PELVIC FLOOR DYSFUNCTION IN FEMALE TRIATHLETES

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Declaration

I, Welile Mkhombe, declare that the present dissertation is my own original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree to this or any other university.

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ABSTRACT

Background: In the past few decades, an increasing number of women have been participating in high-impact sports which involves jumping, landing and/ or running activities. Recent data have shown, however, that this kind of activity might be associated with adverse effects, including pelvic floor disorders. Nevertheless, there is very little in the literature about pelvic floor effects associated with endurance sports where high-impact exercise is performed at submaximal intensity for prolonged periods of time.

Objective: The primary objective of the present paper is to describe the prevalence of pelvic floor dysfunction (PFD) in a female triathlete population.

Methods: An anonymous on-line survey was administered from September 2015 to March 2016 to women who self-identified as triathletes. We used two validated questionnaires: the Pelvic Floor Distress Inventory Questionnaire short form (PFDI) and the Pelvic Floor Impact Questionnaire short form (PFIQ). In addition, respondents were asked for demographics (age, height, weight, occupation), general health status (medical history, pelvic/abdominal surgical history, pregnancy and birth history) as well as sport practice characteristics (duration of training, level of competition, number of hours spent per week swimming, cycling, and running), so as to characterise these female triathletes. The survey remained active online for seven months, during which time the majority of responses were obtained from having our survey on the IRONMAN December 2015 newsletter. The balance of responses came from various triathlon clubs which we had approached within Western Cape Province.

Results: Sixty-seven female triathletes responded to the online survey which we designed on SurveyMonkey. The respondents were between the ages of 22 and 56 years, the mean being 37 years. They had a mean BMI of 22.6 kg/m^2. None of them had any medical conditions known to increase the risk of PFD. Of the known surgical history risk factors, 74.6% had had no previous pelvic or abdominal surgery. In the cohort, 69.2% were nulliparous and 30.8% parous. Most of the respondents competed in the recreational age group (70.4%), compared with 29.6% who described themselves as being in the competitive age group. Over 94.4% of the participants had been

involved in triathlon training for a period of more than 6 months. At the peak of their training, athletes described their weekly training regime as comprising a mean of 5.4 hours running, 3.9 hours swimming and 9.1 hours cycling. Of those who performed any form of ‘core exercises’, 29.6% performed pelvic floor exercises, 16.7% yoga, and 25.9% Pilates as part of their routine training. Eighty-two per cent of the triathletes had competed in the half IRONMAN and 37.8% in at least one full IRONMAN competition.

The PFDI revealed a number of commonly occurring pelvic floor symptoms. The most reported urinary symptoms were urinary frequency, stress urinary incontinence (SUI) and urge urinary incontinence (UUI) (45.8%, 33.3% and 37.5%, respectively). The most reported colorectal symptoms were incomplete bowel emptying (41.7%), faecal urgency (43.8%), and flatal incontinence (41.7%). Pelvic organ prolapse symptoms were least reported, but those who had symptoms mostly experienced heaviness or dullness in the pelvic area (33.3%), pressure in the lower abdomen (31.3%) and a need for vaginal/rectal digitation in order to have or complete a bowel movement (25%).

It was noteworthy to find that the nulliparous triathletes had more pelvic floor symptoms than the parous group. A higher prevalence of colorectal/rectal symptoms were reported by those who had had forceps deliveries. Colorectal symptoms were found to be slightly more prevalent in those who performed any pelvic floor exercises (PFE), yoga or Pilates than amongst those who did not. Even with the myriad symptoms reported, these women were not significantly bothered by their symptoms.

Conclusion: It is apparent that PFDs are prevalent in the population reviewed, although the majority of individuals did not seem to be bothered by the symptoms that also did not appear to interrupt training or quality of life. For those who are concerned or troubled by the symptoms, it would be beneficial for them to be identified early so that management options can be offered to relieve the symptoms.

INTRODUCTION

Background

Pelvic floor dysfunction is a complex process that develops secondary to numerous causes, resulting in trauma and fatigue of the pelvic floor muscles. The term ‘pelvic floor dysfunction’ (PFD) refers to a broad range of clinical features including urinary incontinence (involuntary loss of urine), sensory (increased, decreased or absent bladder sensation) and bladder storage symptoms (urinary frequency, urgency, nocturia, overactive bladder), anal incontinence (involuntary loss of faecal material and/or flatus), pelvic organ prolapse and sexual dysfunction[1]. PFD has a negative effect on women’s quality of life (QOL) and is also a financial burden on the healthcare system. Risk factors for developing PFD are obesity, menopause, previous pelvic surgery, pregnancy, childbirth and possibly connective tissue disorders. Of the many factors contributing to PFD, pregnancy and childbirth are the most documented. Many studies define traumatic birth, use of forceps, prolonged second stage of labour, and sphincter damage as modifiable risk factors for PFD[2]. However, pregnancy on its own has been shown to be an independent risk factor, regardless of mode of delivery.

Preliminary evidence also exists that athletes involved in high-intensity sports for long periods have a higher probability of experiencing a prolonged second stage of labour than do non-athletes. Although the reason for this is unclear, it is thought that muscle hypertrophy and increased muscle tone in athletes may contribute to difficulties in vaginal birth.[3]

Approximately 47% of women who regularly engage in high-impact exercise (jumping, landing, running) have been found to experience a degree of urinary incontinence, causing a number of women to alter or even abandon their exercise activities.[4] Many authors have observed a relationship between sport and PFD, in particular regarding urinary incontinence.[5]

Women have been participating in competitive sport since the early 1900s. Subsequently, there has been an evolution of more women taking part in endurance sports. As much as there are many benefits to regular physical fitness, women who engage in long-term high-impact sport must be made aware of the possible negative

consequences of exercise on pelvic floor function. Without discouraging them from such activities, preventive measures as well as early intervention should be offered to this highly motivated population.

Literature review

It was shown in a prospective comparative study by Kruger, Dietz and Murphy[6] that high-impact, frequent, intense training in nulliparous elite athletes compared with controls, revealed significant differences in a number of measured 3D/4D sonographic parameters. Differences were identified for both function and anatomy of the pelvic floor. A number of authors have also suggested that high-impact sport could contribute to development of urinary incontinence in nulliparous women involved in sport for a prolonged period. This observation suggests that there may be a functional change in the pelvic floor muscles of highly athletic women. It is thought that high-impact landing may cause alterations in pelvic floor morphology and function. There is also limited evidence suggesting that women involved in high-impact, frequent, intense training have difficulties during delivery owing to changes in pelvic floor muscles.[3]

A cross-sectional study by Vitton et al.[7] in southern France showed that high-level sport (defined as a training regimen of at least 8 hours per week) was an independent risk factor for anal incontinence (involuntary leakage of stool or flatus) in healthy young women. They also looked at other symptoms of PFD, i.e. urinary incontinence, constipation and dyspareunia. Seven groups of sports were included in the study: technical, endurance, aesthetic, weight class, ball games, power and gravity. The women were further divided into two groups: an intensive sport group (women practising high-level sport or more than 8 hours weekly or both) and a non-intensive sport group (all other participants). The different variables that were examined for anal incontinence and urinary incontinence were age, body mass index (BMI), parity, sport group, sport practice in the past 6 months, and use of forceps at vaginal delivery. The prevalence of anal incontinence was statistically higher among the intensive sport group than in the

non-intensive sport group. The prevalence of urinary incontinence seen in the intensive sport group was similar to that observed in elite athletes. The prevalence of dyspareunia was also higher in the intensive sport group than in the non-intensive sport group. No single type of sport was more associated with a higher prevalence of anal incontinence than other sports.

In another cross-sectional study by Jȧcome et al.,[8] 106 female athletes involved in athletics (track and field sports), basketball and indoor football were recruited. Data collection was via questionnaire and a focus group interview. Of the 106 participants, 41.5% had experienced urinary incontinence at least once. Those who reported urinary incontinence had lower body weight and lower BMI. The prevalence of urinary incontinence was similar across the three types of sport, and was evident in those who had practised sport for longer periods of time. The majority did not smoke, were nulliparous, and did not present with constipation symptoms. Only 5 athletes had undergone pelvic surgery. None of the known risk factors was significantly associated with urinary incontinence. The focus group revealed that the athletes considered urine loss to be a normal condition unrelated to practising sport. Despite their concerns, they felt the condition had no current effect on their daily lives, but affected their sporting performance. None of the athletes had sought help from a health professional regarding the symptoms and were unaware of the relationship between urinary incontinence and practising sport, or even of methods to prevent or treat the condition.

A prospective observational study conducted by Borin et al.[9] evaluated the pressure of the pelvic floor muscles in female athletes and the associated signs and symptoms of stress urinary incontinence (SUI), defined as involuntary loss of urine occurring through physical exertion. The prevalence was higher in women who practised high-impact sport. Forty female volunteers aged between 18 and 30 years, with a BMI of 19-20 kg/m^2, were divided into 4 groups: volleyball players, basketball players, handball players and non-athletes. These women were subjected to measurement of intracavity perineal pressure during pelvic floor muscle contraction using a perineometer. The

researchers hypothesised that the possible association between urinary incontinence and high-impact sport was that intra-abdominal pressure rises dramatically during strenuous exercise, to the point where it exceeds intra-urethral pressure. The study suggested that perineal pressure is decreased in female athletes in comparison with non-athletes. A lower perineal pressure was found to correlate with increased symptoms of urinary incontinence and pelvic floor dysfunction. However, data could not be generalised to all high-impact sports because only volleyball, handball and basketball players were tested.

In a cross-sectional cohort study by Da Roza et al.,[10] 22 nulliparous female trampolinists were assessed for urinary incontinence. The volume of training and ranking were considered. It was not surprising that these athletes, who were involved in high-impact sport, were noted to progressively develop structural or functional alterations in the pelvic floor muscles, as they were constantly subjected to considerable forces. The findings of the study showed a high frequency of SUI, especially in young trampolinists with higher ranking and training volume.

It is important to note that no study demonstrated a direct relationship between the characteristics of the nature of the training and the severity of pelvic floor dysfunction. Conclusions have mostly been based on assumptions supported by the high frequency of urinary incontinence observed in this population. Several studies have also suggested that leakage might not be a result of morphologic changes or fatigue of pelvic floor muscles, but rather a consequence of muscle responsiveness to mechanical stimulus. More studies are, however, needed to support this hypothesis.

There is limited literature on bicycling and pelvic floor dysfunction. In one review of cycling-related issues by Partin et al.,[11] it was found that between 50% and 91% of both male and female riders reported genital numbness. In this study, investigators looked at handlebar levels in relation to the saddle and how this affected saddle pressure and neurovascular compression. It follows that this relationship influences the potential for increases in nerve fibre loss and decreased genital sensation. Forty-eight female

cyclists aged ≥18 years participated in the study. A bicycling questionnaire was used to assess the bicycle set-up and rider characteristics. Saddle pressures were measured with the participants riding in their typical position. Vibratory thresholds were measured in 8 genital regions to assess sensory nerve function in the genital region. Higher vibratory thresholds indicated less sensitivity to stimulus applied. The different variables included handlebar height, time spent on the saddle, presence or absence of shock-absorbers, saddle firmness and whether the participant remained seated or not while riding on rough terrain. The study findings were that handlebar position, rather than that of the saddle, resulted in increased perineal saddle pressure and decreased genital sensation. With low handlebars, riders tend to lean forward which results in more weight being shifted to the perineal region. Other authors confirmed a similar finding when comparing men and women, when changing from holding the top of the handlebar to holding the dropped sides of the handlebar. Women were found to have a greater change in maximum anterior pressure and neurovascular damage.

Swimming and exercises in water have been found to have many positive benefits for the pelvic floor. It creates less load on the pelvic floor because the body is more buoyant, thus weighing less.

Since 2007, the American College of Sports Medicine (ACSM) has recommended the importance of a pre-participation examination, especially in female tri-athletes. This practice is, however, not common in most countries. According to Parmigiano et al.,[12] this evaluation is important because, for many women, it may be the only contact that the athlete has with a physician. In their study, they included a total of 148 female athletes, with a mean age of 15.4 years, who practised 8 different sport modalities (track and field, basketball, boxing, soccer, handball, judo, wrestling and swimming) at an olympic training and research centre in Brazil. Participants completed a questionnaire called the Pre-participation Gynaecological Examination (PPGE). Following this, the International Consultation on Incontinence Questionnaire – Short Form (ICIQ-SF) for evaluation of urinary incontinence was completed, as well as the Eating Attitude Test (EAT-26) for eating changes. The intention of the study was to identify knowledge about the prevalence of the female athlete triad (disordered eating, amenorrhoea and

osteoporosis), as well as urinary incontinence, pre-menstrual tension and sexually transmitted infections (STIs). The effect of intensive exercise on the menstrual cycle and its counter-influence on sport performance were reviewed. About 50% of participants reported having irregular cycles, and 13.5% amenorrhoea. Over 96% reported no change in sport practice during their menstrual period. Pre-menstrual symptoms were variable. Of the young athletes, 17.7% were sexually active, of whom more than 90% used no contraceptive measures and 23% had no history of STIs. All participants were nulliparous. The majority had no knowledge of the female athlete triad and none of the participants reported all three symptoms of the triad. According to the results of the EAT-26 analysis, 9.5% of the athletes were considered at high risk for developing eating disorders and were referred for a detailed dietary assessment and follow-up. Eighty-nine per cent were not aware that they could be at increased risk for urinary incontinence, although 23.1% had had some degree of urine loss resulting in them being referred to a physiotherapist specialising in urogynaecology. The PPGE proved to be an important tool in identifying issues of the female athlete and offering early intervention by relevant specialists.

There are several factors that contribute to the occurrence of urinary incontinence in female athletes. According to Rivalto et al.,[13] these include inadequate abdominal pressure transmission, pelvic floor muscle fatigue and changes in collagen or connective tissue. The four major categories of treatment are behavioural, rehabilitative, pharmacological and surgical. Pelvic floor rehabilitation (PFR) may include the following steps: biofeedback, functional electrical stimulation, pelvic floor muscle exercises, and pelvic muscle exercises using vaginal cones. This treatment has proven to be efficacious and safe, and should be considered as first-line management. In Rivalta's study, they looked at three female nulliparous athletes (agonistic volleyball players) who were experiencing urinary incontinence during sport and daily life, which required them to use a pad, panty-liner or tampon during training and competition. These women underwent pelvic floor muscle examination with urogynaecologic evaluation and pubococcygeus testing to document pelvic floor muscle function and strength. The

participants also underwent the PFR treatment regimen mentioned above. Following the PFR programme, none of the participants experienced urine leakage during sport or daily life activities. The pubococcygeus test improved in all athletes. PFR may be an effective treatment for urinary incontinence and be effectively used to treat this disorder in female athletes.

Women suffering from pelvic floor symptoms are often advised to do their ‘Kegel’s exercises’ because almost all such disorders may be prevented or treated through programmes that improve pelvic floor muscle strength and coordination. However, long-term adherence to pelvic floor muscle training is poor. The Pilates method (named after the founder, Joseph Pilates, who developed these methods in the 1920s) might provide a new, more compelling ‘full-body’ alternative for the prevention and treatment of pelvic floor dysfunction. Pilates consists of a series of low-impact exercises intended to produce flexibility and strength for the entire body and promote a ‘mind-body’ connection. The method focuses especially on ‘core’ abdominal, lower back, and medial thigh muscles. Most of these exercises are performed in conjunction with a pelvic floor muscle contraction. Many Pilates instructors believe that their methods can produce significant improvements in pelvic floor strength. Culligan et al.[14] held a randomised controlled trial where they compared a standardised physical therapy-based pelvic floor muscle training (PFMT) programme with a standardised Pilates programme in terms of improving pelvic floor muscle strength. Sixty-two women were enrolled and randomised into the groups, comprising 30 and 32 in the Pilates and the PFMT groups respectively. The mean pre-treatment muscle strength for the two groups was measured. Each group had 24 bi-weekly one-hour sessions with either a physical therapist or Pilates instructor. Pelvic floor strength was measured via perineometry. Both groups demonstrated improved strength at the end of the study. The findings were most interesting in that, when groups were compared, the muscle strength improvements were not significantly different between the intensive pelvic floor muscle training and the Pilates groups. These results were encouraging and may eventually lead to widespread use of more

accessible Pilates-based exercise programmes to treat and prevent pelvic floor dysfunction.

Urinary incontinence affects quality of life and participation in social activities, especially physical activity and exercise. Kegel, in 1948, was the first to report the effect of regular, specific, strength training of the pelvic floor muscles on female urinary incontinence and pelvic organ prolapse. He claimed that up to 84% of symptomatic women were cured of urinary incontinence after PFMT. There are a number of randomised controlled trials (RCTs) that evaluated the effects of PFMT on female urinary incontinence. The broad findings were that supervised intensive PFMT reduces the risk of incontinence. Reviews of these RCTs conclude that there was good evidence for the effectiveness of PFMT and that PFMT should be first-line treatment for urinary incontinence.

There is increasing interest in exploring alternative exercises to treat urinary incontinence. These include training of the deep abdominal muscles, contraction of the ring muscles of the mouth and eyes (Paula method), Pilates, yoga, tai chi, breathing exercises, posture correction and general fitness training. Bø et al.[15] did a systematic review to determine if there was any evidence for alternative exercises to specific PFMT, in the treatment of female urinary incontinence. They found no trials that compared alternative exercises with no treatment. There has been no conclusive demonstration that any of these alternative exercises are effective for prevention or treatment of urinary incontinence either as an alternative or complementary to PFMT. They concluded that further development and testing, ultimately with RCTs, is needed before these alternative interventions become routine clinical practice.

Yi et al.[16] recently performed a cross-sectional descriptive study of female triathletes, which included a survey using three questionnaires: the Epidemiology of Prolapse and Incontinence Questionnaire (EPIQ) to evaluate the prevalence of PFDs; the Pelvic Girdle Questionnaire (PGQ) to assess the physical activity limitations and symptoms in women with pelvic girdle pain; and the Female Athlete Triad Questionnaire to assess the associated health risks of the female athlete triad. A total of 311 female triathletes with a median age of 35–44 years responded to the survey. There was a significant prevalence of PFDs, with SUI and AI (anal incontinence) the most common disorders

reported. Nearly 1 in 5 women reported pelvic girdle pain. As expected, parity was noted to lead to a significantly higher rate of PFDs, specifically in SUI and pelvic organ prolapse. However, parous and nulliparous responders had a comparable prevalence of UUI and AI. There was a high rate of AI in these young participants, irrespective of parity. As with previous studies of female athletes, the finding of pelvic girdle pain was noted in approximately 18% of those athletes. Only 8% screened positive for all 3 components of the female athlete triad and PFD in the present study.

It is clear that there has not been sufficient investigation into the impact of endurance sport on the female pelvic floor. As our topic states, we aimed to investigate the prevalence of PFD as well as its effect on the quality of life and training practices amongst women involved in triathlon training and/or participating in the highly recognised branded IRONMAN triathlon.

The World Wide Web (WWW) is increasingly being used as a tool and platform for survey research. This can either be done via email or web based survey. Online surveys have been used to recruit potential respondents with special interests. The self-organized groups can be valuable for researchers interested in designing a study of persons with particular characteristics. The anonymity possible on the internet is believed to help in gaining access to respondents normally difficult to reach and are considered useful when issues being researched are particularly sensitive. Advantages of internet surveys also include economic advantage and efficiency. Online surveys are particularly attractive in this respect when the population under study is distributed across a large geographic region. Sampling bias is a major objection to employing online surveys. It may be problematic to achieve a random sample. It may be argued that online surveys should be reserved for non-probability sampling which then should meet the condition of sufficient response rate.[16]

The word ‘triathlon’ is of Greek origin, derived from *treis* (three) and *athlos* (contest). Therefore, a triathlon involves the competitive completion of three continuous and sequential endurance disciplines, namely swimming, cycling and running in immediate succession over various distances.[17] It consists of a 3.86 km swim, a 180.25 km bicycle ride, and a 42.2 km run, in that order without a break. There is also the half-IRONMAN 70.3 (70.3 refers to the total distance in miles). The physical intensity of the competition – as with other high-impact sports – is rather obvious, and therefore it may not be surprising to find that these women often experience at least one PFD symptom. According to Ortiz,[18] most women with SUI postpone seeking medical help because of their feelings of shame and embarrassment. Therefore, in conducting the present study, we aimed to identify and describe the common pelvic floor disorder symptoms that some of these women are prone so as to promote awareness amongst this population.

METHODOLOGY

An anonymous online survey (SurveyMonkey) was administered from September 2015 to March 2016 to women ≥18 years who identified themselves as triathletes. It was a voluntary survey directed at this specific population of women. We sent an introductory email requesting our survey to be forwarded to female triathletes via various triathlon clubs. We also made contact with the South African director of the IRONMAN to request that our email be sent out with their newsletter to their database of athletes. Our survey link was then forwarded to this target population.

Two validated questionnaires were used: the Pelvic Floor Distress Inventory Questionnaire short form (PFD-20) and the Pelvic Floor Impact Questionnaire short form (PFIQ-7). These questionnaires were validated for women prior to pelvic floor surgery and also administered 3-6 months post operatively to assess the responsiveness of the instruments. They were found to be valid, reliable and responsive short forms of two condition-specific QOL questionnaires for women with PFD.[20] In addition, we requested demographic details (age, height, weight, occupation), general health status (medical history, pelvic/abdominal surgical history, pregnancy and birth history) as well as sport practice characteristics (duration of training, level of competition, and number of hours spent per week swimming, cycling and running). We enquired as to whether any of the triathletes incorporated pelvic floor exercises, yoga and/or Pilates into their training programmes. This was done to characterise female triathletes which could help to identify risk factors for pelvic floor symptoms (Appendices 1, 2 and 3).

Ethics approval was obtained from the University of Cape Town Human Research Ethics Committee (HREC REF: 542/2015)

A data collection sheet was designed by means of SurveyMonkey to capture individual participant information. The data were collected and with the variables transferred onto an Excel spreadsheet and then formatted into a Stata statistical dataset and analysed. The majority of the variables are presented in a descriptive format. Means, medians, ranges and measures of dispersion are presented for interval variables. Proportions are

presented in tabular format for categorical variables. Associations were explored to address the research questions. All statistically significant associations are presented. A *p*-value of <0.05 was used as the level of statistical significance. Interval data were analysed using *t*-tests and categorical variables were analysed using chi-square tests. Where appropriate, measures of association and 95% confidence intervals were calculated.

RESULTS

Sixty-seven female triathletes responded to the online survey on SurveyMonkey. The respondents were between the ages of 22 and 56, with a mean of 37 years. They had a mean BMI of 22.6 kg/m^2 (Table 1). None of the women had any medical conditions known to increase the risk of PFD but two women gave a history of previous prolapse surgery (Table 2). Forty-five (69.2%) were nulliparous and 20 (30.8%) were parous. Amongst the 20 parous women, 11 (55%) gave a history of only having caesarean sections and 9 (45%) had vaginal deliveries of which three were forceps deliveries.

The majority (70.4%) of the women who responded competed in the recreational age group, defined as the health and fitness group whose sole aim was to overcome the challenge of getting to the finish line (preferably in one piece), compared with 29.6% in the competitive age group, defined as women who do one or two half-IRONMAN events as a lead-up to the full IRONMAN. We had no responses from professional triathletes. All but 3 (95.5%) of the participants had been involved in triathlon training for a period of more than 6 months. The mean period of training was 40 months (range 119 months), during which they spent a mean of 5.4 hours (range 39 hours) a week running, 3.9 hours (range 29 hours) per week swimming, and 9.1 hours (range 49 hours) hours per week cycling; at the peak of their training (Table 3). Thirty-seven (82%) of the triathletes had competed in at least one half-IRONMAN competition and 17 (37.7%) in at least one full IRONMAN competition (Table 4).

In the present study, 16 (29.6%) women reported regularly performing pelvic floor exercises, 9 (6.7%) performed yoga and 14 (25.9%) Pilates as part of their routine training.

We identified the 3 most frequently reported symptoms for each category, namely urinary, colorectal and pelvic organ prolapse symptoms. The prevalence of symptoms in

the present study, as reported in the PFDI, is depicted in Table 5. The most reported urinary symptoms were urinary frequency in 45.8%, SUI in 33.3% and UUI in 37.5%. The most reported colorectal symptoms were incomplete bowel emptying (41.7%), faecal urgency (43.8%) and flatal incontinence (41.7%). Pelvic organ prolapse symptoms were least reported, but those who had symptoms mostly experienced heaviness or dullness in the pelvic area (33.3%), pressure in the lower abdomen (31.3%), and a need for vaginal/rectal digitation in order to have or complete a bowel movement (25%).

There was an insignificant difference in PFD symptoms when comparing the recreational and the competitive age groups (Table 6).

We assessed the prevalence of the reported PFD symptoms in the nulliparous compared with the parous triathletes (Table 7). It was interesting to find that the nulliparous triathletes had more pelvic floor symptoms than did the parous group. Of the urinary symptoms, 48.5% of the nulliparous group reported urinary frequency compared with 33.3% of the parous group (p=0.37). There was an equal prevalence of SUI (33.3%) in the groups. Only 16.6% of the parous triathletes compared with 48.5% of the nulliparous triathletes had UUI (p=0.15). The numbers in this sub-analysis were, however, small and a statistically valid conclusion was not possible.

Colorectal symptoms were also found to be more prevalent in the nulliparous group than in the parous triathletes. Faecal urgency was reported by 57.6% of nulliparous triathletes compared with 22.2% in the parous group (p=0.02). Incomplete bowel emptying was reported in 39.4% of the nulliparous group and 50% in the parous group (p=0.61). Flatal incontinence was reported by 42.4% of nulliparous and 33.3% of parous triathletes (p=0.44). Symptoms of pelvic organ prolapse were not common in either group, although a small percentage (6.0%) of nulliparous women experienced the need for vaginal/rectal digitation to make or complete a bowel movement.

The number of parous women who had previous vaginal births were too small to make an adequate statistical analysis. These results are, however, provided in Table 8. There was no difference in urinary frequency between the described modes of delivery. UUI was also experienced more by the unassisted vaginal birth group and, unsurprisingly, a

higher prevalence of colorectal symptoms were reported by those who had had forceps deliveries.

We wished to assess whether birth weights had any further influence on PFD amongst the parous women (Table 9). We classified newborn birth weights as: (1) extremely low birth weight (<999 g); (2) very low birth weight (1000 g–1499 g); (3) low birth weight (1500 g–2499 g); (4) normal birth weight (2500 g–3999 g); and (5) high birth weight (≥4000 g). Because some women had had more than one delivery, we opted to take the highest birth weight for each parous woman. We found that, of the parous women, the majority had had normal birth weight newborns, with the most prevalent symptoms being urinary frequency and incomplete bowel emptying (40% and 46.7% respectively).

PFD symptoms were assessed in triathletes who performed any 'core exercises' such as pelvic floor exercises, yoga and/or Pilates as part of their routine training (Table 10). Twenty-five women reported doing at least some type of core strengthening activity, namely 30% performing pelvic floor exercises, 17% yoga and 26% Pilates. In this group, 10 (40%) reported urinary frequency and 9 (36%) both SUI and UUI. There was no statistical difference in urinary symptoms between those who performed any core exercises and those who did not perform any of the core exercises. The numbers in this part of the analysis were probably too low to make a meaningful assessment. Although not statistically significant, colorectal symptoms were found to be slightly more prevalent in those who performed any core exercises than in those who did not. Interestingly,15 (60%) of the triathletes who included core exercises in their routine training reported pressure in the lower abdomen (p=0.06).

We used the PFIQ-SF to assess how bladder, bowel and vaginal symptoms affected athletes' activities, relationships and feelings (Figure 1). It appeared that these women were not significantly bothered by their symptoms; however, a few felt frustrated by mostly bowel and bladder symptoms (16.3% and 16.7% respectively).

It is known that many of the pelvic floor symptoms do not occur in isolation, so we aimed to see if this applied to our cohort by exploring the associations between bladder, bowel and prolapse symptoms. There was a strong correlation between the occurrence of bladder and pelvic organ prolapse symptoms **(***p*=0.00) in our study (Table 11). The relationship between bowel and bladder symptoms was also statistically significant (*p*=0.01) (Table 12). There was, however, no association between bowel and prolapse symptoms (*p*=0.58) (Table 13).

TABLES AND FIGURE

Table 1: Participants' demographics.

***N*=67**	**Mean**	**Minimum**	**Maximum**
Age (years)	37	22	56
BMI (kg/m^2)	22.6	16	32
Number of births	3	1	4

Table 2: Previous pelvic or abdominal surgery.

Procedure	***n* (*N*=66)**
None	50 (76%)
Abdominal hysterectomy	3 (4.5%)
Caesarian section	5 (7.6%)
Hernia repair	2 (3.0%)
Pelvic organ prolapse repair	2 (3.0%)
Other	4 (6.0%)

Table 3: Number of hours spent on each activity at the peak of training over the past 12 months.

Activity type	**Recreational age group (*N*=38)**	**Competitive age group (*N*=16)**	**Total (mean)**
Running (hours/week)	4.6	7.2	5.4
Swimming (hours/week)	3.2	5.5	3.8
Cycling (hours/week)	7.2	13.4	9.1

Table 4: Competitions participated in.

Type of competition	*n* (*N*=45)
Sprint distance	33 (73.3%)
Olympic-distance triathlon	39 (86.6%)
Half IRONMAN	37 (82.2%)
Full IRONMAN	17 (37.7%)
Half marathon	39 (86.6%)
Full marathon	21 (46.6%)
90 km bicycle race	37 (82.2%)

Table 5: Prevalence of symptoms of PFD based on responses to PFDI.

Symptom	Prevalence
Urinary (*N*=48)	
Frequency	22 (45.8%)
Stress incontinence	16 (33.3%)
Urge incontinence	18 (37.5%)
Colorectal/anal (*N*=48)	
Incomplete bowel emptying	20 (41.7%)
Faecal urgency	21 (43.8%)
Flatal incontinence	20 (41.7%)
Pelvic organ prolapse (*N*=48)	
Heaviness/dullness in pelvic area	16 (33.3%)
Pressure in lower abdomen	15 (31.3%)
Vaginal/rectal digitation	12 (25%)

Table 6: Prevalence of symptoms of PFD in the recreational and the competitive age groups.

Symptom	**Recreational N=36**	**Competitive N=15**
Urinary (*N*=51)		
Frequency	17 (13.3%)	6 (11.7%) *P*= 0.92
Stress incontinence	11 (21.5%)	6 (11.7%) *P*=0.75
Urge incontinence	12 (23.5%)	7 (13.7%) *P*=0.61
Colorectal/anal (*N*=51)		
Incomplete bowel emptying	15 (29.4%)	15 (29.4%) *p*=0.05
Faecal urgency	14 (27.4%)	9 (17.6%) *P*=0.23
Flatal incontinence	13 (25.5%)	7 (13.7%) *P*=0.69
Pelvic organ prolapse (*N*=51)		
Heaviness/dullness in pelvic area	11 (21.5%)	5 (9.8%) *P*=0.93
Pressure in lower abdomen	11 (21.5%)	4 (7.8%) *P*=0.71

Table 7: PFD symptoms in parous v. nulliparous triathletes.

Symptoms	Nulliparous *N*=33	Parous *N*=18
Urinary		
Urinary frequency	16 (48.5%)	7 (38.9%)
Stress urinary incontinence	11 (33.3%)	6 (33.3%)
Urinary urge incontinence	16 (48.5%)	3 (16.6%)
Colorectal/anal		
Incomplete bowel emptying	13 (39.4%)	9 (50%)
Faecal urgency	19 (57.6%)	4 (22.2%) *p*=0.02
Flatal incontinence	14 (42.4%)	6 (33.3%)
Pelvic organ prolapse		
Heaviness/dullness in pelvic area	10 (30.3%)	6 (33.3%)
Pressure in lower abdomen	10 (30.3%)	5 (27.8%)
Vaginal/rectal digitation	2 (6.0%)	0 (0%)

Table 8: PFD symptoms in parous triathletes who have had vaginal births as well as those assisted with forceps.

Symptoms	Normal vertex delivery *N*=6	Forceps delivery *N*=3
Urinary		
Urinary frequency	4 (66.7%)	2 (66.7%)
Stress urinary incontinence	4 (66.7%)	1 (33.3%)
Urinary urge incontinence	2 (33.3%)	0 (0.0%)
Colorectal/anal		
Incomplete bowel emptying	3 (50.0%)	2 (66.7%)
Faecal urgency	1 (16.7%)	2 (66.7%)
Flatal incontinence	4 (66.7%)	2 (66.7%)
Pelvic organ prolapse		
Heaviness/dullness in pelvic area	3 (50.0%)	2 (66.7%)
Pressure in lower abdomen	3 (50.0%)	1 (33.3%)
Vaginal/rectal digitation	0 (0.0%)	0 (0.0%)

Table 9: PFD symptoms in parous triathletes according to birth weights.

Symptoms	Very low BW (<1499 g) *n*=1	Normal BW (2500 g-3999 g) *n*=15	High BW (≥4000 g) *n*=2
Urinary			
Urinary frequency	0 (0.0%)	6 (40.0%)	1 (50.0%)
Stress urinary incontinence	0 (0.0%)	5 (33.3%)	1 (50.0%)
Urinary urge incontinence	0 (0.0%)	2 (13.3%)	1 (50.0%)
Colorectal/anal			
Incomplete bowel emptying	1 (100.0%)	7 (46.7%)	1 (50.0%)
Faecal urgency	0 (0.0%)	4 (26.7%)	1 (50.0%)
Flatal incontinence	0 (0.0%)	4 (24.7%)	1 (50.0%)
Pelvic organ prolapse			
Heaviness/dullness in pelvic area	0 (0.0%)	5 (33.3%)	1 (50.0%)
Pressure in lower abdomen	0 (0.0%)	3 (20.0%)	2 (100.0%)
Vaginal/rectal digitation	0 (0.0%)	0 (0.0%)	0 (0.0%)

BW = birth weight.

Table 10: PFD symptoms in triathletes who performed either PFE, yoga and/or Pilates.

Symptoms	PFE/yoga/Pilates *N*=25	No PFE/yoga/Pilates *N*=25
Urinary		
Urinary frequency	10 (40.0%)	13 (50.0%)
Stress urinary incontinence	9 (36.0%)	8 (30.8%)
Urinary urge incontinence	9 (36.0%)	10 (38.5%)
Colorectal/anal		
Incomplete bowel emptying	12 (48.0%)	10 (38.5%)
Faecal urgency	13 (52.0%)	10 (38.5%)
Flatal incontinence	10 (40.0%)	10 (38.5%)
Pelvic organ prolapse		
Heaviness/dullness in pelvic area	8 (32.0%)	8 (30.8%)
Pressure in lower abdomen	15 (60.0%)	3 (11.5%) *p*=0.063
Vaginal/rectal digitation	1 (4.0%)	1 (3.8%)

Table 11: Relationship between bladder/urine and vaginal/pelvic symptoms.

	Vagina or pelvis			
Bladder or urine	**0**	**1**	**2**	**Total**
0	55 (96.36%)	0 (0.00%)	2 (3.64%)	55 (100.0%)
1	4 (80.00%)	1 (20.00%)	0 (0.00%)	5 (100.0%)
2	4 (100.0%)	0 (0.00%)	0 (0.00%)	4 (100.0%)
3	2 (100.0%)	0 (0.00%)	0 (0.00%)	2 (100.0%)
4	0 (0.00%)	0 (0.00%)	1 (100.0%)	1 (100.0%)
Total	63 (94.03%)	1 (1.49%)	3 (4.48%)	67 (100.0%)

p=0.000

Table 12: Relationship between bladder/urine and bowel/rectum symptoms.

	Bowel or rectum					
Bladder or urine	**0**	**1**	**2**	**3**	**4**	**Total**
0	47 (85.45%)	5 (9.02%)	1 (1.82%)	1 (1.82%)	1 (1.82%)	55 (100.0%)
1	2 (40.00%)	2 (40.00%)	1 (20.00%)	0 (0.00%)	0 (0.00%)	5 (100.0%)
2	3 (75.00%)	1 (25.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	4 (100.0%)
3	2 (40.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	2 (100.0%)
4	0 (0.00%)	0 (0.00%)	1 (100.0%)	0 (0.00%)	0 (0.00%)	1 (100.0%)
Total	54 (80.60%)	8 (11.94%)	3 (4.48%)	1 (1.49%)	1 (1.49%)	67 (100.0%)

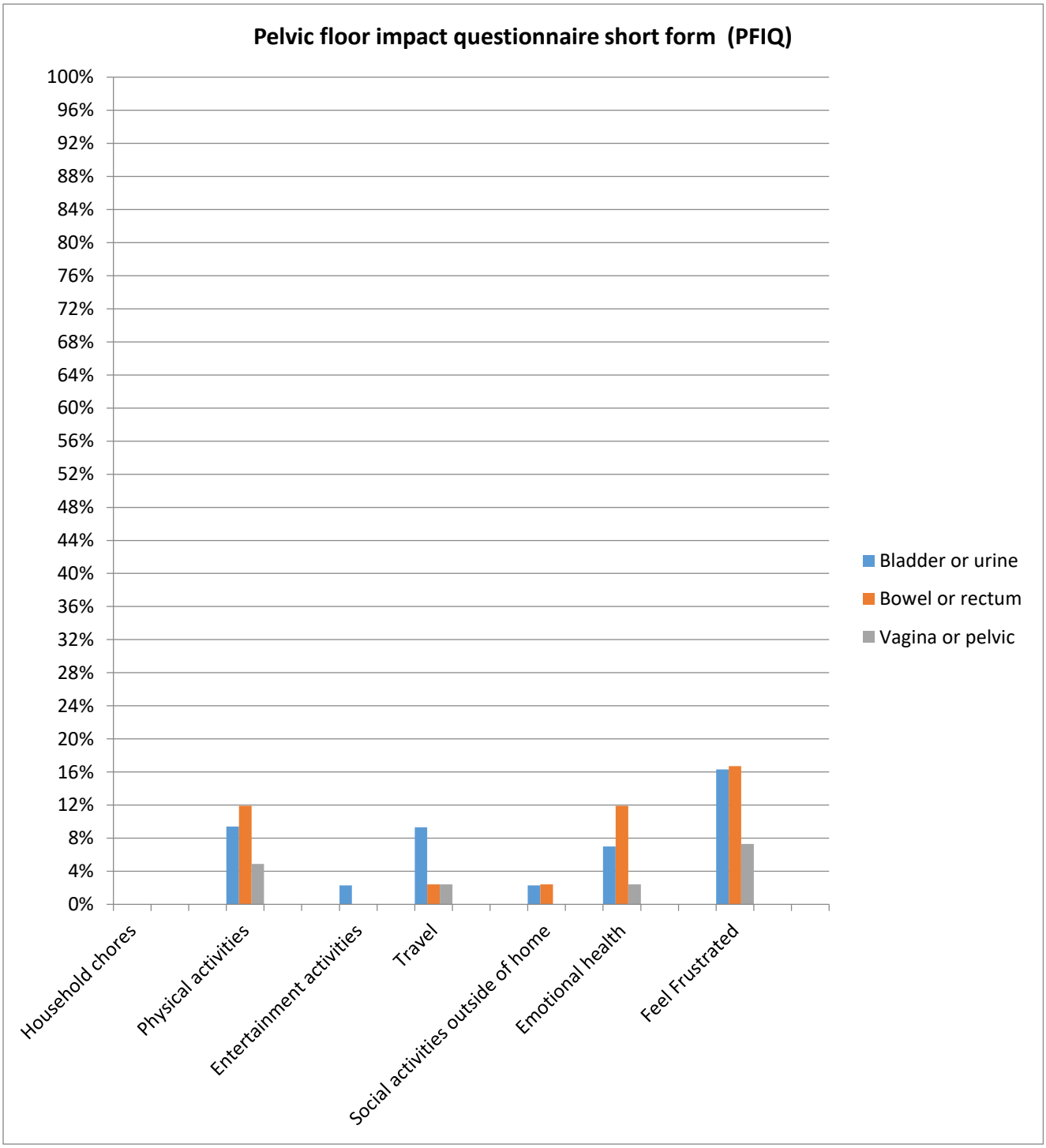
p=0.012

Table 13: Relationship between bowel/rectum and vaginal/pelvic symptoms.

	Vaginal or pelvic			
Bowel or rectum	**0**	**1**	**2**	**Total**
0	51 94.44	1 1.85	2 3.70	54 100.0
1	8 100.0	0 0.00	0 0.00	8 100.0
2	2 66.67	0 0.00	1 33.33	3 100.0
3	1 100.0	0 0.00	0 0.00	1 100.0
4	1 100.0	0 100.0	0 100.0	1 100.0
Total	63 94.03	1 1.49	3 4.48	67 100.0

p=0.578

Figure 1: Effect of symptoms on athletes' activities, relationships and feelings.



DISCUSSION

Summary of results

Sixty-seven female triathletes aged between 22 and 56 years responded to our online survey on SurveyMonkey. The PFDI-SF revealed a number of commonly occurring pelvic floor symptoms in female triathletes. Nearly half of the women reported urinary frequency and more than a third complained of SUI and UUI. Colorectal symptoms were also very common in this cohort, with an incidence of 42% for incomplete bowel emptying, 44% for faecal urgency and 41% for flatal incontinence. Pelvic organ prolapse symptoms were least reported.

PFD symptom prevalence was compared between the nulliparous and the parous triathletes. It was interesting to find that the nulliparous triathletes had more symptoms than did the parous group. There was a high prevalence of urinary frequency and UUI, as well as a significant presence of faecal urgency amongst the nulliparous triathletes. Symptoms of pelvic organ prolapse were similarly not common in both groups. The majority of women had normal birth weight newborns.

Twenty-five women performed at least one of the ‘core exercises’ (pelvic floor exercises, yoga and/or Pilates). Colorectal symptoms were found to be slightly more prevalent in those who performed a ‘core exercise’ than amongst those who did not.

We confirmed some known associations of various symptoms of PFD in our cohort; those between bladder and prolapse symptoms, as well as between bowel and bladder symptoms, were found to be statistically significant.

It was striking that, even with the range and relatively high prevalence of symptoms, these women were not significantly bothered by their symptoms.

Discussion of results

Of the 67 respondents to our online survey there were a number who did not complete the survey completely (left out some questions) and/ or correctly (answered in words instead of digits). This reflects the flaws of such a survey which may result in non-response bias.

1. Prevalence of symptoms

In our study, the most prevalent PFDs were those related to colorectal symptoms. Twenty (41.7%) participants reported incomplete bowel emptying and flatal incontinence, and 21 (43.8%) reported faecal urgency, both of which were relatively prevalent in our study. Urinary symptoms were also commonly reported, and these included urinary frequency, SUI and UUI (45.8%, 33.3% and 37.5% respectively).

It is important to understand if symptoms of PFD are more common amongst the triathletes in the present study than in a comparable non-athlete cohort. Unfortunately, there are not many studies on the prevalence of these symptoms in this age group in South Africa. Of the reports available in this country, the prevalences of some of the symptoms were slightly lower than those found in our study. Bailey et al. found a prevalence of 27.5% for urinary incontinence in women working in a university hospital.[21] Participants were of a comparable age to our study (range 24-62 years, mean 44.4 years). Madombwe et al. reported a prevalence of urinary incontinence of 35.4%, with only a quarter of women seeking help for the condition.[22] The same study also reported on pelvic floor exercises. Of the 99 participants aged between 21 and 76 years, 32.3% had heard of pelvic floor muscle exercises and 18.2% had actually done them. In another South African study, Rienhardt et al.[23] also showed a much lower prevalence for urinary symptoms in a general population compared with that found in the present study. In the former study, the prevalence of urge incontinence was 15.3%, 12.8% and 9.9% amongst the black, coloured and white participants respectively. SUI was reported in 9.0%, 8.2% and 10.3% women respectively. UUI was reported in 23.4%, 25.0% and 15.3% of the participants. The etiology of ethnic differences in the

prevalence of urinary incontinence is still controversial and is most likely multifactorial, including inherent structural and physiological factors.

In comparison, in our study, SUI was reported in 33.3% and UUI in 37.5%.

Pelvic organ prolapse was the least reported of the PFD symptoms in our cohort of female triathletes. This result is most likely because the large majority (over 70% of our study participants) were nulliparous. Many authors have suggested that high-impact sport may contribute to the development of urinary incontinence in nulliparous women involved in sport for a prolonged period of time.[6] It is thought that the high impact of landing (seen with running, in the case of triathletes) may cause alterations in pelvic floor morphology and function, thus leading to incontinence. The force may, however, not be significant enough to cause prolapse.

2. Intensity of exercise

Vitton et al.[7] found the prevalence of AI to be statistically higher amongst the intensive sport group (women practicing a high-level sport or training regimen of at least 8 hours per week). In the 7 sport groups including technical, endurance, aesthetic, weight class, ball games, power and gravity, there was no single type that was associated with a higher prevalence of AI over other sports.

In a cross-sectional study by Jâcome et al.,[8] 41.5% of 106 participants involved in athletics, basketball and indoor football had experienced urinary incontinence at least once. The prevalence of urinary incontinence was similar across the 3 types of sport, and was more evident in those who had practised sport for longer periods of time.

In the only study done on female triathletes, Yi et al.[16] surveyed 311 female triathletes and found that there was a significant prevalence of PFD symptoms. Urinary incontinence and AI were the most common disorders reported (37.4% and 28% respectively). Yi et al. also found that there was a high rate of AI in the participants, irrespective of parity. Pelvic organ prolapse was less common (5.0%), as was demonstrated in the present study. Our study was unable to show any statistically significant differences in PFD symptoms between the competitive and recreational age group triathletes. It is probable that our study was underpowered for assessing this outcome.

3. Influence of pregnancy and childbirth

Pregnancy and childbirth are well-known independent risk factors for PFD, regardless of the mode of delivery (vaginal or caesarian section deliveries). It is widely accepted that pelvic floor trauma is more common in women who have had forceps deliveries, thus increasing the symptoms of PFD. A surprising finding in our study was that the nulliparous triathletes had more PFD symptoms than did the parous triathletes. Sixteen (48.6%) of the nulliparous participants suffered urinary frequency as well as UUI, compared with the parous group of whom only 7 (38.9%) reported urinary frequency and 3 (16.6%) reported UUI. There was an equal prevalence of SUI between the groups (33.3%). Colorectal symptoms were also found to be more prevalent amongst the nulliparous group. Faecal urgency was reported by 19 (57.6%) of the nulliparous triathletes (p=0.02). This result may be influenced by the fact that there were fewer parous participants than in the nulliparous group (18 and 33 respectively). Flatal incontinence was reported by 42.4% of nulliparous triathletes. This finding was in contrast to what has been found in other studies. Yi et al.[16] found that parous and nulliparous responders had a similar prevalence of urinary incontinence and AI, and that there was a high rate of AI found in participants, irrespective of parity. The explanation for our findings could possibly be based on the assumption that most parous women in their postpartum period are often encouraged to do Kegel’s exercises which prove

beneficial in strengthening their pelvic floor muscles at that critical time and beyond, thus preventing PFD in the future.

4. Influence of pelvic floor exercise

Pelvic floor exercises are a widely used form of treatment and prevention of PFD. A number of reviews have described PFMT as the recommended first-line conservative prevention and management programme for women with stress, urge or mixed urinary incontinence as well as faecal incontinence. The poor long-term adherence to PFMT has, however, been demonstrated by many authors. It has been shown that patients are more likely to demonstrate long-term compliance with exercise programmes that cause the least disruption to their normal daily activities and which result in positive feedback. The popular Pilates method is believed to produce flexibility and strength of the entire body. Most of the exercises are performed in conjunction with pelvic floor muscle contractions. The method might provide a new, more compelling, 'full body' alternative for the treatment and prevention of PFD. Culligan et al.[14] demonstrated improved pelvic floor muscle strength when comparing Pilates and PFMT programmes. There was also equal efficacy between the methods.

In our study, 25 women performed either pelvic floor exercises (PFE, synonymous with PFMT), Pilates or yoga in conjunction with their triathlon training. PFMT has been shown in many studies to be an effective first-line modality for prevention and treatment of urinary incontinence and pelvic organ prolapse. Pilates and yoga are considered as alternative modalities. Even though there are an insufficient number of RCTs to support their use and effectiveness in pelvic floor muscle strengthening, their use has become popular. Upon comparing symptoms of PFD amongst women who performed, and those who did not perform, any of these exercises, our study revealed some unexpected results. Those who performed these exercises reported more symptoms of PFD, although the findings were not of statistical significance. There was also an insignificant increased prevalence of pressure in the lower abdomen (p=0.06). Our explanation is

that perhaps the women who resorted to these modalities had probably experienced PFD symptoms prior to commencement, and our results were merely reflecting symptomatic women seeking relief through these interventions.

The PFIQ-SF was designed to assess the life impact on women with PFDs. We assessed how bladder, bowel and/or vaginal symptoms affect these women's activities, relationships and feelings. The women in our study were not significantly bothered by their symptoms; however, a few were frustrated by mostly bowel and bladder symptoms. The various symptoms did not seem to have a considerable effect on the physical activities of these women, meaning that they could continue their training uninterruptedly.

Limitations

The online survey method has become the most popular way of gathering data from target participants. The method has proven to be convenient and has the potential for gathering data from people around the globe. It also has the advantage of the internet to provide access to groups and individuals who would be difficult to reach through other channels, which proved useful in acquiring our study population. Online surveys also have their limitations, of which we encountered a number in our survey. We were unable meet our target sample size of 100 participants, owing to time and resource constraints.

The survey remained active online for 7 months, during which the majority of responses were obtained from having our survey on the IRONMAN December 2015 online newsletter. The balance of responses came from various triathlon clubs that we had approached within Western Cape Province. To keep our survey active online for the study period, we had to pay a monthly subscription of R349 to SurveyMonkey. We realised that accessing potential participants can be challenging but, with some

diplomatic dialogue, we were able to work with the IRONMAN web administrators and received good, yet limited, feedback. This posed an expected but undesired limited access to the population of concern.

Not all questions were answered correctly and completely, thus creating data errors as well as measurement error bias as some respondents, for a variety of reasons, did not answer sensitive questions honestly, or misinterpreted, or made errors in answering questions. The significant lower prevalence might have been the result of under-reporting of symptoms owing to embarrassment, and the study had many other flaws as mentioned, highlighting the challenges of epidemiological research in Africa.

Recommendations for future research

We would like to extend our questionnaire to a general female population who are not involved in any form of intensive physical exercise and compare PFD symptoms with those found in female triathletes.

We would also like to involve physiotherapists who specialise in PFMT to assess and provide training to a randomised group of women.

CONCLUSION

Even with its statistical flaws, our study nevertheless revealed an even higher prevalence of various symptoms of PFD in the study population of female triathletes, particularly symptoms of AI as well as urinary incontinence. With the majority of the studies highlighted in our literature review being either cross-sectional or prospective, we must bear in mind the limitations posed by these study designs. These being especially biased responses as well as bias due to loss to follow up as well as the difficulty in making causal inferences. Some of our results were, however, comparable to those found in other leading studies about PFD in female athletes. This finding has facilitated bringing us to the conclusion that indeed there may be an association between PFD and triathlon involvement in women. We also made some interesting discoveries. The nulliparous triathletes reported more pelvic floor symptoms than did the parous group whom we expected to be more symptomatic from the proven pelvic floor weakness and/or trauma associated with pregnancy and childbirth. Even though we did not assess whether it was the majority of parous triathletes who part took in ‘core exercises’, we assumed that, as it is common practice for women to be advised to ‘do their Kegels’, it might be the reason for the revealed difference between these groups. The triathletes who did any form of PFMT or alternative exercises also seemed to report more pelvic floor symptoms. This finding we attributed to the possibility that these women were very much aware of their symptoms and had sought symptom relief by taking part in these training programmes. Most of the literature supports the use of PFMT as a first-line treatment for most PFDs. Therefore, it is not unreasonable to offer these female triathletes supervised PFMT programmes in conjunction with their routine training, so as to prevent and treat symptoms of PFD. We cannot advocate the use of alternative exercises (yoga and Pilates in our study) until there have been ample RCTs that prove their effectiveness in pelvic floor muscle strengthening. As much as this group reported very little impact of their symptoms on their quality of life, and especially on their physical activity and training, we cannot ignore the small percentage who were troubled mainly by the two prevalent symptoms of anal as well as urinary incontinence.

APPENDICES

Appendix 1

Questionnaire

Demographic and personal data

1. Age
2. Weight (kg)
3. Height (cm)
4. Occupation

General health status

1. Do you suffer from any of these medical conditions? (X)

	YES	NO
Diabetes mellitus		
Connective tissue diseases		
Hypermobility syndrome		
Neurologic disease		

2. Have you had any surgery to your abdomen or pelvis? If yes, please state what surgery.

3. How many times have you been pregnant?
4. How many births? And what were the birth weights?
5. What was/were the mode(s) of delivery? (X)

a) Normal vaginal delivery	
b) Assisted vaginal delivery	
- Forceps	
- Vacuum	
c) Elective caesarean section	
d) Emergency caesarean section	

Appendix 2

Sport practice characteristics

1. How long have you been training for triathlons? (X)

2. Level of competition (X)

Professional	
Competitive age group	
Recreational age group	

3. At the peak of your training over the past 12 months, please specify number of hours spent on each of these activities.

Running	
Swimming	
Cycling	

4. As part of your routine training, do you perform any of the below?

	YES	NO
a) Pelvic floor exercises		
b) Yoga		
c) Pilates		

5. When did you do your first triathlon?

6. How many of the following competitions have you participated in? Please state best times if possible.

a) Sprint distance		
b) Olympic distance triathlon		
c) Half IRONMAN		
d) Full IRONMAN		
e) Half marathon		
f) Full marathon		
g) 90 km cycle race		

Appendix 3

Pelvic floor distress inventory

PELVIC FLOOR DISTRESS INVENTORY

Please answer each question by ticking the best response. While answering these questions, please consider your symptoms over the last 3 months. We realize that you may not be having problems in some of these areas but please fill out both parts of this form as completely as possible.

Urinary Distress Inventory 6 (UDI-6)

Do you experience, and, if so, how much are You bothered by	Not at all	Somewhat	Moderately	Quite a bit
Usually experience frequent urination?				
Usually experience urine leakage associated with a feeling of urgency, this is, a strong sensation of needing to go to the bathroom?				
Usually experience urine leakage related to coughing, sneezing, or laughing?				
Usually experience small amounts of urine leakage (that is, drops)?				
Usually experience difficulty emptying your bladder?				
Usually experience pain or discomfort in the lower abdomen or genital region?				

Colorectal-Anal Distress Inventory 8 (CRADI-8)

Do you experience, and, if so, how much are You bothered by	Not at all	Somewhat	Moderately	Quite a bit
Feel you need to strain too hard to have a bowel movement?				
Feel you have not completely emptied your bowel at the end of a bowel movement?				
Usually lose stool beyond your control if your stool is well formed?				
Usually lose stool beyond your control if your stool is loose?				
Usually lose gas from the rectum beyond your control?				
Do you usually have pain when you pass your stool?				
Experience a strong sense of urgency and have to rush to the bathroom to have a bowel movement?				
Does part of your bowel ever pass through the rectum and bulge outside during or after a bowel movement?				

Pelvic Organ Prolapse Distress Inventory 6 (POPDI-6)

Do you experience, and, if so, how much are You bothered by	Not at all	Somewhat	Moderately	Quite a bit
Usually experience pressure in the lower abdomen?				
Usually experience heaviness or dullness in the pelvic area?				
Usually have a bulge or something falling out that you can see or feel in your vaginal area?				
Ever have to push on the vagina or around the rectum to have or complete a bowel movement?				
Usually experience a feeling of incomplete bladder emptying?				
Ever have to push up on the bulge in the vaginal area with your fingers to start or complete urination?				

Pelvic Floor Impact Questionnaire

Instructions: Some women find that bladder, bowel, or vaginal symptoms affect their activities, relationships, and feeling. For each question place an **X** in the response that best describes how much your activities, relationships, or feelings have been affected by your bladder, bowel, or vaginal symptoms or conditions **over the last 3 months**. Please make sure you mark an answer in **all 3 columns** for each question.

How do symptoms or conditions relate to the following →→→ Usually affect your ↓	*Bladder or Urine*	*Bowel or Rectum*	*Vagina or Pelvis*
1. Ability to do household chores (cooking housecleaning, laundry)?	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit
2. Ability to do physical activities such as walking, swimming, or other exercise?	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit
3. Entertainment activities such as going to a movie or concert?	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit
4. Ability to travel by car or bus for a distance greater that 30 minutes away from home?	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit
5. Participating in social activities outside your home>	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit
6. Emotional health (nervousness, depression, etc)?	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit
7. Feeling frustrated?	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit	☐ Not at all ☐ Somewhat ☐ Moderately ☐ Quite a bit

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