that have integrated SBSHE into the national curriculum experience serious challenges and gaps in implementation, spanning teacher, learner and curriculum-related matters (Mturi & Bechuke, 2019; Pillay, 2022; Adekola & Mavhandu-

Mudzusi, 2023). The need for evaluation and refinement of SBSHE in South Africa is evidenced by the persistently poor ASRH outcomes. This includes an assessment of the value of these interventions.

Chapter 1 presents the background for the thesis, including the definition of SRH and the epidemiological burden of ASRH globally in SSA and South Africa. In addition, the strategies for promoting ASRH are discussed, focusing on SBSHE. This chapter also presents a section focused on adolescent pregnancy in South Africa, and the strategies implemented to promote ASRH in the country, including reducing unintended pregnancy. The chapter presents the rationale for the thesis, the aim, and the objectives. It concludes by providing an outline for the rest of the thesis.

The thesis was conducted alongside a cluster-randomised controlled trial of a SBSHE intervention. The original aim of the thesis was to contribute towards methodological development for the economic evaluation of community-based, multicomponent health promotion interventions. One of the objectives was to conduct a cost-utility analysis. However, due to multiple implementation challenges, the intervention did not show any effect on biological outcomes (pregnancy and STIs, including HIV). Due to this unexpected challenge, the aim of the thesis was revised. Considering the significance of adolescent pregnancy as a significant public health challenge in South Africa, the prominence of SBSHE in the country's multifaceted approach to improving adolescent SRH, and the paucity of evidence on the cost and cost-effectiveness of SBSHE, the thesis aim was revised. The

updated aim was to understand the economic costs of ASRH services and to evaluate the potential value of an SBSHE intervention targeted at adolescent girls in South Africa. The intervention was an after-school programme that uses interactive sports-based lessons with the objectives of increasing knowledge and awareness about STIs (including HIV), enhancing various life skills to encourage students to adopt healthy behaviours, empowering adolescent girls through building their confidence and self-efficacy, addressing issues of gender equity, and building and strengthening support networks. The thesis illustrates the important aspects that need consideration for assessing the value of SRH education interventions. These interventions are inherently different from single-sector interventions and may present additional complexity to the assessment of their value. In this thesis, the potential value of an effective, comprehensive SBSHE intervention is assessed.

The thesis addresses the aim through separate but interlinked parts: a critical review of the community-based health promotion economic evaluation literature, a cost analysis of a SBSHE intervention, a cost analysis of intrapartum care at primary and secondary levels of care, a cost analysis of SRH services for adolescent girls and a cost-consequence analysis of a hypothetical SBSHE intervention.

This final chapter provides a summary of the key findings of the thesis and presents a discussion, including the strengths and weaknesses of the research. While the strengths, weaknesses and limitations have been presented for each of the empirical chapters, this

chapter presents overarching reflections. In addition, the chapter presents policy implications of the research and proposes areas for future research.

7.2 Summary and interpretation of findings

The aim of the thesis was delivered through six objectives. Except for the final objective, these were generally addressed and presented as chapters. We, therefore, summarise the main findings by chapter. The last objective will be addressed in this chapter.

Objective 1: To describe methods for economic evaluation of community-based health promotion interventions through a critical review of the literature.

Chapter 2 presents a brief overview of standard economic evaluation methods as a background to highlight the challenges that arise when undertaking health economic analysis to assess SBSHE interventions. The chapter outlines the characteristics of SBSHE interventions that may require modifications to standard methods. The chapter focuses on the choice of study perspective and timeframe, identifying, measuring, and valuing resource use and outcomes, combining these costs and outcomes into summary measures, and interpreting the results,

Chapter 3 presents a critical review of existing economic evaluation literature concerning individual-level community-based health promotion (CBHP) interventions. Given the paucity of literature regarding the economic evaluation of SBSHE, this chapter took a

broader focus. For the review, we defined CBHP interventions as individual-level health promotion interventions implemented in a community setting. The review found that while the literature on economic evaluation of CBHP is growing, interventions have predominantly focused on promoting physical activity and obesity prevention. The aim was to describe the methods used in the economic evaluation of CBHP interventions and to make recommendations for strengthening these methods.

We assessed the methodological characteristics of the included studies, focusing on the study perspective, the approach taken towards the inclusion of health care and non-health care provider costs, the measurement of health and non-health outcomes, the calculation of summary measures and the nature of the interpretation of value for money. Although the role of economic evaluation towards interpreting the value of public health interventions has gained considerable traction, the findings from the review suggest that challenges in applying standard economic evaluation methods to CBHP remain, particularly regarding the scope of intersectoral/multisectoral costs and outcomes, how these are combined in summary measures and how value for money is determined. While the literature on complex evaluations has already identified difficulties in attributing outcomes to health promotion interventions, leading to misrepresentation of broader impact, this review identifies additional conceptual challenges for economic evaluation.

The review included studies in a wide variety of health promotion topics provided in diverse settings, including schools, workplaces, and the community, by a range of providers. Only

one study was on the topic of SRH. Cost-utility analysis (CUA) was the most common type of economic evaluation. If CUA is used to assess value for money in health-related interventions, standard recommendations are that the incremental cost-effectiveness ratio is limited to healthcare costs and compared against a supply-side cost-effectiveness threshold measuring the marginal productivity of health system spending. In this review, studies that conducted a CUA and included non-medical costs still presented an incremental cost-effectiveness ratio, which was compared to a supply-side threshold. This might not be appropriate in CUA of CBHP because the intervention costs are typically not health care costs.

The review also identified the issue of the exclusion of non-health outcomes. Given these shortcomings, the cost-benefit analysis has many advantages for CBHP in that it can accommodate any costs or outcomes and can enable intersectoral value-for-money decision-making. While no cost-consequence analysis (CCA) studies were found in the review, further recommendations were made around the consideration of the CCA for CBHP, given its potential to enable the inclusion of a range of health care and non-health care costs, different costing perspectives as well as the ability to accommodate a variety of intermediate and final outcomes.

The review confirmed the lack of cost-effectiveness evidence in the area of SBSHE, which corresponds with previous recognition of this gap (Kaiser et al., 2021).

Objective 2: To estimate the costs of providing a girl-centered comprehensive sexual and reproductive health education intervention in a school setting from a Department of Education provider perspective

Chapter 4 presents a within-trial (G4G trial) cost analysis of a comprehensive SBSHE intervention (SKILLZ). While extensive research has been done on the effectiveness of school-based SRH promotion interventions, studies assessing the costs of these interventions in LMICs are limited (Kaiser et al., 2021). This study aimed to fill this gap and presented a cost analysis of a multi-dimensional SBSHE intervention implemented in a complex environment. The cost per learner reached ($69.43) was comparable to other pilot school-based sexual education interventions implemented in similar contexts.

Under the base case analysis, transport costs were a key driver of costs. These included transport for the coaches to and from the schools and transport for the learner's home. Learner transport was offered in response to the high rates of violence in South African townships, which poses a safety concern for adolescent girls (Kutywayo et al., 2024). Another option is to implement such an intervention as an in-school programme. However, due to competing academic priorities, SRH education within the South African classroom-based curriculum is only taught for two hours a week, which is not enough time to cover all the necessary topics (Adesina & Olufadewa, 2019).

Personnel costs represented a minor component of the total intervention costs. Peer educators do not require the same level of remuneration as teachers, which has positive

implications for the level of resources required for implementation. In addition, this model can be more sustainable in the long term.

Scale-up analysis revealed that implementing the intervention to cover 80% of no-fee schools and 80% of adolescent girls within those schools would require 4.5 times the current budget allocated to the classroom-based programme implemented within the national curriculum. This raises questions about the adequacy of the investment in the current programme. While there is an argument that SBSHE requires a low-cost investment, limited resources are among the barriers to providing SBSHE in South African schools (Venketsamy, Sing & Smart, 2020).

Objective 3: To estimate the costs of vaginal and c-section deliveries at two levels of care from a Department of Health provider perspective.

Chapter 5 presents a cost analysis of intrapartum care at primary and secondary levels of care in South Africa. The benefits of intrapartum care (care provided by a skilled healthcare professional during labour, delivery and immediate postnatal period) are undeniable and critical for preventing maternal deaths. While maternal care services are free at the point of use in South Africa, the quality of care is variable and high levels of institutional maternal mortality remain. This analysis aimed to present the costs of quality service in order to inform investments in these services. The costing was also required as an input to the cost consequence analysis given that obstetric services are a key potential cost offset from an

effective SRH promotion intervention and given that no costing data were available from South Africa.

The study results estimated a per-patient cost of vaginal delivery at a midwife-led unit of $142.47 compared to $557.49 at an obstetric hospital, and a c-section was estimated at $943.33 per patient. While personnel costs represented the most significant proportion of the unit costs, length of stay was a key cost driver. Increased length of stay was associated with higher costs, as observed in vaginal delivery vs c/section and uncomplicated delivery vs delivery with complications.

South Africa is in the process of implementing the National Health Insurance scheme. Economic evidence is required to create a benefits package (Republic of South Africa, 2024). Health benefits packages must be financially sustainable; understanding the costs of skilled birth attendance for uncomplicated births and emergency obstetric care (including c/sections) for complicated cases is critical for the allocation of funds.

Compared to costs from other LMICs, the study found that costs of vaginal delivery and c/section in South Africa were higher, as shown in two recent systematic reviews (Banke-Thomas et al., 2020; Mori et al., 2020). However, the studies included in these reviews were heterogeneous regarding the range of costs included, which presented challenges for comparison. Nevertheless, comparing only direct costs still showed that vaginal and c/section costs were higher in South Africa. Average costs were higher in countries where

personnel salaries were higher, which would mirror the case in South Africa, which spends more on public healthcare than any other African country, with higher salaries for healthcare personnel (Malakoane et al., 2020; Abrahams, Thani & Kahn, 2022).

Objective 4: To describe the economic burden of adolescent girl sexual and reproductive health services from a Department of Health provider perspective

and

Objective 5: To assess the value of an adolescent girl-centered sexual and reproductive health education intervention via a modelled cost-consequence analysis and a multi-sector perspective

Even though promoting adolescent SRH through CSE has been identified as a priority, many LMICs experience challenges with implementing such programmes for several reasons, including the unavailability of resources and a lack of formalised multisectoral collaboration (Chavula, Zulu & Hurtig, 2022). While it is logical for economic evaluation to be conducted alongside an effective intervention, there is an extremely limited economic evidence base regarding the level of investment that would be needed to achieve impact (Meherali, Punjani & Mevawala, 2020). A recent scoping review that found 462 economic evaluation studies of sexual and reproductive health and rights interventions in LMICs found only two that evaluated comprehensive SBSHE and raised this as a key gap in the literature (Kaiser et al., 2021).

In this study, a within-trial economic evaluation complemented by a modelled analysis was undertaken to understand how costs and consequences might change if a successful comprehensive SBSHE intervention were implemented for secondary school girls in South Africa. The evaluation took a multisectoral provider and learner perspective and modelled a range of intermediate and final outcomes. Baseline data from the trial (control group) was used to understand the cost of needed SRH services given observed levels of STIs, HIV and uptake of contraceptives. While high levels of loss to follow-up and drop out from school meant that we were unable to estimate pregnancy incidence from the trial, the model was calibrated against secondary data indicating that up to 20% of girls have begun childbearing by age 18. Scenario analysis was used to understand how costs and outcomes might change depending on the effectiveness of any similar intervention.

Using a 3% discount rate and a five-year time horizon, if nothing changes, the study estimated that providing sexual and reproductive health services to adolescent girls costs approximately $270 per learner from a Department of Health perspective. In this base case analysis, 22.9% would fall pregnant, 20% would give birth, there would be 4.6 life years and 4.1 QALYs, and 96.7% of the time would be available for school. The comprehensive SBSHE intervention would cost $134, and learner transport costs would be $23. Total multisectoral provider and learner costs would be $427.

Scenario analysis around increases in abstinence and increased contraceptive use both generated improved outcomes. However, as expected, the contraceptive route was more

costly, with the increased uptake of contraceptives considerably outweighing reductions in obstetric costs. These findings suggest that emphasis should be placed on interventions that work via both mechanisms (abstinence and contraceptives) and that reducing the costs of contraceptive services is a key priority to drive value for money and affordability. Ongoing provision of accessible termination of pregnancy services is also critical. Although this analysis shows that increasing contraceptive costs would outweigh the averted demand for short-term maternal healthcare services and associated costs, increasing the use of contraceptives would have positive impacts on long-term mother and child health and maternal mortality, avoiding broader societal costs (Kelly et al., 2023). This highlights the need for further analysis that captures the full value of comprehensive SBSHE interventions.

Another significant finding from this work was that contraceptive and obstetric costs for this population considerably outweigh STI and HIV costs from a healthcare provider's perspective. This is partly driven by the relatively low HIV prevalence within the population included in the G4G trial (<1%), which is less than the national prevalence rate of 5.7% (HSRC, 2023). Notwithstanding, STIs were highly prevalent in the trial population (>20%). This signifies an increased risk of HIV acquisition associated with STI-induced genital inflammation (Jarolimova et al., 2023).

Multisectoral collaboration is essential for improving ASRH outcomes, especially in SSA. While the benefits of this approach are undeniable, its implementation can be challenging compared to sectoral approaches (Efevbera et al., 2020). In addition, the complexity of the

risk factors associated with poor ASRH indicates that broader factors beyond the individual and the school setting might influence SRH outcomes. There is increasing recognition that a single intervention may not be sufficient to address the multifaceted risk factors related to ASRH. An integrated approach which includes multiple components is required (Rudgard et al., 2023).

By presenting disaggregated costs and outcomes, our study intends to support better interpretation of the evidence, enabling different sectors to gain insights from their perspectives (Ramponi et al., 2024). This is critical in South Africa, as the persistent SRH disease burden in adolescents requires a better understanding of their SRH needs to inform the design of multisectoral policies and programmes (Ndlazi & Masango, 2022).

7.3 Limitations

Studies in this thesis were conducted alongside a cluster randomised control trial. Changes in outcomes might occur a long time after the implementation of the intervention. The follow-up duration of the trial might, therefore, not be long enough to capture these

The costing of intrapartum care in the thesis was conducted from the perspective of a healthcare provider. As maternity care in South Africa is free at the point of service, these costs are critical for decision-making. However, the exclusion of direct non-health costs of accessing this care is a limitation. The costs of accessing comprehensive essential obstetric

care in this context were previously found to be high compared to assessing other primary healthcare services (Cleary et al., 2013).

The benefits of SBSHE can extend beyond the 5-year mark used in the CCA. In our study, we only accounted for immediate or near-term effects and did not account for cumulative health and economic benefits that could accrue over a lifetime. This can result in an incomplete picture of the value of the intervention. In addition, the lack of a single summary measure in CCA does not provide a definitive answer, which can make decision-making more challenging. In addition, presenting a wide range of outcomes can overwhelm decision-makers and make it challenging to interpret the results and draw clear conclusions.

Another limitation of this method is that there is a risk that decision-makers might focus selectively on certain outcomes that align with their biases or preferences, potentially leading to suboptimal decisions. In addition, decision-makers must use their judgment to weigh different outcomes against each other. This can introduce subjectivity and potentially inconsistent decision-making processes. Furthermore, comparing the results of multiple CCAs across studies or contexts might be challenging.

Complex public health issues with multiple risk factors across all socio-ecological levels, such as adolescent SRH, require a combination of interventions at several levels (Wight et al., 2015). This thesis only focuses on a single intervention at the individual level, which might limit the broader applicability of the results. In addition, findings from this thesis may

not be transferrable to other settings with different implementation contexts. Generalisability to other settings might also be limited by the demographic group receiving the comprehensive SBSHE, as well as the variability in programme design and content.

7.4 Strengths

The economic evaluation in the thesis was conducted using a model. This allowed for a combination of all available evidence.

The cost-consequence analysis fosters transparency by presenting disaggregated costs and outcomes, allowing the relevant stakeholders from each sector to see the results that are relevant to them. This is of particular importance for multisectoral interventions like comprehensive SBSHE.

7.5 Policy recommendations for investing in comprehensive sexual and reproductive health education interventions

Adolescent SRH in South Africa is nested within a complex landscape of risk factors (Davids et al., 2020). These include factors across socio-ecological levels. At the individual level, there are factors related to SRH knowledge, attitudes, skills, and self-concept. At the family level, there is family support, care, and attention. Structural factors include socio-cultural practices, norms, socioeconomic status, laws, and policies. Comprehensive SBSHE as a

strategy for promoting ASRH is backed by thirty years of global research (Goldfarb & Lieberman, 2021). Investing in comprehensive SBSHE interventions is thus critical for improving health and social outcomes and fostering economic development. This section outlines key recommendations for policymakers to enhance the value of these interventions.

7.5.1 Strengthen multisectoral collaboration to promote ASRH

Findings from the thesis highlighted that addressing the SRH needs of adolescents requires a coordinated effort across various sectors, including health, education, and social development. Fostering partnerships between different government sectors, non-governmental organisations, the private sector, and civil society is at the core of improving ASRH. The issues of transport and poor programme attendance highlighted in the cost analysis of the SKILLZ intervention emphasise the need for an approach which includes multiple components across the socio-ecological levels and involves multiple sectors.

In addition, the findings from the cost-consequence analysis presented an application of a method that makes economic evaluation accessible to multiple stakeholders. A comprehensive and transparent presentation of costs and outcomes accrued across all involved sectors is critical to encourage the leveraging of resources.

7.5.2 Increase funding for SBSHE

The scale-up analysis of the SKILLZ intervention indicated that currently allocated funds would only be enough to cover 30% of adolescent girls in secondary school. While evidence on the unit costs of the current classroom-based curriculum is not available, comparing the scale-up costs with the proposed budget suggests that the budget for SBSHE needs to be revised. This again highlights the importance of transparent analyses that allow stakeholders from different sectors to understand the value of such interventions from their perspective to support resource mobilisation.

7.5.3 Evaluate strategies aiming to improve implementation of school-based sexual and reproductive health interventions

In South Africa, a gap exists between planned comprehensive SBSHE interventions and their implementation, as seen in this thesis and reported in the available literature. In addition to promoting investment in comprehensive SBSHE interventions, political, social, and cultural factors determine the successful implementation of these interventions (Achen et al., 2023). While the country has progressive policies that promote ASRH, the political landscape can also work as a barrier to implementation. The combination of politics and African identity creates resistance to implementation. Parental and community involvement are also crucial for the success of programmes. However, parents and lobby groups have obstructed efforts by the DBE to strengthen the current programme (Ngabaza, 2022). Furthermore, South Africa is culturally diverse, which adds complexity to the implementation landscape. Cultural and

religious beliefs influence societal norms, creating stigma towards sexuality, which contributes to the avoidance of certain topics by teachers (Rossouw, 2024). Therefore, successful implementation of any SBSHE intervention would require a multifaceted approach that addresses all the above-mentioned challenges. Such strategies should be invested in to improve the implementation of SBSHE interventions. It will be important to understand the set of conditions that need to be met to optimise implementation. An assessment of implementation barriers for the SKILLZ intervention within the G4G trial highlighted the need for understanding the cultural contexts within which interventions are implemented (Pike, Coakley, Lee, et al., 2023). Girls hold diverse cultural roles in society, including being caregivers, which might affect attendance rates for afterschool programmes, as seen in the trial. Therefore, programmes must be flexible and adaptive, engage parents and families, and engage with context-specific cultural practices. Additionally, research collaboration between all the stakeholders in this area of research should be encouraged to foster cross-learning, especially from failed projects, as these are generally unpublished.

7.5.4 Strengthen links between schools and healthcare facilities

Strengthening the links between schools and healthcare facilities can create a more comprehensive approach to promoting ASRH (Brittain et al., 2022). In South Africa, adolescent girls face barriers to accessing sexual healthcare services, which include judgement from healthcare professionals, unfriendly clinic times, and stigma associated with visiting the clinic for sexual health (Holtman, Bimerew & Mthimunye, 2024). Despite the

high prevalence of sexual ill health in the country, secondary schools do not offer school-based sexual healthcare services (Ahmed et al., 2023). Establishing these services within schools would represent a fundamental step in improving access to SRH services. In addition, establishing formal referral pathways to nearby clinics would ensure that adolescents receive care when needed. While the National Department of Health endorses the adolescent and youth-friendly services approach, these services are still lacking (James et al., 2018).

7.6 Future research

As the country grapples with interventions to promote ASRH, further research is needed to understand the set of interventions across all the socio-ecological levels that would have an impact on ASRH outcomes, taking into consideration the complexity of ASRH and its determinants in South Africa. In addition, an analytical framework is needed to aid in understanding the effectiveness and cost-effectiveness of interventions both in isolation and in combination. This would also include assessing the longer-term costs and benefits of such interventions. Finally, efforts to promote intersectoral collaboration for health should be further encouraged. This should include evidence-based processes to allocate resources across sectors.

7.7 Conclusion

Adolescent sexual ill-health is a significant and persisting challenge in South Africa, with implications for health, education and economic prospects, especially for girls. While SBSHE interventions are recognised as a key strategy for promoting ASRH, there is limited economic evidence to support the implementation of these interventions. This thesis addresses a critical evidence gap by assessing the value of SBSHE interventions.

As the thesis was conducted alongside a cluster randomised trial, which faced contextual complexities with implications for implementation and impact, adaptations were made to the thesis aim to ensure the relevance of the evaluation. While the trajectory of the thesis shifted, it still contributed meaningfully and added to the limited body of knowledge on the cost and cost-effectiveness of SBSHE interventions. The findings from this thesis offer robust evidence that is significant for promoting ASRH in South Africa. These findings provided critical data and actionable insights that can contribute to decision-making for comprehensive SBSHE interventions and related healthcare services.

The findings show key cost drivers in a gender-specific near peer-led SBSHE intervention. The CCA captures some of the complexity in SBSHE. The analysis moves away from the narrow focus of a single provider perspective and includes costs borne by multiple sectors. Delineating costs by sector ensures comprehensive cost identification, supports transparency and can foster collaboration across sectors. Through the CCA framework, the scope of the evaluation is also broadened by providing disaggregated outcomes and

allowing for the presentation of non-health outcomes. This is significant for demonstrating the multidimensional value of SBSHE interventions, with benefits that accrue across multiple sectors.

In addition to addressing the scarcity of economic evidence for comprehensive SBSHE interventions, the research adds to the evidence on the CCA approach by applying it to the complex context of SBSHE. It lays the foundation for further evaluation of such interventions, including exploring long-term outcomes.

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9 Appendices

9.1 Appendix 1: Supplementary information linked to Chapter 3

Initial search strategy for PubMed

	Query	Results
#9	((((cost benefit analysis [MeSH Terms]) OR (cost and cost analysis[MeSH Major Topic])) OR health economic evaluation)) AND ((((((community based OR community level))) AND ((behavioural) AND public health interventions))) OR ((((community based OR community level))) AND ((health promotion OR health promotion[MeSH Terms]))))) Sort by: Best Match Filters: Full text; Publication date from 2002/01/01 to 2019/12/31	2249
#8	((((cost benefit analysis [MeSH Terms]) OR (cost and cost analysis[MeSH Major Topic])) OR health economic evaluation)) AND ((((((community based OR community level))) AND ((behavioural) AND public health interventions))) OR ((((community based OR community level))) AND ((health promotion OR health promotion[MeSH Terms]))))) Sort by: Best Match Filters: Full text	2509
#7	((((cost benefit analysis [MeSH Terms]) OR (cost and cost analysis[MeSH Major Topic])) OR health economic evaluation)) AND ((((((community based OR community level))) AND ((behavioural) AND public health interventions))) OR ((((community based OR community level))) AND ((health promotion OR health promotion[MeSH Terms]))))) Sort by: Best Match	2712
#6	(((cost benefit analysis[MeSH Terms]) OR ((cost and cost analysis[MeSH Major Topic]))) OR health economic evaluation)	156639
#5	(((((community based OR community level))) AND ((behavioural) AND public health interventions))) OR ((((community based OR community level))) AND ((health promotion OR health promotion[MeSH Terms]))))	24214
#5	(((community based OR community level))) AND ((behavioural) AND public health interventions)	9892

#4	(behavioural) AND public health interventions	83749
#3	(((community based OR community level))) AND ((health promotion OR health promotion[MeSH Terms]))	16372
#2	health promotion OR health promotion [MeSH Terms[	142821
#1	(community-based OR community level)	262163

Table A1 Quality appraisal

	Item	Akanni, O. 2017	Anderson, Y.C. 2018	Anokye, N. 2018	Barton, R. 2011	Canaway, A. 2019
1.	Title	Yes	Yes	Yes	Yes	Yes
2.	Abstract	Yes	Yes	Yes	Yes	Yes
3.	Background and objectives	Yes	Yes	Yes	Yes	Yes
4.	Health economic analysis plan	No	No	Yes	No	Yes
5.	Study population	Yes	Yes	Yes	Yes	Yes
6.	Setting and location	Yes	Yes	Yes	Yes	Yes
7.	Comparators	Yes	Yes	Yes	Yes	Yes
8.	Perspective	Yes	Yes	Yes	Yes	Yes
9.	Time horizon	Yes	Yes	Yes	Yes	Yes
10.	Discount rate	Yes	N/A	N/A	N/A	Yes
11.	Selection of outcomes	Yes	Yes	Yes	Yes	Yes
12.	Measurement of outcomes	Yes	Yes	Yes	Yes	Yes
13.	Valuation of outcomes	Yes	N/A	N/A	Yes	Yes
14.	Measurement and valuation of resources and costs	Yes	Yes	Yes	Yes	Yes
15.	Currency, price date, and conversion	Yes	No	Yes	Yes	Yes
16.	Rationale and description of model	N/A	N/A	N/A	N/A	N/A
17.	Analytics and assumptions	N/A	N/A	N/A	N/A	N/A
18.	Characterizing heterogeneity	Yes	Yes	N/A	No	No
19.	Characterizing distributional effects	Yes	No	No	No	No
20.	Characterizing uncertainty	Yes	No	Yes	Yes	Yes
21.	Approach to engagement with patients and others affected by the study	No	No	Yes	No	No
22.	Study parameters	Yes	Yes	Yes	Yes	Yes
23.	Summary of main results	Yes	Yes	Yes	Yes	Yes
24.	Effect of uncertainty	Yes	No	Yes	Yes	Yes
25.	Effect of engagement with patients and others affected by the study	N/A	N/A	No	N/A	N/A
26.	Study findings, limitations, generalizability, and current knowledge	Yes	Yes	Yes	Yes	Yes
27.	Source of funding	No	Yes	Yes	Yes	Yes
28.	Conflicts of interest	Yes	Yes	Yes	No	Yes

	Item	Fitzgerald, S. 2017	Gilmer, T. 2018	Hollingworth, W. 2011	Johansson, P. 2009	McAuley, K.A. 2009	Michaud, T.L. 2017
1.	Title	Yes	Yes	Yes	Yes	Yes	Yes
2.	Abstract	Yes	Yes	Yes	Yes	Yes	Yes
3.	Background and objectives	Yes	Yes	Yes	Yes	Yes	Yes
4.	Health economic analysis plan	Yes	No	No	No	No	No
5.	Study population	Yes	Yes	Yes	Yes	Yes	Yes
6.	Setting and location	Yes	Yes	Yes	Yes	Yes	Yes
7.	Comparators	Yes	Yes	Yes	Yes	Yes	Yes
8.	Perspective	Yes	Yes	Yes	Yes	Yes	Yes
9.	Time horizon	Yes	Yes	Yes	Yes	Yes	Yes
10.	Discount rate	N/A	Yes	Yes	Yes	N/A	Yes
11.	Selection of outcomes	Yes	Yes	Yes	Yes	Yes	Yes
12.	Measurement of outcomes	Yes	Yes	Yes	Yes	Yes	Yes
13.	Valuation of outcomes	Yes	Yes	Yes	Yes	Yes	N/A
14.	Measurement and valuation of resources and costs	Yes	Yes	Yes	Yes	Yes	Yes
15.	Currency, price date, and conversion	Yes	Yes	Yes	Yes	Yes	Yes
16.	Rationale and description of model	N/A	Yes	N/A	Yes	N/A	Yes
17.	Analytics and assumptions	N/A	Yes	N/A	Yes	N/A	Yes
18.	Characterizing heterogeneity	No	Yes	No	No	No	Yes
19.	Characterizing distributional effects	No	No	No	No	No	No
20.	Characterizing uncertainty	Yes	Yes	Yes	Yes	No	Yes
21.	Approach to engagement with patients and others affected by the study	No	No	No	No	No	No
22.	Study parameters	Yes	Yes	Yes	Yes	Yes	Yes
23.	Summary of main results	Yes	Yes	Yes	Yes	Yes	Yes
24.	Effect of uncertainty	Yes	Yes	Yes	Yes	No	Yes
25.	Effect of engagement with patients and others affected by the study	N/A	N/A	N/A	N/A	N/A	N/A
26.	Study findings, limitations, generalizability, and current knowledge	Yes	Yes	Yes	Yes	Yes	Yes
27.	Source of funding	Yes	No	Yes	Yes	Yes	Yes
28.	Conflicts of interest	Yes	No	Yes	No	Yes	Yes

	Item	Moodie, M.L. 2013	Neuman, A.2017	Panca, M. 2017	Robertson, W. 2016	Rosenthal, M.S. 2009	Satish, T. 2020
1.	Title	Yes	Yes	Yes	Yes	Yes	Yes
2.	Abstract	Yes	Yes	Yes	Yes	Yes	Yes
3.	Background and objectives	Yes	Yes	Yes	Yes	Yes	Yes
4.	Health economic analysis plan	No	No	Yes	Yes	No	Yes
5.	Study population	Yes	Yes	Yes	Yes	Yes	Yes
6.	Setting and location	Yes	Yes	Yes	Yes	Yes	Yes
7.	Comparators	Yes	Yes	Yes	Yes	Yes	Yes
8.	Perspective	Yes	Yes	Yes	Yes	Yes	Yes
9.	Time horizon	Yes	Yes	Yes	Yes	Yes	Yes
10.	Discount rate	Yes	Yes	Yes	Yes	Yes	Yes
11.	Selection of outcomes	Yes	Yes	Yes	Yes	Yes	Yes
12.	Measurement of outcomes	Yes	Yes	Yes	Yes	Yes	Yes
13.	Valuation of outcomes	Yes	Yes	Yes	Yes	N/A	Yes
14.	Measurement and valuation of resources and costs	Yes	Yes	Yes	Yes	Yes	Yes
15.	Currency, price date, and conversion	Yes	Yes	Yes	Yes	Yes	Yes
16.	Rationale and description of model	Yes	Yes	N/A	N/A	Yes	Yes
17.	Analytics and assumptions	Yes	Yes	N/A	N/A	Yes	Yes
18.	Characterizing heterogeneity	No	No	No	No	Yes	No
19.	Characterizing distributional effects	No	No	No	No	No	No
20.	Characterizing uncertainty	Yes	Yes	Yes	Yes	Yes	Yes
21.	Approach to engagement with patients and others affected by the study	No	No	Yes	No	Yes	No
22.	Study parameters	Yes	Yes	Yes	Yes	Yes	Yes
23.	Summary of main results	Yes	Yes	Yes	Yes	Yes	Yes
24.	Effect of uncertainty	Yes	Yes	Yes	Yes	Yes	Yes
25.	Effect of engagement with patients and others affected by the study	N/A	N/A	No	N/A	Yes	N/A
26.	Study findings, limitations, generalizability, and current knowledge	Yes	Yes	Yes	Yes	Yes	Yes
27.	Source of funding	Yes	Yes	Yes	Yes	No	Yes
28.	Conflicts of interest	Yes	Yes	Yes	Yes	No	Yes

	Item	Smith, L. 2019	Sutherland, R. 2016	Van den Brand. 2020	Vijgen. S.M.C, 2008	Wang, H. 2019
1.	Title	Yes	Yes	Yes	Yes	Yes
2.	Abstract	Yes	Yes	Yes	Yes	Yes
3.	Background and objectives	Yes	Yes	Yes	Yes	Yes
4.	Health economic analysis plan	No	No	Yes	No	Yes
5.	Study population	Yes	Yes	Yes	Yes	Yes
6.	Setting and location	Yes	Yes	Yes	Yes	Yes
7.	Comparators	Yes	Yes	Yes	Yes	Yes
8.	Perspective	Yes	Yes	Yes	Yes	Yes
9.	Time horizon	Yes	Yes	Yes	Yes	Yes
10.	Discount rate	Yes	Yes	Yes	Yes	Yes
11.	Selection of outcomes	Yes	Yes	Yes	Yes	Yes
12.	Measurement of outcomes	Yes	Yes	Yes	Yes	Yes
13.	Valuation of outcomes	Yes	N/A	N/A	Yes	Yes
14.	Measurement and valuation of resources and costs	Yes	Yes	Yes	Yes	Yes
15.	Currency, price date, and conversion	Yes	Yes	Yes	Yes	Yes
16.	Rationale and description of model	Yes	N/A	N/A	Yes	N/A
17.	Analytics and assumptions	Yes	N/A	N/A	Yes	N/A
18.	Characterizing heterogeneity	Yes	No	No	No	No
19.	Characterizing distributional effects	No	No	No	No	No
20.	Characterizing uncertainty	Yes	Yes	Yes	Yes	Yes
21.	Approach to engagement with patients and others affected by the study	No	No	No	No	No
22.	Study parameters	Yes	Yes	Yes	Yes	Yes
23.	Summary of main results	Yes	Yes	Yes	Yes	Yes
24.	Effect of uncertainty	Yes	Yes	Yes	Yes	Yes
25.	Effect of engagement with patients and others affected by the study	N/A	N/A	N/A	N/A	N/A
26.	Study findings, limitations, generalizability, and current knowledge	Yes	Yes	Yes	Yes	Yes
27.	Source of funding	Yes	Yes	Yes	No	Yes
28.	Conflicts of interest	Yes	Yes	Yes	Yes	Yes

9.2 Appendix 2: Ethics approval and renewal, University of Cape Town, Faculty of Health Sciences (HREC REF Number 045/2020)

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room G50- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-enquiries@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

13 February 2020

HREC REF:045/2020

A/Prof S Cleary
Health Economic Division
Room 1.17 Maintenance Workshop Building
FHS

Dear A/Prof Cleary

PROJECT TITLE: ECONOMIC EVALUATION OF MULTICOMPONENT INTERVENTIONS WITHIN COMPLEX SYSTEMS: IMPROVING THE SEXUAL AND REPRODUCTIVE HEALTH OF SCHOOL GOING ADOLESCENT GIRLS IN SOUTH AFRICA (PhD candidate Dr Funeka Bango) sub-study linked to 138/2018

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 28 February 2021.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student: Dr F Bango will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

Signed by candidate

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.

HREC 045/2020sa

FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
☐ Approved	Annual progress report	Approved until/next renewal date	28.02.22
☐ Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee		Date Signed	4/2/2021

Note: Please note that incomplete submissions will not be reviewed.
Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.

Please clarify your plan for research-related activities during COVID-19 lockdown

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	03 February 2021		
HREC REF Number	045/2020	Current Ethics Approval was granted until	28 February 2021
Protocol title	Economic Evaluation of Multicomponent interventions within complex systems: Improving the Sexual and Reproductive Health of School-Going Adolescents		
Principal Investigator	A/Prof S Cleary		
Department / Office Internal Mail Address	Health Economics Division, School of Public Health and Family Medicine		
1.1 Does this protocol receive US Federal funding?		☐ Yes	√ No

2. Protocol status (tick ✓)

√	Research-related activities are ongoing
☐	Data collection is complete, data analysis only

Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository.

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval		0
Total number of records or specimens collected, reviewed or stored since last progress report		0
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report.	☐ Yes	√ No

UNIVERSITY OF CAPE TOWN

HUMAN RESEARCH ETHICS COMMITTEE
- 2 FEB 2022
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	28/02/23
☐ Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee		Date Signed	4/2/2022

Note: Please note that incomplete submissions will not be reviewed.
Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.

Please clarify your plan for research-related activities during COVID-19 lockdown

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	01 February 2022		
HREC REF Number	045/2020	Current Ethics Approval was granted until	28/02/2022
Protocol title	Economic Evaluation of Multicomponent interventions within complex systems: Improving the Sexual and Reproductive Health of School-Going Adolescents		
Principal Investigator	A/Professor Susan Cleary		
Department / Office Internal Mail Address	Health Economics Division, School of Public Health and Family Medicine		
1.1 Does this protocol receive US Federal funding?		☐ Yes	√ No

2. Protocol status (tick ✓)

☐	Research-related activities are ongoing
√	Data collection is complete, data analysis only
Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository.	

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval		■
Total number of records or specimens collected, reviewed or stored since last progress report		380 records reviewed
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report.	☐ Yes	√ No

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	30.7.2024
☐ Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee		Date Signed	6/8/2023

Note: Please note that incomplete submissions will not be reviewed.
Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.

HUMAN RESEARCH ETHICS COMMITTEE
- 4 AUG 2023
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

Please clarify your plan for research-related activities during COVID-19 lockdown

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	03 August 2023		
HREC REF Number	045/2020	Current Ethics Approval was granted until	28/02/2023
Protocol title	Economic Evaluation of Multicomponent interventions within complex systems: Improving the Sexual and Reproductive Health of School-Going Adolescents		
Principal Investigator	Professor Susan Cleary		
Department / Office Internal Mail Address	Health Economics Division, School of Public Health		
1.1 Does this protocol receive US Federal funding?		☐ Yes	√ No

2. Protocol status (tick ✓)

☐	Research-related activities are ongoing
√	Data collection is complete, data analysis only
Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository.	

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval		■
Total number of records or specimens collected, reviewed or stored since last progress report		380 records reviewed
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report.	☐ Yes	√ No

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH

FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
✓ Approved	Annual progress report	Approved until/next renewal date	30.7.2025
O Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee		Date Signed	9/8/2024

Note: Please note that incomplete submissions will not be reviewed.
Our website address: **https://health.uct.ac.za/home/human-research-ethics**

HUMAN RESEARCH ETHICS COMMITTEE
07 AUG 2024
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	06 August 2024		
HREC REF Number	045/2020	Current Ethics Approval was granted until	30/07/2024
Protocol title	Economic Evaluation of Multicomponent interventions within complex systems: Improving the Sexual and Reproductive Health of School-Going Adolescents		
Principal Investigator	Professor Susan Cleary		
Department and email address	Health Economics Division, School of Public Health		
1.1 Does this protocol receive US Federal funding?		O Yes	O☒ No

2. Protocol status (tick ☐)

O	Research-related activities are ongoing
O☒	Data collection is complete, data analysis only
O	Publication or thesis submitted and final completion?

Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository.

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval		380 records reviewed
Total number of records or specimens collected, reviewed or stored since last progress report		
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report.	O Yes	O☒ No

9.3 Appendix 3: Ethics approval for Goals for Girls, University of Cape Town, Faculty of Health Sciences (HREC REF Number 138/2018)

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6626
Email: shuretta.thomas@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

20 April 2018

HREC REF: 138/2018

Prof Linda-Gail Bekker
Desmond Tutu, HIV Foundation
IIDMM
Medical School

Dear Prof Bekker

PROJECT TITLE: GOALS FOR GIRLS: A CLUSTER RANDOMIZED TRIAL TO EVALUATE THE FEASIBILITY, ACCEPTABILITY AND IMPACT OF INTEGRATING AN IN-SCHOOL SEXUAL AND REPRODUCTIVE HEALTH (SRH) EDUCATION PROGRAMME WITH AN AFTER-SCHOOL SPORTS-BASED PROGRAMME AMONGST ADOLESCENT FEMALE LEARNERS

Thank you for submitting your response to the Faculty of Health Sciences Human Research Ethics Committee 6 April 2018.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study subject to submitting the Focus Group Guide before the Focus Groups begin as promised in para 5 of the response to the HREC.

Approval is granted for one year until the 30 April 2019.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

9.4 Appendix 4: Approval for Provincial Health Research

STRATEGY & HEALTH SUPPORT
Health.Research@westerncape.gov.za
tel: +27 21 483 0866: fax: +27 21 483 6058
5th Floor, Norton Rose House,, 8 Riebeek Street, Cape Town, 8001
www.capegateway.gov.za)

REFERENCE: WC_202002_028
ENQUIRIES: Dr Sabela Petros

University of Cape Town
Anzio Road
Observatory
Cape Town
7925

For attention: Prof Susan Cleary, Dr Funeka Bango

Re: Economic evaluation of multicomponent interventions within complex systems: Improving the sexual and reproductive health of school going adolescent girls in South Africa

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research.
Please contact the following people to assist you with any further enquiries in accessing the following sites:

Khayelitsha (Site B) CHC	**Dr Leigh Wagner**	**021 360 5228/ 5238**

Kindly ensure that the following are adhered to:

1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted.
2. Researchers, in accessing provincial health facilities, are expressing consent to provide the department with an electronic copy of the final feedback (**annexure 9**) within six months of completion of research. This can be submitted to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
3. In the event where the research project goes beyond the *estimated completion* date which was submitted, researchers are expected to complete and submit a progress report (**Annexure 8**) to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
4. The reference number above should be quoted in all future correspondence.

Yours sincerely

DR M MOODLEY
DIRECTOR: HEALTH IMPACT ASSESSMENT
DATE: 22/10/2020
CC

Western Cape Government
Health

STRATEGY & HEALTH SUPPORT
Health.Research@westerncape.gov.za
tel: +27 21 483 0866: fax: +27 21 483 6058
5th Floor, Norton Rose House,, 8 Riebeek Street, Cape Town, 8001
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REFERENCE: WC_202002_028
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Cape Town
7925

For attention: Prof Susan Cleary, Dr Funeka Bango

Re: Economic evaluation of multicomponent interventions within complex systems: Improving the sexual and reproductive health of school going adolescent girls in South Africa

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research.

Please contact the following people to assist you with any further enquiries in accessing the following sites:

Mowbray Maternity Hospital	**Chantal J Stewart**	**021 659 5579**

Kindly ensure that the following are adhered to:

1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted.
2. Researchers, in accessing provincial health facilities, are expressing consent to provide the department with an electronic copy of the final feedback (**annexure 9**) within six months of completion of research. This can be submitted to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
3. In the event where the research project goes beyond the *estimated completion* date which was submitted, researchers are expected to complete and submit a progress report (**Annexure 8**) to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
4. The reference number above should be quoted in all future correspondence.

Yours sincerely

DR M MOODLEY
DIRECTOR: HEALTH IMPACT ASSESSMENT
DATE: 22/10/2020
CC