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The Development of a Questionnaire for the Assessment of Menstrual Health Literacy Amongst Active Females

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Abstract

Background: Poor menstrual health literacy (MHL) is a factor that contributes to females not seeking medical help for abnormal menstrual symptoms that may impact their mental, social, and physical health (Garside et al., 2008). Few studies have focused on testing baseline functional knowledge of the menstrual cycle (MC) outside the context of pregnancy and menopause. The primary objective of this study was to investigate MHL levels of physically active females residing in New Zealand using a developed validated questionnaire. A secondary objective was to understand where females get their MC information from, what sources they consider to be trustworthy and what MC information they would like to know more about.

Methods: A MC knowledge questionnaire was developed by the research team (n=3), and reviewed by academics (n=4), medical experts (n=4), sporting organisation staff (n=5), and target population (n=10) to ensure content validity. Active females (n=203) between the ages of 16-40 years completed an online questionnaire. The questionnaire included a total of 25 knowledge questions and was split into four categories: menstrual cycle (Q=9), menstruation (Q=6), symptoms (Q=4), and health outcomes (Q=6). All correct options were coded as '1' and incorrect options were coded as '0'. A total score of 44 was possible. Responses (single and multiple answer multi-choice questions) were analysed using descriptive statistics which were presented as mean, SD and frequency (%).

Results: The overall knowledge score was 51.8% (22.8 ± 3.4). The highest knowledge scores were noted for symptoms (80.5%), followed by menstruation (79.8%), and the menstrual cycle (64.2%). Females scored poorly when asked about health outcomes related to the MC (20.4%). The majority of the participants (n=123, 61.5%) identified the internet as their main source of MC information. Friends (n=82, 41%), school sex education (n=73, 36.5%) and social media (n=73, 36.5%) were the next most common sources of MC information. Participants considered the most trustworthy sources of information to be doctors/general practitioners (n= 96, 48%) and healthcare professionals (n=70, 35%). The most common topics that females wanted to know more about were diet and the MC (n=115, 57.5%), training and the MC (n=115, 57.5%), MC tracking (n=78, 39%), MC and mood (n=75, 37.5%) and Relative Energy Deficiency in sport/Low Energy Availability/Female Athlete Triad (n=71, 35.5%).

Conclusion: Overall functional knowledge levels of the MC and associated health outcomes is low in active females in New Zealand. Healthcare professionals and doctors are considered the most trustworthy sources of information; however, they are not the most common sources of information that females will engage with. Developing online educational resources on the MC, associated health

outcomes and lifestyle factors (diet, physical activity) with medical and healthcare professionals may be considered in future female health education.

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Abbreviations

Abbreviation	Meaning
BBT	Basal Body Temperature
FHA	Functional Hypothalamic Amenorrhea
HC	Hormonal Contraception
HMB	Heavy Menstrual Bleeding
HPO	Hypothalamic Pituitary Ovarian Axis
LEA	Low Energy Availability
MC	Menstrual Cycle
MHL	Menstrual Health Literacy
OCP	Oral Contraception Pill
PA	Physical Activity
PCOS	Polycystic Ovary Syndrome
REDs	Relative Energy Deficiency in Sport

Terminology disclaimer:

To avoid gendering the menstrual cycle I have used inclusive terminology such as ‘people who menstruate’ or referred to the biological sex (female). This ensures that everyone in Aotearoa who menstruates and may not identify as a woman is considered in this thesis and review of the literature. As such, individuals who are non-binary, trans-men, intersex people, and other gender-diverse groups are considered throughout this thesis.

Chapter 1 Purpose

1.1 Introduction

In the 21st century, the menstrual cycle (MC) is still considered a taboo topic by many, despite being a natural/biological process experienced for 3-4 decades of life by ~51% of the population (Marván et al., 2006). Over 20 years ago, Diorio and Munro (2000) demanded a need for change in the way we view menarche and how we provide education surrounding menstruation. In New Zealand, young females are taught about menstruation in a scientific/medical manner, which focuses on reproduction and hygiene (Diorio & Munro, 2000). Typically, sex education classes are aimed at reducing unwanted pregnancies by delivering the dangers of intercourse, whilst also enforcing the belief that sexuality is fundamentally heterosexual (Diorio & Munro, 2000). However, recent research suggests a shift in perspective toward menstruation, stating that “menstruation unites the personal and the political, the intimate and the public, and the physiological and the socio-cultural” (Winkler, 2020). As such, research has proposed that people are considering menstruation as something far greater than just another bodily process (Winkler, 2020).

For some, menstruation is considered to be a negative, unhygienic process that should be managed discretely by the person who is bleeding (Johnston-Robledo et al., 2007; Roberts et al., 2002). A recent systematic review investigated the lived experiences of over 10,000 people who menstruate in high income countries and compared these experiences to those living in lower socioeconomic countries (Barrington et al., 2021). The review confirmed that menstruation is overwhelmingly considered a negative experience and brings with it many adverse outcomes and stigma for the person who is bleeding. Independent of socioeconomic status and geographical contexts, the lived experiences of menstrual stigma were similar and negative experiences were expressed more commonly than positive ones. As a result, females have reported a high degree of difficulty when talking openly about the topic of menstruation, which possibly contributes to the reinforcement of negative ideas and perceptions that menstruation is shameful and unhygienic (Johnston-Robledo et al., 2007; White, 2013).

These attitudes towards menstruation have reportedly caused declines in mental health and wellbeing of people who menstruate due to individual self-objectification (Spadaro et al., 2018), their self-worth being challenged, and increased feelings of shame and inadequacy (Tiggemann, 2011). In addition, self-objectification has been identified as a contributing factor to the development of eating disorders and depression, both experienced at disproportionately higher rates by females (Tiggemann, 2011). It has been proposed that the observed attitudes and behaviours of females towards menstruation may

reflect broader sociocultural beliefs, where the female body is sexually objectified, and the pursuit of a thin ideal is encouraged. It is theorised that females who live in cultures where their body is sexually objectified are obligated to conceal physical functions; i.e. menstruation or breast feeding (Roberts, 2004). To achieve menstrual health is to experience menstruation in a positive and respectful environment which is 'free from stigma and psychological distress', to encourage individuals to confidently care for their bodies without concealment of a naturally occurring process (Hennegan et al., 2021).

Health literacy, a term which refers to an individual's ability to use cognitive and social skills to promote and maintain health, is an independent predictor of health outcomes (Paasche-Orlow & Wolf, 2007). People with limited health literacy may have delayed care due to a lack of understanding which signs/symptoms of disease require medical attention (Paasche-Orlow & Wolf, 2007). MHL can be seen as a subcomponent of health literacy. It is defined as the complete physical, mental and social wellbeing in relation to the individuals menstrual cycle (Hennegan et al., 2021). Poor menstrual health literacy results in low numbers of females seeking medical help for abnormal menstrual symptoms (Garside et al., 2008). As demonstrated in multiple studies in the United States of America, ~86% of females with dysmenorrhea (painful periods) do not seek healthcare or support from clinicians, despite this menstrual symptom being strongly associated with reductions in work capacity and quality of life (Banikarim et al., 2000; Chen et al., 2016). Low levels of MHL may be a contributor to the globally normalised perspective of menstrual pain (dysmenorrhoea) being part of becoming a 'woman', not necessarily a symptom that requires medical attention or review (Armour et al., 2016; Banikarim et al., 2000; Wong, 2011). The normalisation of menstrual pain paired with a low level of MHL could result in females being undiagnosed and not treated for chronic health conditions (endometriosis, poly-cystic ovary syndrome, gynaecologic cancers, etc) which would negatively impact physical and mental wellbeing and reducing their quality of life (Morassutto et al., 2016). Outcomes of decreased MHL have also been associated with increased vulnerability to sexually transmitted infections (STIs) and unplanned pregnancies (White, 2013), both of which have can negative consequences on the mental, social and physical health of the individual (Group, 2014). Of note, the awareness of MC symptoms and the knowledge of reproductive physiology in the absences of pregnancy and menopause is an under researched area within premenopausal females.

Whilst improving knowledge and awareness of menstrual symptoms and functions could help to reduce adverse health outcomes and improve quality of life, the level of current knowledge needs to be more thoroughly investigated and considered. Results from premenopausal, sedentary females

consistently demonstrate that MHL is alarmingly inadequate. A study in Poland assessed 20,002 premenopausal female's knowledge of health issues and contraceptive methods, with 62% giving correct answers to 5 out of 7 questions. However, when it came to reproductive health issues only 3% were aware of cervical cancer risk factors (Warzecha et al., 2019). Hamdanieh et al. (2021) assessed sexual and reproductive health knowledge amongst single women in Lebanon, where out of 491 participants only 8% were reported to have adequate knowledge. In Australia, out of a cohort of 4,202 females attending secondary or tertiary education, 51% of those with dysmenorrhea believe it to be normal, and only 53% had heard of endometriosis, a common and undiagnosed reproductive condition (Armour, Ferfolja, et al., 2020). Out of three surveys conducted in The United States (Ayoola et al., 2016; Harmanli et al., 2014; Volck et al., 2013) with a total of 861 females, general knowledge about hormones, ovulation and other menstrual health topics were cumulatively scored less than 70%. A qualitative study by DeMaria et al. (2020) assessed the beliefs of menstruation amongst 70 females; and highlighted the experiences of some females as, "I didn't learn about menstruation, it just happened", "it's a taboo subject so I didn't talk about it much" and "you can't get pregnant on your period". All of these studies independently and cumulatively underscore the gaps in menstrual education and literacy through persistent misconceptions and low knowledge scores. The current literature therefore emphasizes the need for broader awareness and understanding of the MC in various populations including active and athletic females.

Only a few studies have investigated MC knowledge directly in female athletes (Larsen et al., 2020; Solli et al., 2020), whilst others have investigated perceptions of female athletes and whether they believe their MC affects training (Brown et al., 2021; Findlay et al., 2020; Höök et al., 2021). Solli et al. (2020) assessed the knowledge athletes have on the phases of their cycles and how this impacts training, to which only 8% of athletes (out of a cohort of 140 women) had sufficient knowledge (determined by the researchers of the study). Larsen et al. (2020) used a questionnaire to assess MC and hormonal contraception knowledge among athletes. The mean score from 189 athletes for 14 questions was 5.3 ± 3.06 (36%), indicating a low level of knowledge for this group. A recent study by Lodge et al. (2022) created a detailed questionnaire testing cross-country athletes on their knowledge of the Female Athlete Triad and Relative Energy Deficiency in sport (REDs). A mean impact score (knowledge + confidence) of 18.81 ± 7.05 out of 38 questions (49%) was observed, suggesting a low level of knowledge surrounding these areas. Whilst more studies are beginning to test the knowledge and understanding in females, both sedentary and athletes, on their MC, no studies to date have investigated MHL in recreational athletes. Recreational athletes are considered an at-risk group for the female athlete triad and REDs, and are likely to experience MC disruptions as due to high exercise volumes, restricting their caloric intake and/or pursuing thinness (Stafford, 2005). Therefore,

knowledge and awareness of their MC is required to identify when support is needed for any disruptions that can occur due to energy imbalances, exercise induced stress and/ or psychological stress.

To date, most studies evaluating the general public's awareness and knowledge of the MC have been conducted in either low- to middle-income nations, or The United States. The content assessed has primarily involved pregnancy, contraception, and menopause, with few considering the functional understanding or influence of the menstrual cycle in reproductive years. In New Zealand, there have been no studies evaluating menstrual knowledge and literacy for both healthy females and female athletes. As most studies to date have assessed the knowledge of sedentary females, an area which requires future investigation includes recreational athletes. Additionally, it remains unclear where most young females learn about or obtain information about their menstrual cycle, and how this might correlate to their current knowledge level.

1.2 Research Aim(s) and objective(s)

Aim: The primary aim of this research is to determine the menstrual health literacy of New Zealand female athletes and recreationally active females.

A secondary aim is to determine the primary sources of menstrual cycle information in this cohort.

Objectives:

- a. Develop a peer-reviewed questionnaire that can be used to test functional menstrual health literacy.
- b. Determine menstrual health literacy among New Zealand-based female athletes and recreationally active females using the knowledge score from a developed menstrual cycle knowledge questionnaire.
- c. Describe and evaluate the primary sources that most recreationally active females and female athletes obtain their information regarding the menstrual cycle.

Hypothesis:

1. Both recreationally active females and female athletes in New Zealand will typically have low menstrual health literacy, demonstrated by a low average knowledge score of <70%*.
2. School health education and social media will be the main sources of information on the menstrual cycle.

* In aligning with prior research, any score lower than 70% will be considered low. Therefore, an average score of <70% will indicate a knowledge gap and will justify the need for enhancing menstrual health education (Volck et al., 2013).

1.3 Structure of thesis

The thesis will begin with an introduction chapter discussing the purpose of this study. The reader will be informed of the importance of adequate MC knowledge among those who menstruate and the potential consequences that can occur when knowledge in this group is low. This will conclude with the study aims, objectives and hypothesis. The following chapter will provide an in-depth review of what the current knowledge is among two groups: female athletes and premenopausal females. Chapter three will include a manuscript of the study and provide the reader with details on the methods and results of the questionnaire. The final chapter will summarise the implications of this research, strengths and limitations, and provide a base to build future research in this area.

1.4 Researcher's contributions

Table 1.1 Researcher's contributions to study

Researcher	Contribution to Thesis
Danielle Fletcher MSc Student Nutrition and Dietetics	Primary author of thesis Questionnaire developer Development of study information sheet Recruitment for pre-questionnaire feedback from research demographic Recruitment for questionnaire participants Entering questionnaire into Qualtrics Managing data collection, data entry and statistical analysis Thesis editor
Dr Claire Badenhorst Primary Supervisor Senior Lecturer School of Sport, Exercise and Nutrition	Conceptualised the study Questionnaire developer Ethics application Recruitment for questionnaire feedback from academic experts Recruitment for questionnaire participants Provided guidance and feedback on all elements of the thesis

	Development of Menstrual Cycle information sheet Thesis editor
Dr Laura Pedofsky Co-supervisor	Conceptualised the study Questionnaire editor/developer Provided guidance and feedback on all elements of the thesis Recruitment for questionnaire participants Thesis editor

Chapter 2 Literature Review

2.1 Introduction

To improve health literacy in New Zealand and incentivise improvements in health education, researchers and health organisations need to understand what the current level of baseline health knowledge is (Nutbeam & Lloyd, 2021). The same is needed when it comes to improving MHL in active females (McGawley et al., 2023). Questionnaires can be used to determine baseline knowledge. This literature review will present a discussion on previous research that has attempted to investigate MHL, and provides commentary on the strengths and limitations of these studies, while also highlighting directions for further research in this area.

The focus of the review is to compare MHL from two cohorts, premenopausal females and female athletes. For each cohort the review will aim to assess knowledge (e.g., anatomy, hormones, and functions), attitudes/beliefs, management practices, and sources of information. Previous studies and questionnaires that investigate pregnancy, menopause, or reproductive disorders (Poly Cystic Ovarian Syndrome (PCOS), endometriosis, etc) will be excluded as they are not the primary focus of this review and thesis.

Review methods

To determine a) the current level of MHL amongst females of reproductive age, b) what/who are the main sources of MC information, and c) which sources of information are deemed most trustworthy, the author conducted a systematic search of online databases for relevant articles. This review included papers published between 2013-2023. Electronic databases, PubMed and Google Scholar were used and the review search criteria included:

- “premenopausal women” OR “women” OR “females”
- “Female athletes” OR “active females”
- “Pregnant females” OR “preconception” OR “fertility”
- “Knowledge” OR “education” OR “health literacy” OR “awareness”
- “Menstruation” OR “menstrual cycle” OR “reproductive health” OR “female health” OR “reproductive disorder”

Abstracts of articles from literature search were reviewed and screened for topic relevance. Papers were included if they included females who were of reproductive age and had at least one of the following: measured knowledge using a validated assessment (questionnaire or interview), analysed experiences/perceptions of the menstrual cycle, and/or sources of knowledge. Three papers were

discarded from the literature review due to them being reviews and not original works (Armour, Parry, et al., 2019; Chandra-Mouli & Patel, 2020; Kilfoyle et al., 2016). A total of four studies met the criteria for the literature review on MC in premenopausal females and additional details are provided in table 2.1.

Table 2.1 Knowledge questionnaires from previous studies

Author	Country	Sample size/ characteristics	Design	Questionnaire characteristics	Aim	Results
Warzecha et al. (2019)	Poland	20,002 females mean age 27.7 years	Cross sectional study. Face to face interviews and anonymous online questionnaire.	Female physiology: 7 Questions included: average cycle length, first day of cycle, ovulation, length of bleeding & average blood loss, phase of conception, site of genital tract for fertilization, BBT increase. Contraception: 3 Infertility: 2 Cervical cancer: 2	Investigate women's knowledge of the physiology of the MC, contraceptive methods, infertility, and cervical cancer prevention.	Significant positive impacts on knowledge were higher education levels, geographical area (living in a larger city) and more frequent gynaecological appointments. 62% respondents got at least 5/7 questions correct for female physiology section. The question which seemed to cause the most issues for participants in this section was "when does basal body temperature increase during the menstrual cycle". Only 10.4% of participants answered correctly (in the luteal phase after ovulation) and 82.6% of them answered "at the time of ovulation".
Hamdani et al. (2021)	Lebanon	491 females mean age 22.5±5.4 years	Cross-sectional. Self-administered questionnaire.	8 knowledge sections with a total of 33 close ended questions. 9 sections included pregnancy, premarital tests, menstruation, honeymoon, STI, vitamins, vaccines, and contraception.	Assess sexual and reproductive health knowledge and awareness among single, unmarried women.	8.8% had adequate overall knowledge. Highest score was in pregnancy and lowest score was in contraceptives. Out of the participants who had adequate knowledge (n=44), 41 of them had attended university showing a positive impact of education level. One section tested menstruation and its abnormalities which included questions about the MC, ovulation, amenorrhea, and dysmenorrhea. The overall knowledge in this section was 35.6%. Menstruation duration was answered incorrectly by 75.1% of participants and less than half knew that ovulation occurred in the middle of the cycle.

Ayoola et al. (2016)	United States	125 females Age group 18+ years	Survey	Questions for Knowledge of the Female Body (KFB) scale based on: female reproductive system incl. hormones, ovulation & timing, menstrual cycle, signs of pregnancy, mechanism of action of common birth control methods. "Yes", "no" or "don't know" options.	Examine knowledge of female reproduction-anatomy, hormones and their functions, the menstrual cycle, ovulation and its associated changes, conception, and signs of pregnancy among a predominantly low-income group of minority women.	The KFB score was categorised as low knowledge (a score of <70% correct) and high knowledge (a score of >70% correct). 68% of respondents had a low KFB score (<70% correct). Most knew about structures/anatomy (80%) but less than half knew about hormones and ovulation (49%). 30% knew about estrogen and 24% knew about progesterone. 38% knew when ovulation occurred during the cycle. 79% were not aware of how many eggs are released from the ovary each month.
Volck et al. (2013)	The United States	236 (138 females and 98 males) aged 18-36 years	Survey	22 item questionnaire based on female anatomy gynaecology.	Evaluate the level of gynaecologic knowledge among college students, particularly to investigate the differences in knowledge between males and females.	The mean score was 11.9 out of 20 (59%). General knowledge was low (only 40% scored over 75%). Women scored higher than men. Knowledge was higher in those who been tested for an STI or whose parents' discussed anatomy with them. Males were just as likely to answer gynaecological questions correctly as females were, however, females were more likely than males to know what can cause delayed periods. Males were also significantly less able than females to correctly identify anatomical structures and features.

2.2 Premenopausal females

2.2.1 Premenopausal females physiological knowledge of the menstrual cycle (anatomy, hormones and functions)

Sex education is an important aspect of the public health curriculum. Multiple studies have assessed female health knowledge to determine which health issues require further education as seen in table 2.1. Insights from previous research has suggested that knowledge about the terminology of the MC may be adequate (Warzecha et al. (2019)), whereas functional awareness of how the MC and hormonal changes affect the physiology of the individual are low. For example, natural family planning (NFP) methods may suggest tracking basal body temperature (BBT) to detect when ovulation is occurring as temperature slightly drops at ovulation, followed by an increase as a result of progesterone concentrations increasing (Bull et al., 2019; Israel & Schneller, 1950). However, results from previous research have demonstrated that 82.6% of females may be unaware of progesterone's effect on body temperature, and majority selected ovulation as the point at which body temperature increases (Warzecha et al. (2019)). Such results would demonstrate a lack of functional knowledge surrounding the physiology of the female body and the thermogenic effect of progesterone. More importantly, these results may reflect the lack of depth in MC education which teaches basic terminology of menstruation (Diorio & Munro, 2000) rather than discussing the entirety of the MC. Previously used MC knowledge questionnaires, outlined in table 2.1, have mimicked school curriculums and have heavily focused on testing MC terminology. As such, the assessment of functional knowledge, which shows a deeper understanding of MHL, using consequential/situational type questions through appropriately designed questionnaires may yield different results and remains to be investigated in premenopausal females.

Previous research has demonstrated some demographical characteristics that may predict differences in MC knowledge in premenopausal females. Both Warzecha et al. (2019) and Hamdanieh et al. (2021) reported a positive correlation between MC knowledge and higher levels of education (e.g. tertiary as compared to secondary school). In addition, regularity of gynaecological appointments (Warzecha et al., 2019), residing in an urban location (Warzecha et al., 2019) and previous testing for STIs (Volck et al., 2013) were associated with higher MC knowledge. Such results may imply that residing in larger urban cities may have improved access to educational institutions, resources and services compared to regional towns, and contribute to differences scores. Regularity of medical appointments and improved MC awareness may be due to the opportunity for individuals to discuss and monitor their menstrual health with trusted healthcare professionals. Finally, having higher education levels may suggest individuals have potentially received further information about the MC, degree and education dependent, compared to those who have only been exposed to it in secondary school. Interestingly, some research has investigated MC knowledge in both sexes (Volck

et al. (2013), and did report that females had better knowledge when compared to males (65% vs 50%). However, despite sex based differences in knowledge, the low score of 59% in females would be in agreeance with previous MC knowledge research (Ayoola et al., 2016). Differences in knowledge scores between studies would suggest a degree of geographical influence on the level of education and resources available to females. Warzecha et al. (2019) had the highest knowledge levels for physiology, insinuating better education resources may be available in Poland compared to the United States and Lebanon. Of note, these results have been demonstrated primarily in European, northern Hemisphere countries and whether similar trends are observed in New Zealand remains to be determined.

There was a strong emphasis on testing the understanding of terminology amongst all studies with commons themes of pregnancy, anatomy and contraception. One could argue that whilst these themes are important, they lack the ability to demonstrate functional knowledge about the hormonal changes that define the MC, how this interplays with other physiological processes (cardiovascular, skeletal, etc) and finally what implications these processes have on health overall, thus displaying total MHL. It is worth noting the limitations of the previous research, especially in regards to questionnaire design and development. Ayoola et al. (2016) created the entirety of their questionnaire with binary yes/no or I don't know responses. Whilst binary questions can improve readability, therefore making the questionnaire suited for a wide range of education levels, they can be considered leading (Aday & Cornelius, 2006). Without adequate instructions on how to complete the survey, individuals may be inclined to guess answers they are unsure of, instead of choosing the "I don't know" option, as there is a 50% chance they will get it correct (Aday & Cornelius, 2006).

To ensure an in depth review of MHL, future questionnaires should consider testing knowledge of the cycle as a whole making use of situational/consequential type questions. This includes functional knowledge levels of the cycle itself and how it links with other body processes, as well as health consequences that can occur if the MC is disrupted. Such questionnaires are likely to provide a clearer, more precise understanding of MHL rather than just knowledge of the MC, and may provide results that could support changes to school curriculums, as well as the creation of educational resources and content development for menstruating females.

2.2.2 Attitudes and behaviours towards menstruation/the menstrual cycle

It is known that attitudes and beliefs held by individuals shape and influence their health-related behaviours (Abraham & Sheeran, 2015). Therefore, understanding the beliefs and attitudes toward the MC may provide a deeper insight into menstrual health related behaviours of individuals. In addition, acknowledging how these beliefs and attitudes are influenced by factors such as culture, education, and age is important and will contribute to MHL.

Attitudes and beliefs that arise due to misinformation, consequently resulting in adverse health conditions could be avoided with improved health literacy (Nutbeam & Lloyd, 2021). For example, the belief of MC irregularities being normal has been reported to result in individuals being less likely to seek medical support if their cycle is disrupted or absent (Garside et al., 2008). Research has highlighted how cultural and social norms appear to affect menstruation and MC misconceptions. Family members have a significant role in preparing young females for this pivotal physiological process by either considering it to be a topic which can be openly spoken about or one which needs to be hidden (DeMaria et al., 2020; Dipti & Chandra, 2011). This is particularly relevant when comparing the attitudes, beliefs and behaviours of developed versus developing countries, the latter potentially discouraging open discussion about the MC (Singh et al., 1999). De Maria et al (2020) investigated the attitudes and beliefs towards menarche and menstruation across the lifespan of people living in the United States. However, they missed the opportunity to analyse the impact culture, health literacy levels and age can have. Regardless this research noted that menarche was associated with their first experiences of gender separation as they were told “periods mean you don’t mess with boys anymore”. The association between menarche and gender separation has also been observed in sex education classes in New Zealand, which primarily focus on avoiding pregnancy; this not only reduces the MC to reproduction, but also initiates the idea of fear when it comes to sexually interacting with the opposite sex (Diorio & Munro, 2000). This notion lacks the understanding of the MC being a holistic experience that is intricately tied to the individual’s health and wellbeing (Hennegan et al., 2021). Therefore, future research may consider assessing and comparing more diverse communities (e.g. age, sex, geographical locations, cultures) to add further insight on how cultural differences may impact experiences, attitudes and behaviours of females with regards to their menstrual cycle.

Young females and males are suggested to have differing attitudes towards the MC. Previous research that investigated attitudes towards menstrual pain in the US noted that females were more likely to apologise when asking about MC related topics on question and answer platforms (Chen et al., 2018). Examples include, “Sorry for the kind of gross question” or “sorry if you are a boy”. Some asked if the topic of dysmenorrhea grosses males out (e.g., “do guys get grossed out if girls are just talking about how their cramp from their period hurts”). Such questions/statements may reflect the sociocultural perspective that menstruation is a taboo topic that should be discussed and managed in private (Johnston-Robledo et al., 2007; Roberts et al., 2002). Interestingly, these questions were contradicted by some of the questions asked by males. Most questions from males appeared to try to understand what females endure when they are on their period, why they have symptoms and how they could support someone (e.g., a partner, friend or sibling) (Chen et al., 2018). Whilst this

doesn't provide overarching attitudes towards menstruation as such, it does show an attitudinal gap may exist between the two sexes. This previous study suggests there may be perceived pressures to stay silent about menstrual topics, especially towards the male sex, even if these perceived pressures don't necessarily stem from males themselves. However, these results differ to other research studies that have outlined male attitudes towards menstruation and are typically negative (Allen & Goldberg, 2009; Marván et al., 2014; Roberts et al., 2002; Wong et al., 2013). Negative attitudes of both males and females are likely due to the cultural taboos and health education perspectives that are currently present in developed countries (Wong et al., 2013). These negative attitudes experienced by both males and females combined with cultural taboos and education levels further perpetuate harmful stigmas regarding the MC. Consequently the apparent attitudes towards menstruation and the MC may be associated with silenced discussion, reduced empathy, and reduced health seeking behaviours which overall is likely contributing to poor MHL.

2.2.3 Awareness of menstrual cycle symptoms

A deficit in MHL combined with social normalisation of adverse or severe symptoms, such as extreme period pain, could result in more serious menstrual disorders (e.g. endometriosis) being underdiagnosed and thus untreated (Armour, Ferfolja, et al., 2020; Armour, Sinclair, et al., 2020; Garside et al., 2008). It can also result in decreased quality of life, absenteeism, and increased risk of depression and anxiety (Azurah et al., 2013; Balik et al., 2014).

Determining what awareness people who menstruate have about symptoms may indirectly reflect their level of menstrual health literacy. Previous research has suggested how those who menstruate may create an idea of what a 'normal' period is based on their own experiences (Wood et al., 2007). Therefore, if an individual is advised that their period pain is abnormal, they would still consider it to be normal if this is what they had always known (Wood et al., 2007). Previous research has demonstrated that despite many individuals reporting period pain (92.2%) which disrupted academic and extracurricular activities, the majority (83.3%) believed this pain to be normal (which dropped to 51% when pain became severe) and resulted in a decreased likelihood of seeking medical care for it (Armour et al., 2021). Various factors such as a lack of understanding which symptoms require medical assistance, previous experience with medical professionals disregarding symptoms or the normalisation of this pain overtime may contribute to these results. This can impact their overall wellbeing as pain can negatively affect their social life, academic performance, work, fertility, and sexual relationships.

Poor awareness of MC symptoms in addition to the inadequate support from medical professionals has adverse effects on the timely diagnosis of reproductive disorders such as polycystic ovary syndrome (PCOS) and endometriosis (Armour, Ferfolja, et al., 2020; Armour, Sinclair, et al., 2020). An

outcome that is corroborated with reports of the delay in the diagnosis of endometriosis with people waiting an average of 4-11 years (Agarwal et al., 2019). Within previous research, only 53% of participants in the study by Armour et al. (2021) had heard of endometriosis and out of 500,000 online queries about menstrual pain only 0.05% included questions about endometriosis (Chen et al., 2018). It is important to note that poor symptom awareness is not the only factor for delayed diagnoses. Out of 4,300 people with endometriosis who recalled the first visit to a medical professional (GP), 63% were told nothing was wrong (Greene et al., 2009). The available research suggests there are gaps in the awareness of symptoms that may be secondary to underlying menstrual disorders in both the general population and within the general practice medical profession. Without better symptom awareness by individuals and first contact medical professionals (e.g. GPs) the health and wellbeing of individuals who menstruate may not be optimised.

Aside from period pain, there is a lack of research exploring other symptoms believed to be normal; this includes symptoms such as breast tenderness, gastrointestinal upset (diarrhea and constipation), migraines, regularity of periods, and vaginal discharge. Therefore, future research should consider exploring the health and wellbeing of individuals by investigating other symptoms people who menstruate may be experiencing throughout their cycle and potentially dismissing as normal.

2.2.4 Management of the menstrual cycle

The management of the MC encompasses a range of non-pharmacological and pharmacological techniques reflecting personal preferences and knowledge. Low health literacy has been suggested to act as a barrier for optimising management of the MC (Armour et al., 2021). Therefore, how individuals manage their MC is considered an alternative and subjective method to ascertain MC knowledge and awareness (Armour et al., 2021). Previously identified methods used for MC management have identified heat (67.6%) and rest (60%) were preferred (Armour et al., 2021). These results reflect those of previous research that reported a preference for non-pharmacological treatments (Subasinghe et al., 2016). Pharmacological methods are still used, especially when pain becomes severe (Armour et al., 2021; Subasinghe et al., 2016), however, it would appear the correct doses recommended by medical professionals are not used (Armour et al., 2021). Of the pharmacological options used, the most common are ibuprofen (51.7%), paracetamol (51.7%) and mefenamic acid (22.4%) (Armour et al., 2021). The discrepancies of management choices (pharmacological vs non-pharmacological) could be explained by a potential resistance towards analgesic use or a lack of knowledge about effective pharmacological treatments for MC management. Further research would need to be conducted to understand whether the lack of

analgesic use and the incorrect dosing of analgesics is related to attitudes about medications or a knowledge deficit. This extends to the type of analgesic used as paracetamol has been shown to be less effective than ibuprofen in managing MC symptoms (Daniels et al., 2019; Marjoribanks et al., 1996). It is also interesting to note the underutilisation of exercise in previous studies results (Armour et al., 2021; Subasinghe et al., 2016), despite exercise being recognised as an effective method for minimising pain (Armour, Ee, et al., 2019). This could reflect a lack of knowledge amongst this population about effective non-pharmacological management strategies that can be used alongside pharmacological methods. However, this proposition requires further investigation.

Contraception has also been considered as a method to manage period pain of individuals who menstruate. Research would suggest that ~35% may use hormonal contraception (HC) for MC management, with the main reasons for starting being to reduce period pain (57.3%) followed by reducing heavy bleeding (42.8%), contraception (42.7%) and making a cycle more regular (39.8%) (Armour et al., 2021). It was more likely for people who had endometriosis (73.2%) and those with PCOS (54.7%) to use oral contraceptive pill (OCP) compared to those who didn't report having either of these conditions ($p=0.001$) (Armour et al., 2021). The inclusion of contraception as a management tool for MC issues emphasizes its utility beyond just birth control. It may be considered that the use of HC in the management for secondary dysmenorrheic conditions (endometriosis, PCOS, etc) may reflect higher levels of MHL, however this remains to be investigated.

The findings indicate there is a knowledge gap for optimal management of the MC, particularly when it comes to dysmenorrhea. Non-pharmacological treatments are utilised and preferred by a large proportion of females. In terms of pharmacological treatments, paracetamol is used just as frequently as ibuprofen despite ibuprofen being more effective (Armour et al., 2021). Self-administration of analgesic use is common and underpins the importance of seeking medical advice as subtherapeutic doses are being administered. Further research is needed to determine whether the cause of this is due to hesitancy in seeking medical help, lack of knowledge/limited MHL or attitudes/beliefs around medications.

2.2.5 Sources of information

To improve knowledge levels, it is important to understand where individuals source their information from. In doing so, it provides context for which avenues are more accessible to certain populations and why this may be their preferred option. Sources of MC information vary across cultures, though relying on family/friends was common for most, as evidenced by multiple studies (Armour et al., 2021; Dipti & Chandra, 2011; Hamdanieh et al., 2021). Research has suggested premenopausal females in Australia get their MC information from the internet (49.8%) or friends/family (36.3%) (Armour et al., 2021), individuals residing in Lebanon mostly get their

information from friends/family (77.3%) (Hamdanieh et al., 2021), and individuals in India, primarily get their information from their mothers (52.2%) (Dipti & Chandra, 2011). When it came to seeking information from medical professionals, only 31.1% of females in Australia reported asking a doctor (Armour et al., 2021). Individuals in Lebanon were more likely to receive MC information from TV/social media (11%) than their doctor/gynaecologist (Hamdanieh et al., 2021). Similarly, another study which included Australian females who have dysmenorrhea found 86% sought symptom information from the internet, social media, and friends/family compared to 34% who consulted a doctor (Subasinghe et al., 2016). Interestingly, the most trustworthy sources of information were medical professionals (72.1%) followed by family (56.7%) and the internet (54.6%) (Armour et al., 2021). These results reflect how different cultures and perspectives have an impact on how information is obtained. Seeking information from healthcare professionals, whilst seen as the most trustworthy source, isn't always accessible or completed by individuals.

As previously mentioned, social and cultural considerations of the MC are an important factor to consider, as not everyone considers it to be a topic they can openly discuss with others. As well as this, many females have experienced their symptoms not being taken seriously by medical professionals (Greene et al., 2009). Therefore, it may be easier for some to talk to family/friends and access social media compared to physically seeing a doctor. However, whether similar trends in information access and trustworthy sources of information by females within New Zealand remains to be investigated.

2.3 Female athletes

2.3.1 Knowledge and perceptions

Adequate knowledge surrounding the MC is key for athletes (McGawley et al., 2023). It provides them with the ability to identify symptoms of menstrual disruptions that may be associated with the female athlete triad, RED-S, and ultimately could help prevent/reduce health consequences that can arise, i.e., bone stress injury (BSI) (Koltun et al., 2019; Mountjoy et al., 2023). Many studies assessing MC knowledge in female athletes have primarily focused on REDs and or the triad, neglecting the relationship between these disorders and the MC. Whilst athlete and support staff knowledge of REDs and the triad are reported as low (Gillbanks et al., 2022; Lodge et al., 2022), few studies have extended this discussion to include menstrual disruptions and the health consequences. Of the previous research in female athletes, a questionnaire testing the triad knowledge included three questions about menstrual disruptions (Lodge et al., 2022); these were true or false options for the classification of amenorrhea, whether menstrual disturbances for athletes are normal or not, and if menstrual disturbances hold a bearing later in life. The average knowledge results for athletes was 67%, however, when this was adapted to their confidence with answers their final result dropped to

48%. Whilst this study provides some insight on awareness of menstrual disturbances, it lacks an assessment of an athlete's understanding of the broader health implications and functional understanding of the MC. Similarly, a study that primarily focused on REDs awareness provided insights to what rowers and physiotherapists knew about REDs (Gillbanks et al., 2022). However, it did not test their understanding of the MC and its relation to the adverse health and performance outcomes associated with REDs. Any awareness on MC irregularities/distruptions will be largely influenced by the individual's personal experiences (Gillbanks et al., 2022). Therefore, a more comprehensive assessment that investigates MHL will likely provide more detail on the current functional knowledge and awareness of female athletes towards their MC.

Female athletes have been shown to have high use of HC (60%), therefore knowledge of both MC and HC have been considered in previous research. Larsen et al. (2020) questioned athletes on the MC and OCP, with the authors reporting a mean score of 5.03 ± 3.06 out of 12 (42%). Results from this study suggested that 17.5% of female athletes investigated could define what amenorrhea was, however 66.7% were unaware of what could happen to a female who overtrains (menstruation may stop). OCP use and individual athletes were reported to have higher knowledge scores compared to those who were not currently taking OCP or participated in team sports ($p < 0.004$) (Larsen et al., 2020). However a limitation of this study was that the knowledge questionnaire primarily focused on hormonal contraception (9 out of 12 questions), suggesting measurement and subsequent determination of MHL was biased towards those currently using the OCP. Regardless, similar research has suggested that national representatives in both individual and team sport perceived their knowledge to be poor/very poor and ~69% were not able to name the phases of the MC (von Rosen et al., 2022). These findings suggest that while participants might struggle with medical terminology, they have some idea of physiological outcomes, which is arguably more important. Thus, future studies should prioritise consequential/situational questions over testing medical terminology and include an equal balance of MC and HC question within the knowledge assessment tools for athletes and active individuals.

The current literature highlights a gap for holistic and comprehensive MHL assessments in athletes and their coaches/support staff. Previous questionnaires have shown inadequate knowledge levels, however, the emphasis has been placed on defining medical terminologies rather than consequential health outcomes. Future questionnaires should be aimed towards addressing this gap to foster informed health decisions by both athletes and their support staff.

2.3.2 Perceived impact on performance

When it comes to female athletes, the MC has been identified as a factor that could influence performance (Mountjoy et al., 2023). It has been recognised that females (both active and

sedentary) experience physical and emotional symptoms during different phases in their menstrual cycle (Höök et al., 2021). For athletes in particular, this can potentially have self-reported negative impacts on their overall health and well-being as well as their performance (Armour, Parry, et al., 2020; Findlay et al., 2020; Solli et al., 2020). Most of the previous research that has sought to define changes in female athlete performance within the MC has been identified to be quantitative and as a result, the qualitative or personal experiences of athletes and how they believe the MC affects their performance has not readily been considered (Brown et al., 2021; Findlay et al., 2020). Previous research has used interviews to determine lived experiences in elite athletes and international rugby players (Brown et al., 2021; Findlay et al., 2020), and reported that 50% of the athletes stated they experience severe pain (cramps) whilst menstruating and dealt with these symptoms by either accepting them or adapting to them (Findlay et al., 2020). Interestingly, female athletes reported that analgesic use was driven by competitive pressures rather than personal well-being. This may reflect poorer MHL suggesting they may not understand the relationship between the MC, performance and health (Mountjoy et al., 2023).

Conflicting results have been reported with athletes when it comes to their MC and competition, as experiences differ between individuals. Some athletes reported achieving their best results whilst on their period, whilst others faced psychological challenges such as the fear of leaking (Brown et al., 2021). Bruinvels et al. (2016) found that over half of the athletes felt their MC affected their training and performance, but the study lacked clarity on which specific phases had the biggest impact to athlete's readiness to performance. In more expansive studies, self-reported experiences were scrutinized amongst the different phases (Armour, Parry, et al., 2020; Solli et al., 2020), with many athletes reporting that they felt the worst during menstrual bleeding, and many reported peak performance during their follicular and early luteal phase (i.e. after menstrual bleeding had finished). However, a large proportion of athletes did not believe they were affected either way throughout their MC (Solli et al., 2020). Interestingly, 8% of participants in the study by Solli et al. (2020) indicated adequate MHL, meaning there may be a lack of awareness about the more subtle effects athletes may experience throughout the MC.

It should be noted that the previous research has assessed relatively small sample sizes of female athletes which makes it difficult to draw meaningful results and implications for a wider cohort (Brown et al., 2021; Findlay et al., 2020). The focus of this previous research has primarily been based on menses and the symptoms surrounding this rather than complete MHL. This is particularly relevant when considering that menstrual disruptions such as secondary amenorrhea occur in athletes at higher rates than the general population, especially those partaking in sports which strive for leanness (Findlay et al., 2020). Therefore, determining athletes' perceptions of not only their

cycle but symptoms that may arise from menstrual disruptions is important to identify current MHL levels and areas that require education to support athletes in optimise their health, training and performance.

2.3.3 Barriers to communication with coaches

It is well understood that a strong coach-athlete relationship based on communication and trust is a crucial factor for success in elite sport (Jowett & Poczwardowski, 2007). However, the MC is a topic often overlooked presumably due to it being private/taboo in nature and may be an uncomfortable topic to talk about for both athletes (Solli et al., 2020) and coaches (Clarke et al., 2021). A common communication barrier identified from both athletes and coaches was a lack of knowledge and understanding of the MC. Athletes who are unsure about their own understanding of the MC are hesitant to initiate discussions with coaches (Höök et al., 2021). Athletes may also have concerns that this topic may go beyond their coaches' expertise (Höök et al., 2021). This perspective was confirmed by coaches, as they too often feel unprepared to discuss the subject, feeling like their knowledge deficit stops their ability to offer guidance and support for their athletes (Höök et al., 2021; Solli et al., 2020). This mutual barrier demonstrates the need for enhanced education on the MC, for both athletes and their support teams.

Interpersonal dynamics such as navigating taboos and discomfort about the topic can deter athletes from discussing the MC with their coaches. Both athletes and coaches resonate with feelings of discomfort when discussing the topic (Brown et al., 2021; Höök et al., 2021), with coaches specifically perceiving it as a taboo topic and discussing it would encroach on the athlete's privacy. The sex of their coach may also influence the athlete's ability to have MC discussions. Some athletes have stated a preference for discussing their MC with female coaches, and others indicated discomfort regardless of coach sex (Brown et al., 2021; Findlay et al., 2020). Previous research has demonstrated that within athlete-coach communication, only 27% of athletes had discussed their MC with their coach, which was lower (22%) if their coach was male and higher (44%) if their coach was female (Solli et al., 2020). This is concerning as only 11% of accredited coaches are female (Nunes, 2019). However, athletes appear to be impartial to sex when it came to discussing MC topics with a doctor (Brown et al., 2021; Findlay et al., 2020; Höök et al., 2021). Such results may suggest that supporting menstrual health knowledge and literacy of both athletes and coaches through medical professionals may aid improve athlete-coach communication and support for female athlete health, wellbeing and subsequently performance.

Elite sport is known to emphasize performance as a priority, sometimes to the detriment of the athlete's health and wellbeing. This has been observed with issues such as the loss of MC, weight management (weight classes/divisions in sport), and adverse physical and performance outcomes of

REDs (Gillbanks et al., 2022; Höök et al., 2021). This follows the attitude of 'do elite sport first and get your period back later' (Höök et al., 2021). This common narrative not only poses significant health risks, but it is also contradictory as it disregards the potential performance declines associated with adverse health outcomes that are specified in REDs syndrome (Mountjoy et al., 2023). Insights from previous research results would suggest that improving menstrual health literacy of both athletes and coaches may need to help support athlete performance through enhanced communication and medical support for athletes.

2.3.4 Sources of information

To the author's knowledge no studies have directly assessed where active females/athletes source information about the MC. Gillbanks et al. (2022) provided athlete's recommendations on methods that can be used to aid health knowledge acquisition and included presentations/talks, articles in sporting magazines and educational handbooks. Due to the gap in this field of research, future investigations should aim to determine where active or athletic females receive MC information from to help inform educational content creation and dissemination.

2.4 Summary

The review has highlighted the levels of inadequate knowledge about the MC that is apparent in both premenopausal females and female athletes. MHL has not been assessed due to the lack of functional based questionnaires testing applicable knowledge rather than an emphasis of terminology. Low levels of knowledge were not only evident in formal knowledge assessments but were also evident in the individual's attitudes, beliefs and management of the MC. Most of the research has been biased towards key life cycle stages of premenopausal females, use of HC or understanding of medical terminology. Conversely, active females' MHL levels have not been sufficiently explored.

Of note, throughout the review of the current literature it was unclear if recreationally active females have been included in previous research. This cohort's knowledge also needs to be explored as approximately half of exercising females (ranging from recreational through to elite athletes) experience menstrual disturbances that have long term health consequences if left untreated (De Souza et al., 2010; Mountjoy et al., 2023). Inadequate functional MHL may contribute to this issue (McGawley et al., 2023). Therefore, tailoring future questionnaires to assess all active females' knowledge of potential health consequences of menstrual disruptions (the female athlete triad, REDs, menstrual irregularities) would be beneficial. Such questionnaires would help identify what knowledge gaps are present and require further education. It was also noted that low knowledge amongst athletes and coaches acted as a barrier to communication about the athlete's menstrual cycle. Generally, within the athletic cohort a theme for the prioritisation of performance over health

was apparent. As such, MHL assessmenta are not only required for athletes but support staff and coaches too.

The review also highlighted where premenoapausal females receive MC information from, however, there were no studies, to the best of the authors knowledge, that assessed where active females source their MC information from. Given their unique needs, understanding their preferred channels is important as these avenues can be used to enhance MHL It is also important to understand which sources they believe to be the most trustworthy, as this will help ensure the information they are being given is deemed both valid and reliable by the individuals and as such would improve the credibility of the educational content.

Chapter 3 Research Study Manuscript

3.1 Abstract

Background: Poor menstrual health literacy (MHL) is a factor that contributes to females not seeking medical help for abnormal menstrual symptoms that may impact their mental, social, and physical health (Garside et al., 2008). Few studies have focused on testing baseline functional knowledge of the menstrual cycle (MC) outside the context of pregnancy and menopause. The primary objective of this study was to investigate MC knowledge levels of physically active females residing in New Zealand. A secondary objective was to understand where females get their MC information from, what sources they consider to be trustworthy and what information on the MC they would like to know more about.

Methods: A MC knowledge questionnaire was developed by the research team (n=3), and reviewed by academics (n=4), medical experts (n=4), sporting organisation staff (n=5), and target population (n=10) to ensure content validity. Active females (n=203) between the ages of 16-40 years completed an online questionnaire. The questionnaire included a total of 25 knowledge questions and was split into four categories: menstrual cycle (Q=9), menstruation (Q=6), symptoms (Q=4), and health outcomes (Q=6). Correct options were coded as '1' and incorrect options were coded as '0'. A total score of 44 was possible. Responses (single and multiple answer multi-choice questions) were analysed using descriptive statistics which were presented as mean, SD and frequency (%).

Results: The overall knowledge score was 51.8% (22.8 ± 3.4). The highest knowledge scores were noted for symptoms (80.5%), followed by menstruation (79.8%), and the menstrual cycle (64.2%). Females scored poorly when asked about health outcomes related to the MC (20.4%). Of participants, 61.5% (n=123) identified the internet as their main source of MC information. Friends (n=82, 41%), school sex education (n=73, 36.5%) and social media (n=73, 36.5%) were the next most common sources of MC information. The most trustworthy sources of information were doctors/General Practitioners (n= 96, 48%) and healthcare professionals (n=70, 35%). The most common topics that females wanted to know more about were diet and the MC (n=115, 57.5%), training and the MC (n=115, 57.5%), MC tracking (n=78, 39%), MC and mood (n=75, 37.5%) and Relative Energy Deficiency in sport/Low Energy Availability/Female Athlete Triad (n=71, 35.5%).

Conclusion: Overall functional knowledge levels of the MC and associated health outcomes is low in active females. Healthcare professionals and doctors are considered the most trustworthy sources of information; however, they are not the most common sources of information that females will engage with. Developing online educational resources on the MC, associated health outcomes and

lifestyle factors (diet, physical activity) with medical and healthcare professionals may be considered in future female health education.

3.2 Introduction

The MC is considered a vital factor for a female's health and reproduction, and may be used to provide insight to any potential hormone imbalances that may be present for the individual (Mikhael et al., 2019). However, low MHL, where individuals have poor awareness of the changes to the intricate hormonal signalling pathways of the hypothalamic-pituitary-ovarian (HPO) axis, has been shown to impact mental, social, and physical health (Shufelt et al., 2017). Health literacy can be viewed as three sequential domains including functional, interactive and critical (Nutbeam & Lloyd, 2021), and is not a fixed asset of the individuals but can be improved with the provision of education (Nutbeam & Lloyd, 2021). MC knowledge has been assessed via questionnaires to be low in sedentary, premenopausal females (Ayoola et al., 2016; Hamdanieh et al., 2021; Volck et al., 2013; Warzecha et al., 2019). While there is evidence of MC knowledge questionnaires in premenopausal females, there are no studies that have directly assessed MHL amongst active females.

Subtle to severe disruptions in the HPO axis may range from irregular menstruation (oligomenorrhoea), insufficient sex hormone concentrations, and finally cessation of the MC (amenorrhoea) (Stafford, 2005). Previous research has demonstrated that 52% of active females (>2 hours physical activity per week) may experience MC abnormalities compared to only 5% of sedentary females (De Souza et al., 2010). It is suggested that female athletes are particularly vulnerable to menstrual disruption due to their often insufficient energy intake with increased energy demands in sports (Torstveit & Sundgot-Borgen, 2005). Subsequently, previous research has indicated that traditional perceptions that may reflect the low levels of MHL of female athletes has possibly contributed to the belief that absent periods (e.g., amenorrhea) may be considered a positive outcome, and was a symptom that the athlete/individual was training hard (Höök et al., 2021). Whilst these MC disturbances are reversible, if left untreated as a result of the individuals low levels of MHL, there is a high risk of the individual experiencing negative health consequences including but are not limited to osteoporosis, premature cardiovascular disease, depression, infertility and iron deficiency (Mountjoy et al., 2023; Shufelt et al., 2017). Early identification of menstrual disruptions and prevention through MHL education are required to avoid the development of long-term adverse consequences on active female's health and performance.

Recently, in acknowledgement of the low levels of MHL in the active female population, a six step process for individuals or organisations to address MC knowledge deficits was proposed (McGawley et al., 2023). The first step required the identification of the problem, in this case the level of MHL of

the target population. This is required to ensure that subsequent educational interventions could be developed to the athletes and females needs and addresses the areas of MHL that are unique to the population assessed. The following steps of this process outlines the development of and the implementation of the educational programme. To improve MHL literacy amongst the target population understanding which avenues are most accessible and trustworthy is crucial to not only improve functional health literacy, but also to improve interactive and critical literacy (McGawley et al., 2023; Sykes & Wills, 2018). Therefore, the primary aim of this study is to develop a questionnaire to test functional health literacy of the MC and use it to assess MHL levels of active females with a secondary aim to determine where active females source their information from and which sources they deem to be trustworthy. It is hypothesised that active females will have low MHL levels (<70%) and will receive most of their MC information from sex education classes and social media.

3.3 Methods

3.3.1 Study design and participants

The initial phase of the present study incorporated the development of a questionnaire to assess MHL. Following the questionnaire development, a cross-sectional, evaluation analysis was completed. For the second phase of the project, the recruited participants were active females residing in Aotearoa, New Zealand; who participated in >2.5 hours of physical activity per week. All participants were between the ages of 16-40 years and completed an online consent form prior to beginning the survey. The present study was evaluated and reviewed by the Massey University Human Ethics Committee (MUHEC) as low risk.

3.3.2 Development of Menstrual Cycle knowledge questionnaire

A questionnaire was developed to assess the understanding and knowledge levels regarding the MC amongst active females. The initial questionnaire underwent an extensive expert peer-review process as per the Delphi methodology to ensure content validity and readability (Aday & Cornelius, 2006; De Villiers et al., 2005).

A team of three New Zealand based researchers, including a Senior Lecturer in Exercise and Sport Science, an Engineer (PhD in reproductive health) and a second year Master of Science (Nutrition and Dietetics) student, developed the first version of the questionnaire. The health survey guidelines (Aday & Cornelius, 2006) and questions from previous MC knowledge questionnaires (Ayoola et al., 2016; Gillbanks et al., 2022; Larsen et al., 2020; Lodge et al., 2022; Volck et al., 2013; Warzecha et al., 2019) were reviewed, discussed and edited prior to the initial draft of the questionnaire.

Detailed justification for questionnaire content and phrasing logic are detailed in Appendix B. The design and development process took into account factors to be aware of when creating health

questionnaires as outlined by Aday and Cornelius (2006). Specifically, the formatting and order of questions was important to ensure one item didn't influence the response to preceding questions. The type of question (open or close ended) was also considered during the creation of the questionnaire with regards for time to complete, ease of analysis, ease for participants and ability for comparability between answers. Due to this, the knowledge section only included closed answer questions to improve readability and understanding of the questions, to reduce the time to complete and optimise data analysis. To reduce the likelihood of false positives or negatives in the responses and total knowledge score, "I don't know" options were included for every question for when individuals were unsure of the answer. Instructions on when to use the 'I don't know option' were presented at the beginning of the survey and participants were encouraged to select this option when they were unsure of their answer and refrain from looking any answers up. The first draft of the questionnaire was created in January 2023.

As per the delphi process a research team (students and supervisors of this thesis) sought to undertake and monitor the peer-review process of the questionnaire. The research team selected three different cohorts of reviewers including external experts in the area (one endocrinologist, one high performance sport doctor, one female-health physiotherapist, three international academic experts in female health and performance), athlete support crew (two coaches, one dietitian, and one national sport organisation female health officer) and non experts/user group (10 active females between 18-40 years). To guide the subsequent peer review process, the research team provided key perspective for the experts and non-experts to focus on when reviewing questions. These perspectives included interest in question clarity, relevance, holistic approach, structure and flow, question type, wording and bias, and level of difficulty.

Following expert panel formation, the Delphi process required pilot review of the questionnaire with two out of the three researchers (thesis supervisors) assessing any ambiguities and vagueness with the process. This step allowed any necessary revisions to be made before sending the questionnaire to the panel of experts.

Subsequent steps of the Delphi process were repeated multiple times until the research team, experts and non-expert panels were in agreeance on the final questionnaire. During this process, the draft questionnaire and peer-review prompts were sent to the panel of external experts and athlete support crew. They were given 1-2 weeks to provide feedback. Feedback/opinions received from the external experts was reviewed and changes were made to the questionnaire. The updated draft of the questionnaire and review prompts were then sent via email to the non experts/user group. They

were also given 1-2 weeks to provide feedback. Feedback/opinions received from the non experts/user group were reviewed and changes were made to the questionnaire.

To conclude the Delphi process for questionnaire development, common themes in the feedback from both review groups (expert and non-expert) were identified and revisions made. Feedback themes included: reducing the difficulty level of questions, reducing the amount of medical definitions/hormone questions, increasing the functionality/health impact style questions, change of wording for questions/answers to improve clarity and decrease bias, removal of irrelevant questions, style of question. All questionnaire edits and adjustments can be found in Appendix C.

The final questionnaire was created in May 2023 and was built into an online survey platform (Qualtrics, 2023). The questionnaire was split into three main sections: knowledge testing, sources of information and demographics.

The knowledge testing section was further divided into 4 categories: The Menstrual Cycle (9 questions), Menstruation (7 questions), Symptoms (5 questions) and Health Impacts (6 questions). Scores allocated for each category were 9 for Menstrual Cycle, 6 for Menstruation, 4 for Symptoms, 25 for Health Impacts. A total of 20 questions were scored out of 1, and five questions had more than 1 mark allocated (all in the health impacts category). All correct options were coded as '1' and incorrect or 'I don't know' was coded as '0'. Thus, a total score for the questionnaire was out of 44. Two questions in the knowledge section (one in symptoms and one in menstruation) were unscored as the research team and experts recognised that responses would reflect participants individual perceptions based on their personal experience and hence results would be biased. The questions were still included as perceptions on what is considered normal was deemed as a valid MHL question as it demonstrated what participants may normalise (e.g. pain, vomiting) with regards to their MC.

For the sources of information section participants were able to choose multiple options. This was designed as radio buttons rather than drop down options as this method is more accessible and convenient to the respondent (Baatard, 2012). This section comprised of three questions: where they sourced their MC knowledge from, which sources did they deem to be most trustworthy and what areas regarding the MC they would like to know more about.

The demographics section concluded the questionnaire and included questions on the individual's ethnicity, age, contraception type, (duration of) contraception use, main sport, and physical activity levels.

3.3.3 Data collection

Following the questionnaire development the final online questionnaire was shared using existing industry connections and social media platforms. All participants were invited to complete the survey in their own time from the 31st May 2023 through to 14th July. The questionnaire commenced with an information sheet (see Appendix A) outlining the aims of the research, participant rights and the benefits/risks of the study. A pre-screening question was completed by all participants before the knowledge questionnaire was made available to them to ensure all participants met with the study inclusion criteria. The participants did not receive their final mark or score at the end of the questionnaire. Instead, all participants were given the opportunity to download a Menstrual Cycle Health information pdf, created by the researcher team, which provided educational information related to the questions in the knowledge section of the questionnaire. Ethically this was considered by the research team as best practice, as our participants could then have access to a resource that would provide insights on the questions that were asked without having any negative effect on their mental wellbeing that may be induced by a low score. The final survey can be found in Appendix A.

3.3.4 Sample size

The sample size for the present study was determined based on a power analysis with the smallest detectable effect size of 0.20. By maintaining a maximum Type 1 error rate of 5% and maximum Type 2 error rate of 20%, a total of 195 participants was needed to provide sufficient power to detect effect. A total of 203 participants completed the the survey and 200 completed both knowledge and demographic sections.

3.3.5 Statistical method for data analysis

Response data was downloaded from the online survey tool, Qualtrics. Data was reviewed and cleaned (i.e. unanswered questionnaires and bot data were removed). Text answers to 'other' options were categorised and matched to existing options or independently coded. Data was then imported to IBM SPSS statistics (version 27.0) for analysis. Descriptive statistics, including measures of central tendency (median and mean), and measures of variability (range, standard deviation) of the data set were calculated. Mann-Whitney U test was used to determine the correlation of non-normally distributed knowledge scores and two independent groups (contraception use, recreational vs athlete). Spearman's rank correlation was used to determine correlations between non-normally distributed knowledge scores and continuous variables (age and education). Kruskal-Wallis H test was chosen to analyse differences in scores between more than 2 independent groups (hours spent on activity per week and highest level of competing).

3.4 Results

3.4.1 Participant characteristics

A total of 277 questionnaire responses were identified. From which 203 responses were analysed from the knowledge section of the questionnaire. Details on the questionnaire response rate are provided in figure 3.1.

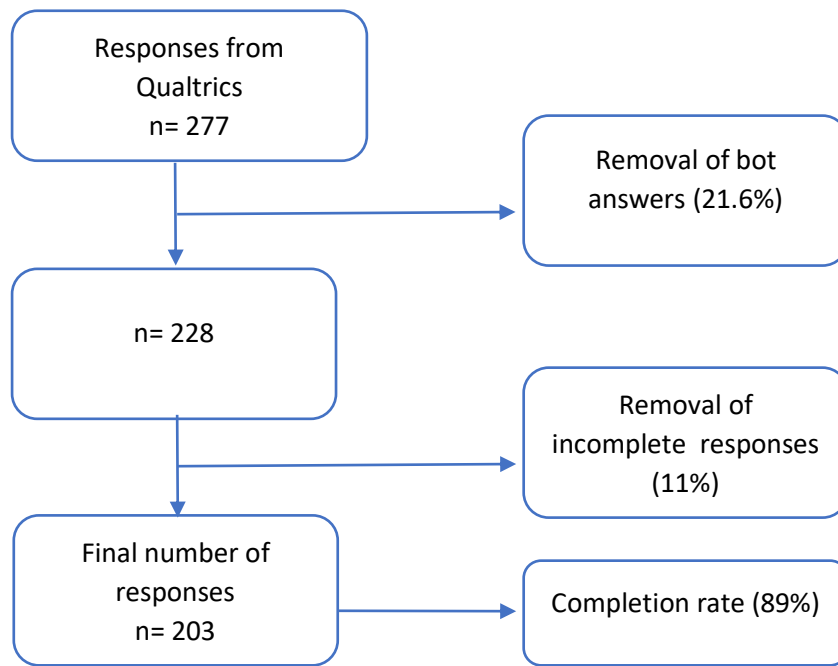


Figure 3.1 Flow chart of questionnaire response and completion rate

Of the 203 responses, 200 completed the sources of information section and 198 completed the demographics section. Majority of the participants identified as New Zealand European, were between 20-29 years old, had completed tertiary level education, regularly completed 3-4 hours of exercise per week and had used or were using HC.

Table 3.1 Participants characteristics		
Variable		Participants, n (%)
Age	16-19	6 (3.1%)
	20-24	74 (37.9)
	25-29	58 (29.7%)
	30-34	40 (20.5%)
	35-40	17 (8.7%)
	Total (n)	195 (100%)
Ethnicity*	New Zealand European	173 (87.4%)
	Māori	19 (10%)
	Samoan	4 (2%)
	Cook Islands Māori	0
	Tongan	0
	Niuean	2 (1%)
	Chinese	3 (1.5%)
	Indian	0
	Other	

		24 (12.1%)
Highest education level	<high school/secondary	1 (0.5%)
	High school/secondary	25 (12.6%)
	Tertiary undergraduate	108 (54.5%)
	Tertiary postgraduate	57 (28.8%)
	Other	7 (3.5%)
Total (n)		198 (100%)
First menstrual bleed	<10 years	1 (0.5%)
	10-12 years	85 (43.1%)
	13-15 years	102 (51.8%)
	>16 years	9 (4.6%)
	Yet to have first natural bleed	0
Total (n)		197 (100%)
Current and/or past HC use	Yes	171 (86.4%)
Total (n)	No	27 (13.6%)
		198 (100%)
Type HC*	Oral contraceptive pill	135 (78.9%)
	Hormonal IUD	43 (25.2%)
	Implanon/implant	19 (11.1%)
	De Pro/injection	19 (11.1%)
	Other	8 (4.7%)
Total (n)		171 (100%)
Total length HC use	<5 years	53 (31.5%)
	5-10 years	85 (50.6%)
	>10 years	30 (17.9%)
Total (n)		168 (100%)
Main sport/PA*	Functional	23 (11.7%)
	Low Impact	9 (4.6%)
	Resistance Training	42 (21.3%)
	Team	23 (11.7%)
	Solo	14 (7.1%)
	Running	22 (11.2%)
	Triathlon	5 (2.5%)
	Mix	46 (23.4%)
	Cycling	5 (2.5%)
Total (n)		197 (100%)
Time spent on sport/PA	<3 hours	23 (11.6%)
	3-4 hours	63 (31.8%)
	5-6 hours	58 (29.3%)
	7-8 hours	24 (12.1%)
	9-10 hours	13 (6.6%)
	>10 hours	17 (8.6%)
Total (n)		198 (100%)
Highest level of sport participation	Local/regional	92 (46.5%)
	National	28 (14.1%)
	International – age group	6 (3%)
	International – open/elite	7 (3.5%)
	Other	2 (1%)
	NA	63 (31.8%)
Total (n)		198 (100%)
Years at highest level of sport participation	<1 year	32 (20.9%)
	1-3 years	44 (28.8%)
	3-5 years	26 (17%)
	5-10 years	28 (15%)
	>10 years	23 (15%)

Total (n)	153 (100%)
*Solo sport: Badminton, mixed martial arts, tennis, swimming and squash; Team: Soccer, hockey and water polo; Functional: BFT, F45 and CrossFit; Mix: Participants partaking in more than one activity (e.g., running, Pilates and resistance training); Multi: Participants partaking in multiple sports (e.g., soccer and netball); Resistance training: Gym and weight training; Low impact: Pilates, walking and yoga	

3.4.2 Menstrual health literacy amongst recreationally active females and competitive females

Overall knowledge was low, details of total score, and subsection scores are presented in Table 3.2.

Active females were originally analysed as two different groups, recreational (<4 hours) and competitive (>4 hours). There were no statistically significant differences between their knowledge scores of 52.6% vs 51.1% (p-value= 0.182). Following this, the remainder of results were analysed as total participants where the average score was 51.8%.

The highest scoring category was symptoms (80.5%), followed by menstruation (79.8%), the menstrual cycle (64.2%), and lastly, health outcomes (20.4%). It was observed that no incorrect answers were selected and rather participants selected 'I don't know'.

Table 3.2 Knowledge presented according to 4 categories

Category variable	Recreational (<4 hrs/week) Mean ± SD	Score (%)	Competitive athletes (>4 hrs/week) Mean ± SD	Score (%)	Total Mean ± SD	Total (%)
Overall knowledge	23.2 ± 3.4	52.6%	22.5 ± 3.4	51.1%	22.8 ± 3.4	51.8%
Menstrual cycle	5.9 ± 1.8	65.6%	5.7 ± 1.8	63.3%	5.8 ± 1.8	64.2%
Menstruation	4.9 ± 1.1	81.6%	4.7 ± 1.2	78.7%	4.8 ± 1.1	79.8%
Symptoms	3.3 ± 0.7	81.7%	3.2 ± 0.8	79.5%	3.2 ± 0.7	80.5%
Health outcomes	9.1 ± 1.3	36.3%	8.9 ± 1.4	35.6%	9 ± 1.3	20.4%
(n)	86		112		203	

3.4.3 Category: Menstrual Cycle

Within this section, participants were more likely to select the 'I don't know' option regarding questions that asked for the specific functions of progesterone (47.3%) and luteinizing hormone (77.8%). Of the participants, 73.9% were aware of the role of estrogen and 52.7% were aware of the role of progesterone in relation to their effects on the endometrium. Most participants had adequate knowledge when it came to the definition of ovulation (91.1%), when it occurs (78.8%), and the number of eggs released during ovulation (74.9%). However, only 22.2% of participants were aware of the role of luteinizing hormone for ovulation. Of the participants, 37.9% were unsure of the normal length of a menstrual cycle and 52.2% were unsure of what the primary organ of the female reproductive system was.

3.4.4 Category: Menstruation

Menstruation demonstrated the second highest knowledge scores. Of the participants, 96.1% were able to identify the correct definition of a prolonged menstrual bleed, 99% knew what menstrual fluid consisted of and 86.7% were aware of toxic shock syndrome. Awareness of the increased risk of iron deficiency with heavy menstrual bleeding was high (91.6%). However, 51.7% were not aware of what amount of blood loss during one menstrual bleed would result in the classification of heavy menstrual bleeding. Only 57.6% of participants were able to identify what is clinically considered normal menstrual blood loss.

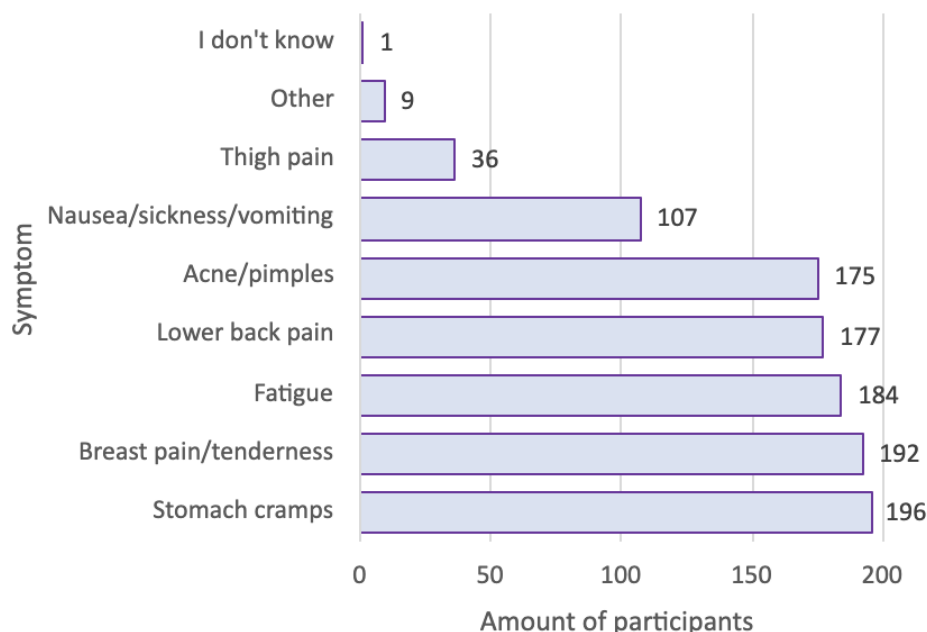


Figure 3.2 Menstruation symptoms considered normal by active females

The single question in this section that was not part of the knowledge scoring system asked about menstrual cycle symptoms that were considered normal. Results are presented in figure 3.2.

Participants chose stomach cramps (96.6%), breast pain/tenderness (94.6%), fatigue (90.6%), acne/pimples (86.2%) and lower back pain (87.2%) as the symptoms they considered to be normal during menstruation. Symptoms that were less commonly selected as normal were nausea/sickness/vomiting (52.7%) and thigh pain (17.7%).

3.4.5 Category: Symptoms

Within this section, participants were aware that any menstrual pain that affected/limited daily activities should be seen by a medical doctor/GP (93.1%). Participants were also aware that it was concerning for a female to lose their period for more than three months if they were not on contraception (93.6%). Only 10.8% of participants were unaware that cervical mucous changes were a sign/symptom of ovulation. However, 52.7% were unaware of the effect of progesterone on basal body temperature during the second half of the MC (e.g., Luteal Phase).

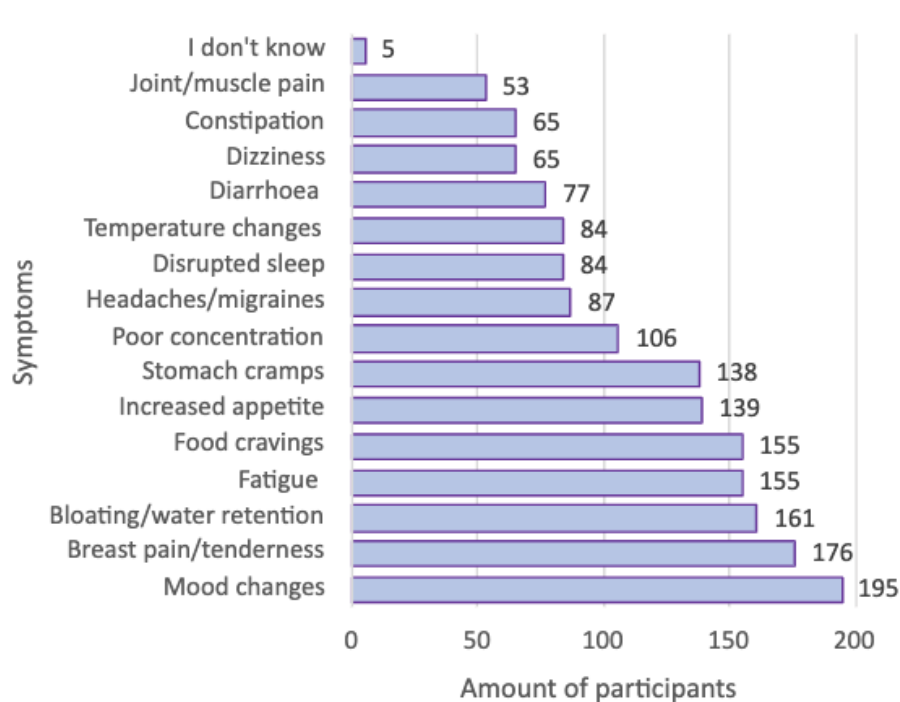


Figure 3.3 Pre-Menstrual symptoms considered normal by active females

The question about premenstrual symptoms prior to menstruation was another unmarked multiple-choice answer question included to review participants' perceptions of what is thought to be normal within the menstrual cycle. The symptoms most considered normal by the participants are presented in figure 3.3.

3.4.6 Category: Health outcomes

The health outcomes section offered the highest potential score out of the four categories. The knowledge scores in this section were low, as reported in Table 3.2. When asked what could cause a

period to be late or missed, 96.6% of participants were able to identify all five factors (pregnancy, stress, excessive exercise, excessive weight loss, and hormonal birth control). The remaining 3.4% of participants were only able to identify hormonal birth control. Only one participant identified all 5 factors and added 'PCOS' in 'other'. When asked how many months in a row without a menstrual bleed requires medical assistance, only 65.8% were aware of the correct answer (3 months).

When asked what effects high stress, restricted food/caloric intake, excessive weight loss and large amounts of training have on female health, only 40% selected 'increased risk of bone stress injuries', while 4.3% chose 'none of the above'. A total of 55.7% chose both 'increased risk of bone stress injuries' and 'none of the above'. No participants were able to correctly identify the four answers (increased risk of bone stress injuries, increase GI upset, decreased immune response and increased menstrual disturbances) to get full marks for this question. When participants were asked about what effect/s an energy deficit can have on physical activity/sport performance, the only correct answer chosen by participants was 'decreased strength and performance' (93.6%). Only 2% of participants chose both 'decreased strength and performance' and 'I don't know', while only 4.4% selected the 'I don't know'. No participants were able to identify all four answers (decreased strength and performance, increased fatigue, impaired judgement and decreased coordination) to get full marks for this question. When participants were asked what females could do to help regain a normal menstrual cycle if they are amenorrhoeic, 35.6% selected the single response of 'reduce amount of physical activity/exercise'. The majority (61.4%) selected both 'reduce amount of physical activity/exercise' and 'I don't know' and 3% solely selected 'I don't know'. No participants were able to identify assessing changes in life stressors and seeking help for energy intake, meaning no participants got full marks for this question. The last question of this section reviewed the individuals' knowledge on the potential health consequences of amenorrhea. Of the eight correct answers, 'declines in muscle strength' was selected by 47% of participants and 'I don't know' option was selected by 35.5% of participants, while the remaining 17.5% selected both declines in muscle strength and 'I don't know'. No participants were able to correctly identify two or more of the health outcomes of amenorrhea.

3.4.7 Demographic characteristics and questionnaire scores

There was no relationship between age and knowledge scores in this study ($r_s=0.004$ and $p\text{-value}=0.957$). There was no significant difference between contraception users and non-contraception users when it came to knowledge scores ($p\text{-value}=0.818$). Spearman's correlation results indicated a small positive correlation in increasing education with increasing knowledge ($r_s=0.024$), however this was weak and not statistically significant ($p\text{-value}=0.740$). Time spent on physical activity per week and highest level of competing in their given sport were not significantly

correlated with knowledge score (p-value=0.093; 0.992). Pre-screening disorders/health conditions had no correlation to knowledge score (p-value=0.461).

3.4.8 Sources of information

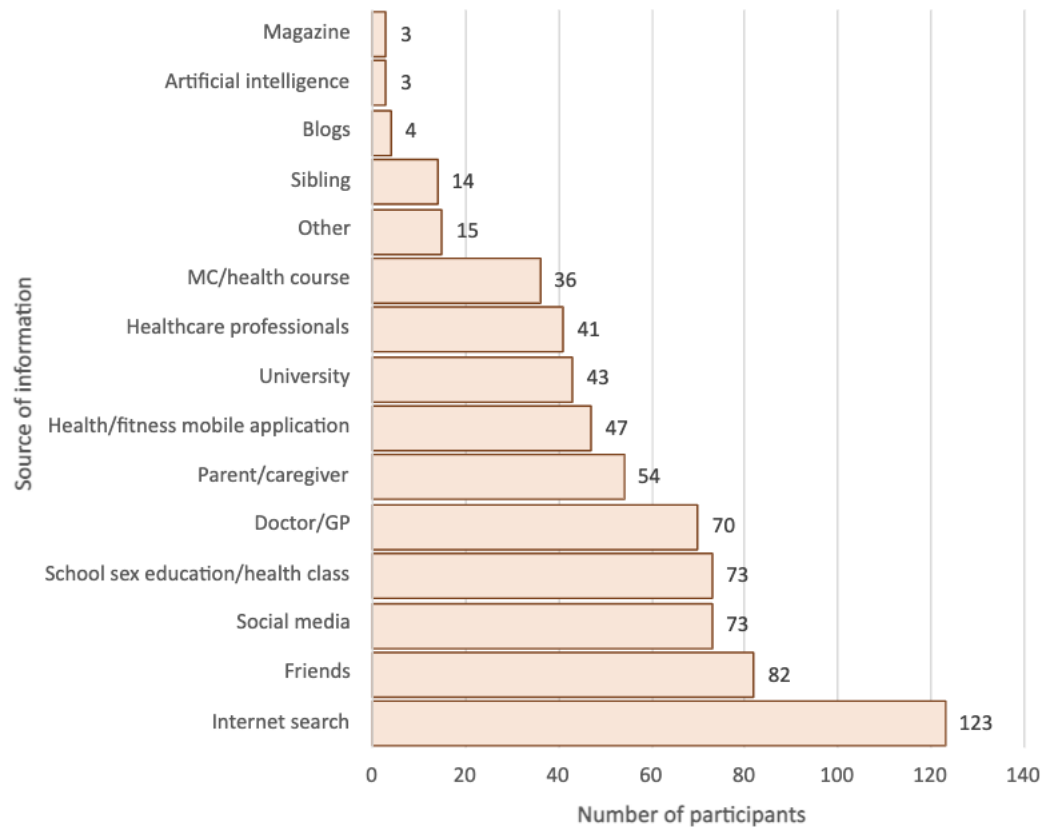


Figure 3.4 The sources of participants' menstrual cycle knowledge

General internet search was the main source of information on the MC and was selected by 61.5% participants. The next common sources were friends (41%) and school sex education classes (36.5%) and social media (36.5%). Doctor/GP's were only selected by 35% of the participants. For additional details on the current sources of information from the participant cohort see figure 3.4.

3.4.9 Most trustworthy sources of information regarding the Menstrual Cycle

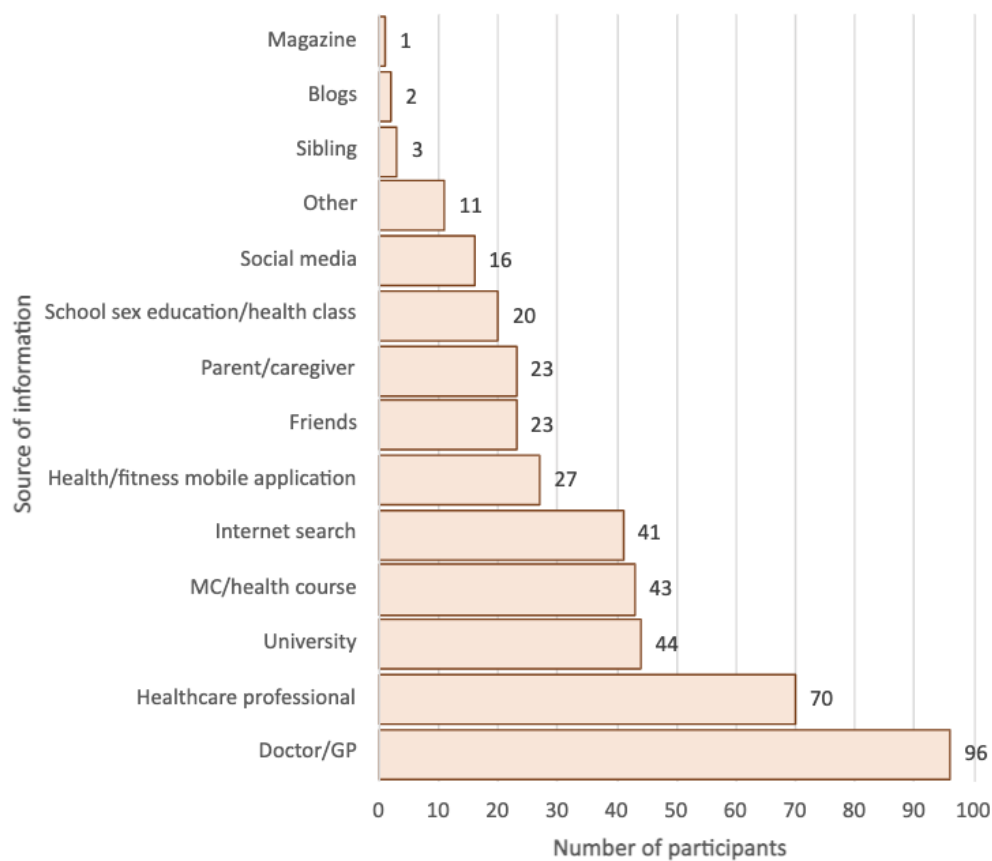


Figure 3.5 Sources considered most trustworthy by participants

Doctor/GP (48%), followed by healthcare professionals (35%) were identified by most participants as trustworthy sources of MC information. Details on the sources considered most to least trustworthy for MC information are presented in figure 3.5.

3.4.10 Areas of interest related to the Menstrual Cycle

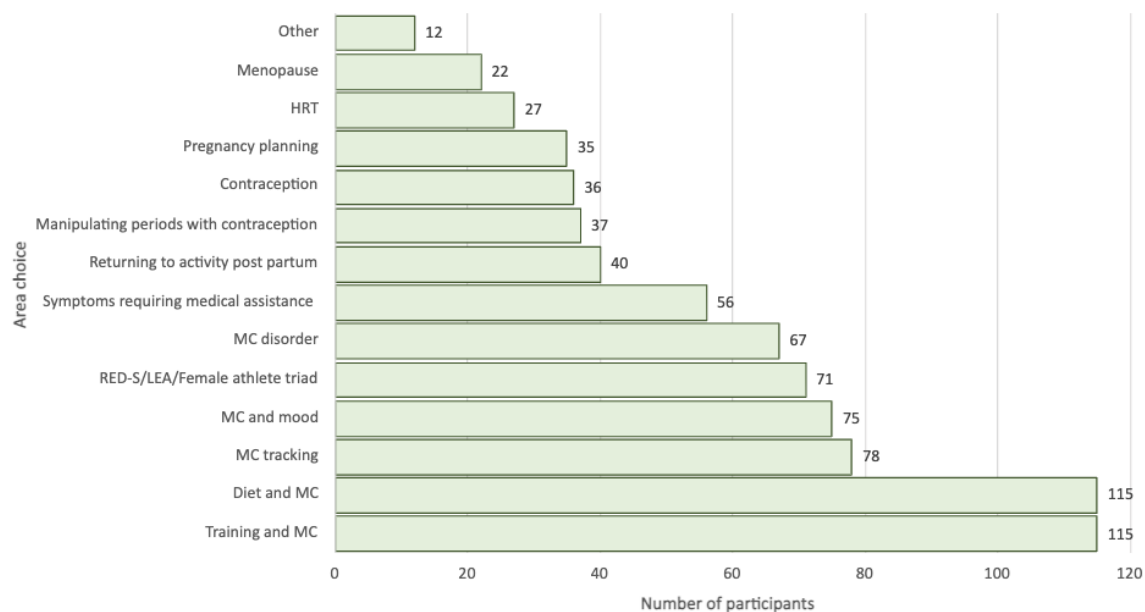


Figure 3.6 Area regarding the menstrual cycle participants would like to know about

Key areas participants were interested in receiving further education on included topics related to diet and training. A third of participants were also interested in education on how to monitor their MC, MC disorders, associated symptoms (mood) and health consequences (REDs). Less common interest areas were noted for topics related to menopause, pregnancy and contraception.

3.5 Discussion

The aims of the current study were to determine MHL amongst active females (both competitive and recreational) and where they source their menstrual cycle information from. Following the development of a validated MHL questionnaire using the Delphi methodology, results from the cross-sectional evaluation analysis in the target population of active females determined that overall functional menstrual health knowledge score for both groups (recreational and competitive) was low, with an average score 51.8%. The health impacts category, that would be most reflective of functional knowledge of the MC, had the lowest score amongst participants (20.4%). For the sources of information, health care professionals and GP's were noted as the most trustworthy, however, in contradiction to this finding the most commonly used sources were the internet, social media and friends.

3.5.2 Questionnaire development

McGawley et al. (2023) outlined a roadmap on how to improve MHL amongst athletes. The first objective of this study was to develop a questionnaire that reflects the initial phase of this process and supports the identification of the problem that needs to change. The current questionnaire

differed to others in previous research due to the extensive peer review process it underwent to ensure content validity. This process was guided by the delphi technique to capture the collective opinion of a group of experts and enhance the individual's judgement (questionnaire designer) (De Villiers et al., 2005).

Previous questionnaires that have sought to test MC knowledge in premenopausal females were heavily definition and terminology based and largely focused on pregnancy, conception and contraception (Ayoola et al., 2016; Hamdanieh et al., 2021; Volck et al., 2013; Warzecha et al., 2019). Terminology style questions bias scores to those of higher education levels, which was evident in the study by Warzecha et al. (2019) as those with higher education had higher knowledge scores. Alternatively, questionnaires that focused mostly on one aspect, e.g., OCP use in the study by Larsen et al. (2020), will bias knowledge scores towards current users of OCP.

Improving functional health literacy is the first step to developing interactive and critical health literacy (Nutbeam & Lloyd, 2021). Previous questionnaires which tested terminology based knowledge were not able to determine functional MHL. Therefore the present questionnaire was developed to extend beyond rote recall and explore concepts applicable to daily life, health and performance. When it came to the wording of questions, definitions were avoided and instead changed to ask about the physiology behind a queried aspect. For example, instead of asking "What is relative energy deficiency in sport (REDs)?" it was rephrased to "if a female is not getting enough energy from the total amount of food they are eating, then they may not have enough energy for the body to maintain basic functions (e.g., the reproductive system) and daily activities. What are the effects that this could have on sport, exercise, and physical activity performance?". Multiple correct/incorrect options were then provided for the participants to choose from. Another example was instead of asking participants to define functional hypothalamic amenorrhea (FHA) the question was rephrased to "What effects (either on their own or combined) do high stress (e.g., workload, training, emotional, social), restricted food/caloric intake, excessive weight loss, and/or large amounts of training have on female health?". These style of questions tested the participants functional understanding of these conditions rather than seeing if they could define a medical term. This arguably displays a more functional to critical level evaluation of MHL.

The present questionnaire was designed to determine a more profound level of understanding by getting participants to apply their current knowledge to situational/physiological examples. The first three categories of the current questionnaire asked questions about the MC itself (hormone specifics), menstruation and symptoms. The final category focused on health impacts, where the researchers developed questions to ask about the impact of RED-S, LEA, stress and the Triad on the

MC and health of the female. This questionnaire is the first of its kind to bridge the gap from abstract knowledge to testing the functional understanding of health and performance implications. The development of this validated questionnaire supports the determination of current functional MHL levels and has the potential to be utilised in future research to assess MHL in other cohorts that require MC education.

3.5.3 Menstrual health literacy amongst active females

It is known there is a causal pathway between health literacy and health outcomes (Paasche-Orlow & Wolf, 2007). Aotearoa New Zealand prides itself on a holistic health education programme in schools in an attempt to improve health literacy during an impressionable time of an individual's life (Fitzpatrick & Burrows, 2017). Policy and curriculum in this area is heavily aimed towards direct health issues in society, i.e. obesity, heart disease, diabetes, poor eating habits and low physical activity (Fitzpatrick & Burrows, 2017). The MC is not prioritised, and when it is discussed it is in relation to pregnancy, menstruation and sexually transmitted diseases (Diorio & Munro, 2000). MHL has been identified as a crucial subcomponent of health literacy which takes into account the entirety of the cycle, not just menstruation (Hennegan et al., 2021). This study was the first of its kind to show a lack of MHL amongst active females in Aotearoa New Zealand.

Knowledge of the MC has previously been shown to be low in both premenopausal females and elite female athletes. The current study's results of 50.1% showed similarities in total knowledge scores when compared to the current literature which has reported results ranging from 42-50.8% (Larsen et al., 2020; Lodge et al., 2022), suggesting that MHL would be low in active females. This is particularly concerning for the current study, as the cohort of participants (active and athletic females) are more likely to experience menstrual disruptions and hormone irregularities compared to healthy, sedentary females (De Souza et al., 2010). If individuals are unable to pick up on the signs/symptoms of these disruptions they may be left untreated. This is where serious health and performance consequences such as osteoporosis, increased fatigue, decrease in strength, premature cardiovascular disease, and more, are seen (Mountjoy et al., 2023).

Previously, individuals with higher education levels were reported to have better knowledge about the MC (Hamdanieh et al., 2021; Warzecha et al., 2019). However, this was not evident in the current study as more than 80% of participants had at least tertiary level education and no significant correlation with education and knowledge scores was observed. It could also be argued that previous research questionnaire formats (use of terminology/definition based questions) may have been biased to those with higher education levels and as such may not be reflective of true functional MHL of females. Future research may need to consider utilising functional MHL questionnaires, such as the one developed in the present study, in various cohorts to fully determine

whether education levels are associated with terminology/definition understanding or deeper, more functional levels of health literacy and MHL.

Menstruation and symptoms were the only two categories where participants had an adequate knowledge scores higher than 70%. Whilst the MC category was considered to be inadequate (<70%) it was not surprising as questions were based on the effects of reproductive hormones on key events during the MC rather than terminology based. When taking the current school curriculum into account and what is taught in sex education classes it is no surprise that menstruation was one of the categories with an adequate knowledge score. Menstruation is the main part of the cycle that is discussed in schools, albeit as a biological and medicalised process (Diorio & Munro, 2000). Menstruation is also the part of a MC which is observable to the individual which could offer another explanation for why confidence and knowledge was higher for this category.

The health outcomes category was the most challenging for participants and resulted in the lowest knowledge score. This category extended beyond basic reproductive biology and tested a comprehensive understanding of MHL incorporating aspects of functional hypothalamic amenorrhea (FHA), REDs, and the female athlete triad. More than half of the marks given in the knowledge section of the questionnaire came from this category alone. Guidelines surrounding the management of FHA have been created but this has not been translated to the individual as seen in our results (Gordon et al., 2017). For example, when asked what someone with FHA could do to bring back a period no one was aware of seeking dietary help for energy balance and stress management alongside reducing physical activity. Whilst this category demonstrated concerning knowledge gaps, it did showed some improvements of FHA knowledge as 96% of participants were able to correctly identify all factors that could cause a period to be late or missed. This result is different to an earlier study by Larsen et al. (2020) where 33% of athletes were not sure what could happen to a female if they overtrain (the cessation of their period). This may suggest an increase in awareness on the absence of menstrual bleeding in this participant cohort or differences in awareness in geographical regions. While it is speculated that awareness of menstrual bleeding absence may have improved, no participant was able to identify more than one correct answer for questions related to health outcomes of FHA, REDs, and the female athlete triad when multiple choice options were given. The adverse long term consequences of these conditions have been extensively outlined in the literature (Barrack et al., 2014; Dave & Fisher, 2022; De Souza et al., 1998; De Souza et al., 2010; Elliott-Sale et al., 2018; Mountjoy et al., 2023), yet our results would suggest that these outcomes are poorly understood by individuals at higher risk. This could be due to the lack of emphasis of health impacts in educational materials which have a narrow focus on the biology of the MC rather than teaching it as a holistic process (Diorio & Munro, 2000). It could also

be related to sociocultural barriers that previously have been recognised to affect MHL (Hennegan et al., 2021). In addition, this could be particularly harmful for athletes as 78% do not discuss their MC with male coaches due to a mutual barrier of knowledge deficits alongside the social taboos that it is a private/personal topic (Solli et al., 2020). Cumulatively, this is likely to deprive athletes of the opportunity to understand and address the relationship between their menstrual health and their performance.

The knowledge of physiological changes and potential consequences throughout the entirety of the MC is a vital component of MHL. In contrast with the findings by Warzecha et al. (2019) the present study showed better comprehension of BBT changes throughout the cycle, where previously 82% of premenopausal females were not aware of this compared to 52% of active females in our study. However, both studies suggest that the majority of people are still not sure how progesterone and BBT are related. In the present study with only 38% of participants were unsure of the duration of the MC, a notable improvement compared to 75% in the study by Hamdanieh et al. (2021). While the overall knowledge scores are comparable in previous studies (Ayoola et al., 2016; Volck et al., 2013), participants in the current study were more likely to answer questions on the MC, menstruation and symptoms correctly, especially when questions were not focused on medical terminology.

An interesting observation in the results was the fact that no participants selected an incorrect answer. When they were unsure they selected the 'I don't know' response. This corroborates the statement by Aday and Cornelius (2006) that participants will likely use this option when they have low confidence and/or are unsure of their answer, especially when advised to do so before survey completion.

This study completed the first step of the process to improve MHL in active females outlined by McGawley et al. (2023). A knowledge gap was confirmed and it is evident that the health impacts of menstrual disruptions is an area of prioritisation. It also demonstrated inadequate functional health literacy levels and a lack of comprehensive understanding by females of their MC.

3.5.4 Information sources

Once a knowledge gap has been assessed the next step in improving MHL amongst active females is to know how to address it (McGawley et al., 2023). Online delivery is thought to be the most accessible way to deliver MC education (McGawley et al., 2023) in an interactive way. This has been a common avenue in previous literature, as premenopausal females mostly sourced their MC information from the internet (Armour et al., 2021; Subasinghe et al., 2016). The final objective of the current study was to assess where active females in Aotearoa New Zealand source their

information from and which sources are deemed most trustworthy. The internet, like previous studies, was the most common way to source information. Next were friends, sex education classes, social media, and lastly, doctors. This aligns with more general health information seeking behaviours where the internet and social media are predominantly used (Wang et al., 2021).

A common theme that was identified was active females do not necessarily source their information from places they deem to be most trustworthy. Despite active females trusting doctors and healthcare professionals more than other sources, few would appear to actively seek information from them. Conversely, whilst many sourced information about their MC on social media, few reported this source as reliable.

Sex education classes were understandably a common source of information, however few people believed it to be reliable. Newer audits of the current school programme would need be conducted, however, based on the last audit (20 years ago) classes were noted to be heavily based on the period itself, hygiene and pregnancy (Diorio and Munro (2000)). Results of the current study would support this proposition as the majority of participants were able to answer questions about their anatomy, but very few were aware of functional components and implications as seen in the health impacts category. Similarly, other common sources of information were the internet, friends and social media and it could be argued that these sources do not provide deeper, functional knowledge of the cycle but provide more a more basic/generic understanding. Whilst understanding the basics of the MC, period hygiene and pregnancy are important health topics for females to be aware of, they are not likely to encompass the functional and holistic understanding of the MC and its influence on an individuals physical and psychological state. As a result, most females, not just the active female participants in the present study, may have a low level of functional MHL, a factor that could affect their health and wellbeing throughout their lifespan.

Regarding interest areas of the MC, participants have a prominent focus on the MC's relation with training and the diet. This extends beyond traditional educational messages that focus on the period itself or pregnancy and reflects a broader shift towards people wanting to know about functional and holistic areas of menstrual health. This interest underscores the potential for expertly crafted messages, ideally from healthcare professionals, which extends further than the basics which are often taught in classrooms and the internet. The relevant disinterest in topics such as pregnancy and menopause may be indicative of the younger age demographic of this cohort. However, it also suggests there is a gap in current educational approaches as it may reflect participants knowledge amongst areas such as pregnancy are adequate, and knowledge in health and performance specific areas is inadequate. This highlights a need for tailored interventions to improve overall functional

MHL to enable active females to make informed decisions about their performance, health and wellbeing.

3.5.5 Future use of the questionnaire

Whilst this questionnaire was initially developed for the assessment of MC knowledge amongst active females, it can now be used in future research as a validated questionnaire to determine MHL levels due to the extensive peer review process it underwent following the delphi methodology. Its broader application allows it to be used in additional cohorts such as coaches, parents and training staff. Knowledge deficits have been identified as a mutual barrier for communication between coaches and athletes (Brown et al., 2021; Höök et al., 2021; Solli et al., 2020) which outlines the importance of determining and addressing knowledge gaps in coaches as well as athletes. Practical applications from the results of the questionnaire demonstrate areas requiring prioritisation for resources/content to address knowledge gaps. These tailored interventions should be developed by healthcare professionals as they are considered trustworthy sources of information by participants and should make use of popular information sources such as social media.

3.5.6 Conclusion

As hypothesised, MHL was low amongst active females residing in New Zealand. A key feature of our study was the development of a content validated MHL questionnaire. This questionnaire is the first to test for functional MHL. It has become evident that despite the increasing focus on female health, menstruating individuals continue to have insufficient functional knowledge in this area. The recurring theme of limited awareness of menstrual disruptions and health issues commonly experienced in active females remains a concern.

The questionnaire not only tested knowledge but offered insights to where active females are sourcing their MC information from and which sources are deemed most trustworthy. This is the first time it has been assessed in this demographic. The disjunction in where they mainly source their information from versus which sources they consider to be most trustworthy indicates opportunity for improvements in MC education development and delivery. As such, healthcare professionals should engage on digital platforms to conjoin reliable information with accessibility.

The findings from this study highlight the need for addressing current education programmes, beginning with school sex education classes. It is necessary to change the current narrative of how the MC is viewed. The MC is more than just a process for achieving or avoiding pregnancy; its intricate hormone signalling pathways play an important role for the overall health and well-being of the female.

Chapter 4 Conclusion and Recommendations

4.1 Overview and achievement of study aims and objectives

The present study aimed to assess MHL amongst active females residing in Aotearoa New Zealand. A secondary aim was to determine sources of menstrual cycle information as this has not been determined in the active female population. To achieve these aims the researchers developed a validated questionnaire which was then uploaded onto Qualtrics. A total of 203 responses were provided by participants and analysed by the research team. The key findings from the analysis are outlined below.

- Overall MHL is inadequate amongst active females. When results were divided into categories, the understanding of health impacts (which tested in depth, functional knowledge of the consequences menstrual disruptions can have on the female health and performance) was identified as the area with the most notable knowledge deficit.
- A validated 42 item MHL questionnaire has been developed which can be used to assess knowledge in future research on active females as well as other cohorts (coaches, support staff and parents).
- Social media is one of the more common sources of MC knowledge, however, it is one of the least trustworthy sources. The opposite is true for healthcare professionals, as participants find them trustworthy but not an easily accessible source of information.
- Effective MC content and educational resources should be developed with healthcare professionals and delivered through channels most frequently used to acquire information.

MHL, as outlined earlier, represents the state of physical, mental and social wellbeing in relation to the MC (McGawley et al., 2023). It is related to health literacy and describes the individual's ability to acquire knowledge and apply it to specific menstrual health-related issues. The present study confirms that MHL is low amongst active females, from recreational through to elite athletes, however, very few evidence-informed resources exist to improve this (McGawley et al., 2023). The lack of sex inclusivity in current sport research does not explain the inadequate knowledge levels seen in this study as these health effects have been consistently outlined in the literature, some over a decade ago (Barrack et al., 2014; Dave & Fisher, 2022; De Souza et al., 1998; De Souza et al., 2010; Elliott-Sale et al., 2018; Mountjoy et al., 2023). It is important for all females to be aware of what is happening in their bodies each month to ensure informed decisions can be made regarding the individual's health. It is extremely important for active females who are at higher risks of health consequences from menstrual disturbances to be aware of the health impacts these may pose (Barrack et al., 2014; De Souza et al., 2010; Mountjoy et al., 2023).

4.2 Strengths and limitations

One of the primary strengths of the present study was its novelty in developing a questionnaire that assessed functional impacts of the MC and MC disturbances. The design of the questionnaire was user-centric, as it exclusively included multiple choice questions that did not require substantial text response, and likely aided in the high response rate that exceeded the sample size required for statistical significance. The content validity of the developed questionnaire via the delphi process is a major strength of the current study as it improves reliability, validity and accuracy of results.

There was an element of selection bias as participants were mostly recruited via research team organisational contacts, social media and personal contacts. This is likely why the study resulted in participants having higher education levels. These factors may limit the generalisability of these findings to a wider population and underscores the need for future studies to involve individuals of other demographic cohorts.

The present study screened for previous/current menstrual disorders/disruptions and pregnancy (previous or current) but did not exclude them from the results. This could be seen as both a strength and limitation as it was inclusive, however, participants with these conditions could have potentially exhibited higher levels of knowledge. However, when this was analysed in the results, no significant correlation between these any of these conditions and knowledge was observed.

The information sheet outlined people wanting to participate had to be active for at least two and a half hours per week. This did not outline moderate to hard physical activity, as evidenced by some participants' main physical sports being yoga, pilates or walking. This may have introduced variability in the findings when it came to comparing the two groups, recreationally active females vs female athletes, as these were based off time spent on PA per week rather than intensity and time. This meant someone partaking in yoga >4hrs/week would have been identified as a female athlete rather than a recreationally active female. This could explain why there were no statistical differences between the groups and knowledge scores. Lastly, the voluntary nature of the study could act as a limitation as people who are more interested in the topic were possibly more likely to take part, thus results may reflect a degree of selection bias. This could potentially skew the results to show higher knowledge levels than what may be true in this population.

4.3 Future use of the questionnaire and application of findings

Prioritising health over performance seems to be a common theme due to the high pressures that come with competitive sport (Gillbanks et al., 2022; Höök et al., 2021). Movements to protect the wellbeing of athletes is gaining traction as more studies are beginning to focus on the health

consequences that can arise from REDs and the Female Athlete Triad (Elliott-Sale et al., 2018; Mountjoy et al., 2023). Whilst this questionnaire was developed for the purpose of testing MC knowledge amongst active females, its potential applicability extends to other demographics, such as coaches, training staff and parents of elite athletes or athletic females. Knowledge gaps are a common barrier for open communication between both coaches and athletes (Brown et al., 2021; Höök et al., 2021). A study similar to this has shown that whilst coaches and training staff had higher MC literacy compared to athletes, their knowledge may still be considered suboptimal (Lodge et al., 2022). Notably, even physiotherapists have been reported to be unaware of the health consequences of REDs (Gillbanks et al., 2022). Using the present questionnaire to test the knowledge of coaches and other training staff about the MC, particularly the health consequences of menstrual disruptions from sport, will determine knowledge gaps that need addressing through education. This could be conducted through collaborations with sport entities across New Zealand such as Sport New Zealand and High Performance Sport New Zealand. This study has currently developed the highest content validity questionnaire on MHL and future research should continue to use it to assess MHL in other cohorts such as coaches, training staff and parents. For a practical implication, the validated questionnaire could be used to assess MHL for interest purposes amongst sports clubs, mobile health/fitness applications, schools/colleges, healthcare professionals, and fitness centres. This allows these institutions, staff and healthcare professionals to determine where knowledge deficits are and how they could tailor education and resources to address these gaps for their population.

The findings from this study underscore a deficit in MHL amongst active females in New Zealand, particularly the understanding of health consequences associated with the menstrual cycle. Further education sessions and resources should be aimed towards improving knowledge in this area. Leveraging general practitioners (GPs) and other healthcare professionals (dietitians, physiotherapists, etc) emerges as a strategy for bridging these gaps, considering they were the most trustworthy sources amongst this demographic. Support for these individuals in conjunction with sport organisations will enable creation of accessible, tailored educational content that uses sources of information most readily viewed by a target market. There was a keen interest from participants regarding diet and training when it comes to the MC. Integrating these topics could potentially enhance engagement levels for healthcare professionals.

The following are the final, summarised future applications of this research:

- Health impacts of menstrual disruptions should be prioritised and targeted with educational programmes/resources as this is the area active females displayed the lowest levels of knowledge/awareness.
- Expert educational content from healthcare professionals to be based around functional interests (diet and training) of the MC.
- Open, stigma-free spaces for active females to discuss their MC with coaches, training staff and parents to create a supportive environment to engage in informed discussions to ultimately improve health and performance.

References:

- Abraham, C., & Sheeran, P. (2015). The health belief model. *Predicting health behaviour: Research and practice with social cognition models*, 2, 30-55.
- Aday, L. A., & Cornelius, L. J. (2006). *Designing and conducting health surveys: a comprehensive guide*. John Wiley & Sons.
- Agarwal, S. K., Chapron, C., Giudice, L. C., Laufer, M. R., Leyland, N., Missmer, S. A., Singh, S. S., & Taylor, H. S. (2019). Clinical diagnosis of endometriosis: a call to action. *American journal of obstetrics and gynecology*, 220(4), 354. e351-354. e312.
- Allen, K. R., & Goldberg, A. E. (2009). Sexual activity during menstruation: A qualitative study. *Journal of Sex Research*, 46(6), 535-545.
- Armour, M., Dahlen, H. G., & Smith, C. A. (2016). More than needles: the importance of explanations and self-care advice in treating primary dysmenorrhea with acupuncture. *Evidence-Based Complementary and Alternative Medicine*, 2016.
- Armour, M., Ee, C. C., Naidoo, D., Ayati, Z., Chalmers, K. J., Steel, K. A., de Manincor, M. J., & Delshad, E. (2019). Exercise for dysmenorrhoea. *Cochrane Database of Systematic Reviews*(9).
- Armour, M., Ferfolja, T., Curry, C., Hyman, M. S., Parry, K., Chalmers, K. J., Smith, C. A., MacMillan, F., & Holmes, K. (2020). The prevalence and educational impact of pelvic and menstrual pain in Australia: A national online survey of 4202 young women aged 13-25 years. *Journal of pediatric and adolescent gynecology*, 33(5), 511-518.
- Armour, M., Hyman, M. S., Al-Dabbas, M., Parry, K., Ferfolja, T., Curry, C., MacMillan, F., Smith, C. A., & Holmes, K. (2021). Menstrual health literacy and management strategies in young women in Australia: a National Online Survey of young women aged 13-25 Years. *Journal of pediatric and adolescent gynecology*, 34(2), 135-143.
- Armour, M., Parry, K., Manohar, N., Holmes, K., Ferfolja, T., Curry, C., MacMillan, F., & Smith, C. A. (2019). The prevalence and academic impact of dysmenorrhea in 21,573 young women: a systematic review and meta-analysis. *Journal of women's health*, 28(8), 1161-1171.
- Armour, M., Parry, K. A., Steel, K., & Smith, C. A. (2020). Australian female athlete perceptions of the challenges associated with training and competing when menstrual symptoms are present. *International Journal of Sports Science & Coaching*, 15(3), 316-323.
- Armour, M., Sinclair, J., Ng, C. H., Hyman, M. S., Lawson, K., Smith, C. A., & Abbott, J. (2020). Endometriosis and chronic pelvic pain have similar impact on women, but time to diagnosis is decreasing: an Australian survey. *Scientific reports*, 10(1), 1-9.
- Ayoola, A. B., Zandee, G. L., & Adams, Y. J. (2016). Women's knowledge of ovulation, the menstrual cycle, and its associated reproductive changes. *Birth*, 43(3), 255-262.
- Azurah, A. G. N., Sanci, L., Moore, E., & Grover, S. (2013). The quality of life of adolescents with menstrual problems. *Journal of pediatric and adolescent gynecology*, 26(2), 102-108.
- Baatard, G. (2012). A technical guide to effective and accessible web surveys.
- Balık, G., Üstüner, I., Kağıtçı, M., & Şahin, F. K. (2014). Is there a relationship between mood disorders and dysmenorrhea? *Journal of pediatric and adolescent gynecology*, 27(6), 371-374.
- Banikarim, C., Chacko, M. R., & Kelder, S. H. (2000). Prevalence and impact of dysmenorrhea on Hispanic female adolescents. *Archives of pediatrics & adolescent medicine*, 154(12), 1226-1229.
- Barrack, M. T., Gibbs, J. C., De Souza, M. J., Williams, N. I., Nichols, J. F., Rauh, M. J., & Nattiv, A. (2014). Higher incidence of bone stress injuries with increasing female athlete triad-related risk factors: a prospective multisite study of exercising girls and women. *The American journal of sports medicine*, 42(4), 949-958.
- Barrington, D. J., Robinson, H. J., Wilson, E., & Hennegan, J. (2021). Experiences of menstruation in high income countries: a systematic review, qualitative evidence synthesis and comparison to low-and middle-income countries. *PloS one*, 16(7), e0255001.

- Brown, N., Knight, C. J., & Forrest, L. J. (2021). Elite female athletes' experiences and perceptions of the menstrual cycle on training and sport performance. *Scandinavian Journal of Medicine & Science in Sports*, 31(1), 52-69.
- Bruinvels, G., Burden, R., Brown, N., Richards, T., & Pedlar, C. (2016). The prevalence and impact of heavy menstrual bleeding (menorrhagia) in elite and non-elite athletes. *PloS one*, 11(2), e0149881.
- Bull, J. R., Rowland, S. P., Scherwitzl, E. B., Scherwitzl, R., Danielsson, K. G., & Harper, J. (2019). Real-world menstrual cycle characteristics of more than 600,000 menstrual cycles. *NPJ digital medicine*, 2(1), 83.
- Chandra-Mouli, V., & Patel, S. V. (2020). Mapping the knowledge and understanding of menarche, menstrual hygiene and menstrual health among adolescent girls in low-and middle-income countries. *The Palgrave handbook of critical menstruation studies*, 609-636.
- Chen, C. X., Groves, D., Miller, W. R., & Carpenter, J. S. (2018). Big data and dysmenorrhea: what questions do women and men ask about menstrual pain? *Journal of women's health*, 27(10), 1233-1241.
- Chen, C. X., Kwekkeboom, K. L., & Ward, S. E. (2016). Beliefs about dysmenorrhea and their relationship to self-management. *Research in nursing & health*, 39(4), 263-276.
- Clarke, A., Govus, A., & Donaldson, A. (2021). What male coaches want to know about the menstrual cycle in women's team sports: Performance, health, and communication. *International Journal of Sports Science & Coaching*, 16(3), 544-553.
- Dave, S. C., & Fisher, M. (2022). Relative energy deficiency in sport (RED-S). *Current Problems in Pediatric and Adolescent Health Care*, 101242.
- De Souza, M. J., Miller, B., Loucks, A., Luciano, A., Pescatello, L., Campbell, C., & Lasley, B. (1998). High frequency of luteal phase deficiency and anovulation in recreational women runners: blunted elevation in follicle-stimulating hormone observed during luteal-follicular transition. *The Journal of Clinical Endocrinology & Metabolism*, 83(12), 4220-4232.
- De Souza, M. J., Toombs, R., Scheid, J., O'Donnell, E., West, S. L., & Williams, N. I. (2010). High prevalence of subtle and severe menstrual disturbances in exercising women: confirmation using daily hormone measures. *Human reproduction*, 25(2), 491-503.
- De Villiers, M. R., De Villiers, P. J., & Kent, A. P. (2005). The Delphi technique in health sciences education research. *Medical teacher*, 27(7), 639-643.
- DeMaria, A. L., Delay, C., Sundstrom, B., Wakefield, A. L., Naoum, Z., Ramos-Ortiz, J., Meier, S., & Brig, K. (2020). "My mama told me it would happen": menarche and menstruation experiences across generations. *Women & Health*, 60(1), 87-98.
- Diorio, J. A., & Munro, J. A. (2000). Doing harm in the name of protection: Menstruation as a topic for sex education. *Gender and Education*, 12(3), 347-365.
- Dipti, S., & Chandra, K. (2011). Awareness and health seeking behaviour of adolescent school girls on menstrual and reproductive health problems. *Asian Journal of Home Science*, 6(2), 150-153.
- Elliott-Sale, K. J., Tenforde, A. S., Parziale, A. L., Holtzman, B., & Ackerman, K. E. (2018). Endocrine effects of relative energy deficiency in sport. *International journal of sport nutrition and exercise metabolism*, 28(4), 335-349.
- Findlay, R. J., Macrae, E. H., Whyte, I. Y., Easton, C., & Forrest, L. J. (2020). How the menstrual cycle and menstruation affect sporting performance: experiences and perceptions of elite female rugby players. *British journal of sports medicine*, 54(18), 1108-1113.
- Fitzpatrick, K., & Burrows, L. (2017). Critical health education in aotearoa New Zealand. *Sport, Education and Society*, 22(5), 552-568.
- Garside, R., Britten, N., & Stein, K. (2008). The experience of heavy menstrual bleeding: a systematic review and meta-ethnography of qualitative studies. *Journal of advanced nursing*, 63(6), 550-562.

- Gillbanks, L., Mountjoy, M., & Filbay, S. R. (2022). Insufficient knowledge and inappropriate physiotherapy management of Relative Energy Deficiency in Sport (RED-S) in lightweight rowers. *Physical Therapy in Sport*, 54, 8-15.
- Gordon, C. M., Ackerman, K. E., Berga, S. L., Kaplan, J. R., Mastorakos, G., Misra, M., Murad, M. H., Santoro, N. F., & Warren, M. P. (2017). Functional hypothalamic amenorrhea: an endocrine society clinical practice guideline. *The Journal of Clinical Endocrinology & Metabolism*, 102(5), 1413-1439.
- Greene, R., Stratton, P., Cleary, S. D., Ballweg, M. L., & Sinaii, N. (2009). Diagnostic experience among 4,334 women reporting surgically diagnosed endometriosis. *Fertility and sterility*, 91(1), 32-39.
- Hamdanieh, M., Ftouni, L., Al Jardali, B., Ftouni, R., Rawas, C., Ghotmi, M., El Zein, M. H., Ghazi, S., & Malas, S. (2021). Assessment of sexual and reproductive health knowledge and awareness among single unmarried women living in Lebanon: a cross-sectional study. *Reproductive Health*, 18(1), 1-12.
- Harmanli, O., Ilarslan, I., Kirupanathan, S., Knee, A., & Harmanli, A. (2014). Women's perceptions about female reproductive system: a survey from an academic obstetrics and gynecology practice. *Archives of Gynecology and Obstetrics*, 289(6), 1219-1223.
- Hennegan, J., Winkler, I. T., Bobel, C., Keiser, D., Hampton, J., Larsson, G., Chandra-Mouli, V., Plesons, M., & Mahon, T. (2021). Menstrual health: a definition for policy, practice, and research. *Sexual and Reproductive Health Matters*, 29(1), 31-38.
- Höök, M., Bergström, M., Sæther, S. A., & McGawley, K. (2021). "Do Elite Sport First, Get Your Period Back Later." Are Barriers to Communication Hindering Female Athletes? *International Journal of Environmental Research and Public Health*, 18(22), 12075.
- Houston, A. M., Abraham, A., Huang, Z., & D'Angelo, L. J. (2006). Knowledge, attitudes, and consequences of menstrual health in urban adolescent females. *Journal of pediatric and adolescent gynecology*, 19(4), 271-275.
- Israel, S. L., & Schneller, O. (1950). The thermogenic property of progesterone. *Obstetrical & gynecological survey*, 5(4), 532-533.
- Johnston-Robledo, I., Sheffield, K., Voigt, J., & Wilcox-Constantine, J. (2007). Reproductive shame: Self-objectification and young women's attitudes toward their reproductive functioning. *Women & Health*, 46(1), 25-39.
- Jowett, S., & Poczwadowski, A. (2007). Understanding the coach-athlete relationship.
- Kilfoyle, K. A., Vitko, M., O'Connor, R., & Bailey, S. C. (2016). Health literacy and women's reproductive health: a systematic review. *Journal of women's health*, 25(12), 1237-1255.
- Koltun, K. J., Strock, N. C., Southmayd, E. A., Oneglia, A. P., Williams, N. I., & De Souza, M. J. (2019). Comparison of Female Athlete Triad Coalition and RED-S risk assessment tools. *Journal of Sports Sciences*, 37(21), 2433-2442.
- Larsen, B., Morris, K., Quinn, K., Osborne, M., & Minahan, C. (2020). Practice does not make perfect: A brief view of athletes' knowledge on the menstrual cycle and oral contraceptives. *Journal of Science and Medicine in Sport*, 23(8), 690-694.
- Lodge, M. T., Ackerman, K. E., & Garay, J. (2022). Knowledge of the Female Athlete Triad and Relative Energy Deficiency in Sport Among Female Cross-Country Athletes and Support Staff. *Journal of Athletic Training*, 57(4), 385-392.
- Marván, M. L., Ramírez-Esparza, D., Cortés-Iniestra, S., & Chrisler, J. C. (2006). Development of a new scale to measure beliefs about and attitudes toward menstruation (BATM): Data from Mexico and the United States. *Health Care for Women International*, 27(5), 453-473.
- Marván, M. L., Vázquez-Toboada, R., & Chrisler, J. C. (2014). Ambivalent sexism, attitudes towards menstruation and menstrual cycle-related symptoms. *International Journal of Psychology*, 49(4), 280-287.
- McGawley, K., Sargent, D., Noordhof, D., Badenhorst, C., Julian, R., & Govus, A. D. (2023). Improving menstrual health literacy in sport. *Journal of Science and Medicine in Sport*.

- Mikhael, S., Punjala-Patel, A., & Gavrilova-Jordan, L. (2019). Hypothalamic-pituitary-ovarian axis disorders impacting female fertility. *Biomedicines*, 7(1), 5.
- Morassutto, C., Monasta, L., Ricci, G., Barbone, F., & Ronfani, L. (2016). Incidence and estimated prevalence of endometriosis and adenomyosis in Northeast Italy: a data linkage study. *PloS one*, 11(4), e0154227.
- Mountjoy, M., Ackerman, K. E., Bailey, D. M., Burke, L. M., Constantini, N., Hackney, A. C., Heikura, I. A., Melin, A., Pensgaard, A. M., & Stellingwerff, T. (2023). 2023 International Olympic Committee's (IOC) consensus statement on Relative Energy Deficiency in Sport (REDs). *British journal of sports medicine*, 57(17), 1073-1097.
- Mountjoy, M., Sundgot-Borgen, J., Burke, L., Ackerman, K. E., Blauwet, C., Constantini, N., Lebrun, C., Lundy, B., Melin, A., & Meyer, N. (2018). International Olympic Committee (IOC) consensus statement on relative energy deficiency in sport (RED-S): 2018 update. *International journal of sport nutrition and exercise metabolism*, 28(4), 316-331.
- Nunes, R. A. (2019). Women athletes in the Olympic Games. *Journal of Human Sport and Exercise*, 14(3), 674-683.
- Nutbeam, D., & Lloyd, J. E. (2021). Understanding and responding to health literacy as a social determinant of health. *Annu Rev Public Health*, 42(1), 159-173.
- Paasche-Orlow, M. K., & Wolf, M. S. (2007). The causal pathways linking health literacy to health outcomes. *American journal of health behavior*, 31(1), S19-S26.
- Roberts, T.-A. (2004). Female trouble: The menstrual self-evaluation scale and women's self-objectification. *Psychology of Women Quarterly*, 28(1), 22-26.
- Roberts, T.-A., Goldenberg, J. L., Power, C., & Pyszczynski, T. (2002). "Feminine protection": The effects of menstruation on attitudes towards women. *Psychology of Women Quarterly*, 26(2), 131-139.
- Shufelt, C. L., Torbati, T., & Dutra, E. (2017). Hypothalamic amenorrhea and the long-term health consequences. *Seminars in reproductive medicine*.
- Singh, M. M., Devi, R., & Gupta, S. (1999). Awareness and health seeking behaviour of rural adolescent school girls on menstrual and reproductive health problems. *Indian Journal of Medical Sciences*, 53(10), 439-443.
- Solli, G. S., Sandbakk, S. B., Noordhof, D. A., Ihalainen, J. K., & Sandbakk, Ø. (2020). Changes in self-reported physical fitness, performance, and side effects across the phases of the menstrual cycle among competitive endurance athletes. *International journal of sports physiology and performance*, 15(9), 1324-1333.
- Spadaro, G., d'Elia, S. R., & Mosso, C. O. (2018). Menstrual knowledge and taboo TV commercials: Effects on self-objectification among Italian and Swedish women. *Sex roles*, 78(9), 685-696.
- Stafford, D. E. (2005). Altered hypothalamic-pituitary-ovarian axis function in young female athletes: implications and recommendations for management. *Treatments in Endocrinology*, 4, 147-154.
- Subasinghe, A. K., Hapoo, L., Jayasinghe, Y. L., Garland, S. M., & Wark, J. D. (2016). Prevalence and severity of dysmenorrhoea, and management options reported by young Australian women. *Australian family physician*, 45(11), 829-834.
- Sykes, S., & Wills, J. (2018). Challenges and opportunities in building critical health literacy. *Global health promotion*, 25(4), 48-56.
- Tiggemann, M. (2011). Mental health risks of self-objectification: A review of the empirical evidence for disordered eating, depressed mood, and sexual dysfunction.
- Torstveit, M. K., & Sundgot-Borgen, J. (2005). The female athlete triad: are elite athletes at increased risk? *Medicine & Science in Sports & Exercise*, 37(2), 184-193.
- Volck, W., Ventress, Z. A., Herbenick, D., Hillard, P. J. A., & Huppert, J. S. (2013). Gynecologic knowledge is low in college men and women. *Journal of pediatric and adolescent gynecology*, 26(3), 161-166.

- von Rosen, P., Ekenros, L., Solli, G. S., Sandbakk, Ø., Holmberg, H.-C., Hirschberg, A. L., & Fridén, C. (2022). Offered support and knowledge about the menstrual cycle in the athletic community: a cross-sectional study of 1086 female athletes. *International Journal of Environmental Research and Public Health*, 19(19), 11932.
- Wang, X., Shi, J., & Kong, H. (2021). Online health information seeking: a review and meta-analysis. *Health Communication*, 36(10), 1163-1175.
- Warzecha, D., Szymusik, I., Pietrzak, B., Kosinska-Kaczynska, K., Sierdzinski, J., Sochacki-Wojcicka, N., & Wielgos, M. (2019). Sex education in Poland—a cross-sectional study evaluating over twenty thousand polish women's knowledge of reproductive health issues and contraceptive methods. *BMC public health*, 19(1), 1-8.
- White, L. R. (2013). The function of ethnicity, income level, and menstrual taboos in postmenarcheal adolescents' understanding of menarche and menstruation. *Sex roles*, 68(1), 65-76.
- Winkler, I. T. (2020). Introduction: menstruation as fundamental. *The Palgrave handbook of critical menstruation studies*, 9-13.
- Wong, L. P. (2011). Attitudes towards dysmenorrhoea, impact and treatment seeking among adolescent girls: A rural school-based survey. *Australian Journal of Rural Health*, 19(4), 218-223.
- Wong, W. C., Li, M. K., Chan, W. Y. V., Choi, Y. Y., Fong, C. H. S., Lam, K. W. K., Sham, W. C., So, P. P., Wong, K., & Yeung, K. H. (2013). A cross-sectional study of the beliefs and attitudes towards menstruation of Chinese undergraduate males and females in Hong Kong. *Journal of Clinical Nursing*, 22(23-24), 3320-3327.
- Wood, J. M., Koch, P. B., & Mansfield, P. K. (2007). Is my period normal? How college-aged women determine the normality or abnormality of their menstrual cycles. *Women & Health*, 46(1), 41-56.

Menstrual cycle knowledge questionnaire

Start of Block: Disclaimer

Disclaimer **Menstrual cycle knowledge amongst active females and female athletes**

Invitation to participate

We would like to invite you to participate in this research project. The project will be testing your knowledge about the menstrual cycle using an online questionnaire. Please read the information sheet before deciding if you would like to participate.

Why are we doing this research?

Outside the basic sex education classes in school, education about the menstrual cycle is lacking. Few studies have tested menstrual cycle knowledge amongst the general population. Even less have assessed knowledge among physically active females. To help us improve education and knowledge about the menstrual cycle it is important that we know the existing level of understanding and knowledge amongst active females. This will help us build educational information to your current understanding and help us identify how we can help improve your knowledge of the menstrual cycle. We are also interested to know where you get your menstrual cycle information from. This will help us deliver menstrual cycle information to you through the sources/methods that you prefer.

Who are we looking for?

- Female athletes and recreationally active females between the ages of 16-40 years (at least 2 ½ hours of exercise at moderate intensity exercise a week)
- Understand English

What is going to happen?

Once you have read the information sheet and if you are willing to participate then please proceed with the online questionnaire. Your completion of the online questionnaire will be regarded as your informed and implied consent for this research project participation.

The online questionnaire should take approximately **15-20 minutes to complete**. Please complete it in your own time and in a space that feels comfortable to you. You will be asked to complete one pre-screening question. You will then begin the knowledge questionnaire. This knowledge section is separated into 4 categories: the menstrual cycle, menstruation, symptoms, and health impacts. For each question, you will be given the option to choose '**I don't know**' if you are unaware/not confident of your answer. Please select this choice if you are unsure of the answer and ***please refrain from looking up any answers as this will jeopardise the aim and results of this research.***

After the knowledge questionnaire, we will ask you a few questions about where you have received

most of your menstrual cycle information from. The questionnaire will end with a few questions which will ask about your age, ethnicity, hormonal contraception use, the age of your first period and your physical activity level.

You won't receive a mark or the correct answers from the questionnaire, but if you're interested to learn more about the menstrual cycle, we have created an information document for you to download and read through at the end. If you would like to receive updates about the study and the research project results, then please feel free to provide your email at the end.

Data management

Your answers will be anonymous, and no personal data will be identified in the analysis. Only the research team (staff and student) will have access to the data. The data will be stored under a survey number to maintain confidentiality. Once the data has been collected it will be analysed as group averages. This means that no individual data will be identified from the results. These averages may be published in academic journals or presented at conferences/seminars/workshops to academic and general population audiences. The raw data from this research will be stored securely for 10 years, and may be used for future research projects investigating menstrual cycle knowledge, after after this it will be destroyed.

Participant rights

You are under no obligation to accept this invitation. If you do choose to participate you have the right to:

- Withdraw at any time before or during the completion of the questionnaire.
- Ask questions about the questionnaire at any time during participation (contact details are included at the end of this information sheet).
- Receive access to a summary of the research findings after the project has been completed.

What are the benefits and risks of taking part in this study?

You will receive a pdf document at the that will provide you with information about the menstrual cycle. You are free to download as many copies as you need.

We are aware of potential risks in completing the questionnaire. There may be questions that you feel uncomfortable, embarrassed, ashamed, or distressed when answering. However, the questionnaire is not asking about your personal menstrual cycle, it is asking about what you know about the menstrual cycle in general. Questionnaires given in a test format may bring up feelings of nervousness, incompetence, doubt in one's intelligence, or anxiousness.

To reduce any discomfort:

- We will keep all data confidential and anonymous by reporting the results from the study as averages instead of individual answers. Your individual results and identify will not be shared or presented.
- You won't receive a final mark from the questionnaire or be given the correct answers once you've completed it as we want to avoid any feelings of anxiety that may arise when someone is completing a test.
- We encourage you to complete the questionnaire on your personal device in a space which feels comfortable and relaxing to you.
- All data collected will be stored on password protected devices and folders which can only be accessed by the research team. No personal information will be kept.

Project contacts:

If you have any questions regarding this study, please do not hesitate to contact either of the following people for help:

The primary researcher:

Danni Fletcher
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Ethics committee approval statement

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Professor Craig Johnson, Director (Research Ethics), email humanethics@massey.ac.nz.

End of Block: Disclaimer

Start of Block: Pre-Survey screening question

Pre-survey Do you currently have any of the following conditions? **(select all that apply)**

- ☐ Currently pregnant (1)
 - ☐ Menopause/Perimenopause (2)
 - ☐ Pregnant in the last 12 months (3)
 - ☐ Polycystic ovarian syndrome (PCOS) (4)
 - ☐ Endometriosis (5)
 - ☐ Premature ovarian failure (6)
 - ☐ Excess prolactin production (7)
 - ☐ Endometrial polyps or fibroids (8)
 - ☐ Adenomyosis (9)
 - ☐ Bleeding disorder (10)
 - ☐ Pelvic inflammatory disorder (11)
 - ☐ Ovarian cysts (12)
 - ☐ Other menstrual related dysfunction (please specify) (13)
-
- ☐ None of the above (14)

End of Block: Pre-Survey screening question

Start of Block: Block 9

Information You will now begin the knowledge section of the questionnaire.

The questionnaire will be split into 4 different knowledge categories:

1. The Menstrual Cycle
2. Menstruation
3. Symptoms
4. Health outcomes

To finish we will ask a few questions about where you typically get your menstrual health information from.

For each question you are given the option to answer '**I don't know**'. Please use this when you are unsure of the response or have very low confidence in your answer.

End of Block: Block 9

Start of Block: Menstrual Cycle

Category 1: The Menstrual Cycle

Menstrual cycle The menstrual cycle is split into phases, for example, the follicular, luteal, and ovulatory phase. In each phase there are different levels of female reproductive/sex hormones that help prepare the body for possible pregnancy. Hormones are a type of chemical messenger and travel through the bloodstream to help the body carry out specific responses. This section will ask you questions about the menstrual cycle.



Q1 What is the normal length of one complete menstrual cycle (as a range)?

- ☐ 21-34 days (1)
 - ☐ 27-29 days (0)
 - ☐ 11-21 days (0)
 - ☐ 30-40 days (0)
 - ☐ I don't know (0)
-



Q2 True or false: Ovulation is when a mature egg is released from the ovary?

- ☐ True (1)
 - ☐ False (0)
 - ☐ I don't know (0)
-



Q3 How many eggs are released in one complete normal/healthy menstrual cycle?

- ☐ 1 (1)
 - ☐ 2 (0)
 - ☐ 3+ (0)
 - ☐ 5+ (0)
 - ☐ I don't know (0)
-



Q4 What is the **primary** organ of the female reproductive system?

- ☐ The ovaries (1)
 - ☐ The fallopian tubes (0)
 - ☐ The uterus (0)
 - ☐ The cervix (0)
 - ☐ The vagina (0)
 - ☐ I don't know (0)
-



Q5 Which is commonly known as the first day (day 1) of the menstrual cycle?

- ☐ Last day of bleeding (0)
 - ☐ First day of bleeding (1)
 - ☐ The day when ovulation occurs (0)
 - ☐ Depends on the person (0)
 - ☐ I don't know (0)
-



Q6 Within the menstrual cycle, when does ovulation typically occur?

- ☐ In the middle of the cycle (1)
 - ☐ At the start of the cycle (0)
 - ☐ At the end of the cycle (0)
 - ☐ I don't know (0)
-



Q7 For approximately two weeks in the lead up to the menstrual bleed/period, the female is in their luteal phase. The high progesterone levels in this phase help to:

- ☐ Cause ovulation (0)
 - ☐ Maintain the regularity of the menstrual cycle (0)
 - ☐ Shed the inner lining of the uterus (the endometrium) for the next menstrual bleed/period (0)
 - ☐ Maintain/prepare the inner lining of the uterus (the endometrium) for a possible pregnancy (1)
 - ☐ I don't know (0)
-



Q8 In the follicular phase, after the menstrual bleed/period has finished, increasing levels of oestrogen helps the inner lining of the uterus (endometrium) to...?

- ☐ Grow thicker (1)
- ☐ Shed causing another menstrual bleed/period (0)
- ☐ Grow the placenta (0)
- ☐ Stop growing (0)
- ☐ I don't know (0)



Q9 High amounts of which hormone is needed for ovulation to occur?

- ☐ Testosterone (0)
- ☐ Luteinising hormone (1)
- ☐ Oestrogen (0)
- ☐ Progesterone (0)
- ☐ Cortisol (0)
- ☐ I don't know (0)

End of Block: Menstrual Cycle

Start of Block: Menstruation

Category 2: Menstruation

Menstruation/Period Menstruation is when an individual has a period or a menstrual bleed. This section will ask you questions about menstruation/menstrual bleeding.



Q10 If an individual is menstruating/on their period, how many days of visible bleeding would be considered a **long** menstrual bleed?

- ☐ 1-3 days (0)
 - ☐ 4-6 days (0)
 - ☐ 7+ days (1)
 - ☐ I don't know (0)
-



Q11 What does menstrual fluid contain?

- ☐ Only contains blood (0)
 - ☐ Contains blood and lining of uterus (0)
 - ☐ Contains blood, lining of uterus and vaginal secretions (1)
 - ☐ I don't know (0)
-



Q12 True or false: Leaving a tampon in for too long can increase the risk of a rare bacterial infection called toxic shock syndrome (TSS)?

- ☐ True (1)
- ☐ False (0)
- ☐ I don't know (0)



Q13 Across an entire menstrual bleed/period (in one menstrual cycle), how much blood loss would be considered a **normal** menstrual bleed?

- ☐ less than 15 ml (1 tablespoon) (0)
- ☐ 40-60 ml (3-4 tablespoons, approx. 1/4 cup) (1)
- ☐ more than 80 ml (more than 1/3 cup) (0)
- ☐ more than 300 ml (more than 1 cup) (0)
- ☐ I don't know (0)



Q14 Across an entire menstrual bleed/period (in one menstrual cycle), how much blood loss would be considered a **heavy** menstrual bleed?

- ☐ less than 15 ml (1 tablespoon) (0)
 - ☐ 40-60 ml (3-4 tablespoons, approx. 1/4 cup) (0)
 - ☐ more than 80 ml (more than 1/3 cup) (1)
 - ☐ more than 300 ml (more than 1 cup) (0)
 - ☐ I don't know (0)
-



Q15 If a female has **heavy** menstrual bleeding they are at an increased risk of: **(select all that apply)**

- ☐ Anemia/Iron deficiency (1)
 - ☐ Calcium deficiency (0)
 - ☐ Vitamin B deficiency (0)
 - ☐ Protein deficiency (0)
 - ☐ None of the above (0)
 - ☐ I don't know (0)
-

Q16 What are the common symptoms **during** menstrual bleeding/the period (**not necessarily your own**) that are considered normal for most females? (**select all that apply**)

- ☐ Stomach cramps (1)
- ☐ Increased tiredness/fatigue (2)
- ☐ Nausea/sickness/vomiting (3)
- ☐ Lower back pain (4)
- ☐ Thigh pain (5)
- ☐ Breast pain/tenderness (6)
- ☐ Acne/pimples (7)
- ☐ Other (8) _____
- ☐ I don't know (9)

End of Block: Menstruation

Start of Block: Symptoms

Category 3: Symptoms

Symptoms An individual who menstruates may experience their menstrual cycle or menstrual bleeding differently than someone else. This section will ask you about the symptoms an individual may experience during their menstrual cycle.



Q17 From the list below, which is a natural sign/indicator of ovulation? (**select all that apply**)

- ☐ Uterine cramps (0)
 - ☐ Change in cervical mucous to stretchy and raw egg white consistency (1)
 - ☐ Headaches (0)
 - ☐ Nausea/Diarrhoea (0)
 - ☐ I don't know (0)
-



Q18 During the second half of the menstrual cycle (the luteal phase), what effect does progesterone have on body temperature?

- ☐ Increases body temperature (1)
 - ☐ Nothing, oestrogen is the hormone that affects body temperature (0)
 - ☐ Nothing, body temperature doesn't change during the menstrual cycle (0)
 - ☐ Decreases body temperature (0)
 - ☐ I don't know (0)
-

Q19 What are the most common **premenstrual symptoms (PMS)** (symptoms in the 3-5 days before you start menstrual bleeding), **not necessarily your own** that are considered normal for most females? (**select all that apply**)

- ☐ Mood changes/anxiety/increased irritability (1)
 - ☐ Poor concentration/problems remembering (2)
 - ☐ Dizziness/light headedness (3)
 - ☐ Disrupted sleep (4)
 - ☐ Fatigue/tiredness (5)
 - ☐ Stomach cramps (6)
 - ☐ Breast pain/tenderness (7)
 - ☐ Food cravings (8)
 - ☐ Increased appetite (9)
 - ☐ Bloating/water retention (10)
 - ☐ Temperature changes (11)
 - ☐ Diarrhoea (12)
 - ☐ Constipation (13)
 - ☐ Joint pain and/or muscle pain (14)
 - ☐ Headaches/migraines (15)
 - ☐ Other (please specify) (16)
-

☐

I don't know (17)



Q20 True or false: If someone experiences pain during menstrual bleeding that affects/restricts their daily activities/tasks they should seek help from a medical doctor/GP?

- ☐ True (1)
- ☐ False (0)
- ☐ I don't know (0)



Q21 True or false: It is mostly normal and **not** a concern for a female (**not using** hormonal contraception) to lose their menstrual cycle for **more than** 3 months.

- ☐ True (0)
- ☐ False (1)
- ☐ I don't know (0)

End of Block: Symptoms

Start of Block: Health

Category 4: Health Outcomes

Health Outcomes The hormones oestrogen and progesterone have important roles in the body and overall health of the individual who menstruates. These hormones can even support an individual's recovery, performance, and metabolism.

Low Energy Availability (LEA), Relative Energy Deficiency in Sports (RED-S), and The Female Athlete

Triad are some of the conditions that females may be at risk of. This section will ask you questions about health outcomes from these conditions and/or other life stressors (e.g. work, emotional stress).



Q22 What can cause a period to be late or missed? (**select all that apply**)

- ☐ Stress/anxiety (workload, training, emotional, social, etc) (1)
- ☐ Pregnancy (1)
- ☐ Excessive exercise (1)
- ☐ Excessive weight loss (1)
- ☐ Birth control/contraception/Oral contraceptive pill etc (1)
- ☐ All the above (5)
- ☐ Other (please specify) (0)

- ☐ I don't know (0)



Q23 What effects (**either on their own or combined**) do high stress (e.g., workload, training, emotional, social), restricted food/caloric intake, excessive weight loss, and/or large amounts of training have on female health? (**select all that apply**)

- ☐ Increased menstrual disturbances/hormone imbalances (1)
- ☐ Improved immune function (0)
- ☐ Dehydration (0)
- ☐ Decreased risk of bone stress injuries (0)
- ☐ Decreased immune response (get sick often) (1)
- ☐ Increased gastrointestinal upset (digestive issues) (1)
- ☐ Increased risk of bone stress injuries (1)
- ☐ I don't know (0)
- ☐ None of the above (0)



Q24 If a female is **not** getting enough energy from the total amount of food they are eating, then they may **not** have enough energy for the body to maintain basic functions (e.g., the reproductive

system) and daily activities. What are the effects that this could have on sport, exercise, and physical activity **performance**? (select all that apply)

- ☐ Decreased coordination (1)
- ☐ Increased fatigue and decreased energy (glycogen) stores (1)
- ☐ Improved coordination (0)
- ☐ Increased strength and endurance performance (0)
- ☐ Impaired judgment and concentration (1)
- ☐ Decreased strength and endurance performance (1)
- ☐ Increased motivation (0)
- ☐ Increased coordination (0)
- ☐ None of the above (0)
- ☐ I don't know (0)



Q25 If a female is concerned they have lost their period, how many months (in a row) **without** menstrual bleeding/a period should they wait before getting medical help?

- ☐ 1 month (0)
- ☐ 3 months (1)
- ☐ 6 months (0)
- ☐ 12 months (0)
- ☐ I don't know (0)



Q26 If a female has lost their menstrual cycle, what could they do to help bring back a regular and natural menstrual cycle? **(select all that apply)**

- ☐ Assess changes in life stressors (e.g., workload, training, emotional, social) and seek support for stress management (1)
- ☐ Consume more protein in their diet (0)
- ☐ Seek support from health professionals for their food intake to improve energy balance (1)
- ☐ Stay active and lose weight (0)
- ☐ Start taking supplements (e.g., primrose oil, fish oil, magnesium) to support their menstrual cycle (0)
- ☐ Get a prescription for oral contraceptives to help get a regular menstrual cycle (0)
- ☐ Reduce their amount of physical activity/exercise (1)
- ☐ None of the above (0)
- ☐ I don't know (0)



Q27 What are potential health consequences if a female loses their menstrual cycle for more than 3 months, or has not started menstruating/getting a period by 16 years of age: **(select all that apply)**

- ☐ Increase in bone mineral density (0)
- ☐ Low levels of oestrogen and progesterone (1)
- ☐ More likely to have heavy menstrual bleeding (0)
- ☐ Declines in bone mineral density (1)
- ☐ Increased diagnosis of iron deficiency (1)
- ☐ Increased mood disturbances (e.g., depression, anxiety, etc) (1)
- ☐ Reductions in body weight (1)
- ☐ Improved rest and recovery (0)
- ☐ Increased gastrointestinal upset (e.g., constipation) (1)
- ☐ Decreased immune response (get sick often) (1)
- ☐ Declines in muscle strength (1)
- ☐ Increased resting metabolism (0)
- ☐ I don't know (0)

End of Block: Health

Start of Block: Sources of information

Category 5: Sources of information

Information This section is not testing your knowledge. Instead, there are a few short questions to help us learn where you receive most of your information about the menstrual cycle.

Q28 Where do/did you **receive** most of your menstrual cycle information from? (select all that apply)

☐

Doctor/GP (1)

☐

Parent/caregiver (2)

☐

Sibling (3)

☐

Healthcare professionals (please specify: dietitian, physiotherapist, etc) (4)

☐

Friends (5)

☐

Internet search engine (google, yahoo, etc) (6)

☐

Social media (please specify: Tiktok, Instagram, Facebook, Reddit, etc) (7)

☐

Sex education/health class in school (8)

☐

Health/fitness mobile applications (please specify) (9)

☐

Television shows (please specify) (10)

☐

Blogs (please specify) (11)

☐

Magazines (please specify) (12)

☐

University (13)

☐

Menstrual cycle or health specific education course/resource (please specify) (14)

☐

Artificial intelligence (Chat GPT or similar) (15)

☐

Other (please specify) (16)

Q29 Who or where do you find to be the most **trustworthy** information source/s regarding the menstrual cycle? (select all that apply)

☐

Doctor/GP (1)

☐

Parent/caregiver (2)

☐

Sibling (3)

☐

Healthcare professionals (please specify: dietitian, physiotherapist, etc) (4)

☐

Friends (5)

☐

Internet search engine (google, yahoo, etc) (6)

☐

Social media (please specify: Tiktok, Instagram, Facebook, Reddit, etc) (7)

☐

Sex education/health class in school (8)

☐

Health/fitness mobile applications (please specify) (9)

☐

Television shows (please specify) (10)

☐

Blogs (please specify) (11)

☐

Magazines (please specify) (12)

☐

University (13)

☐

Menstrual cycle or health specific education course/resource (please specify) (14)

☐

Artificial intelligence (Chat GPT or similar) (15)

☐

Other (please specify) (16)

Q30 What areas regarding the menstrual cycle would you like to know more about? (select all that apply)

- ☐ Menstrual cycle tracking (1)
 - ☐ Training and the menstrual cycle (2)
 - ☐ RED-S/Female Athlete Triad, Low Energy Availability (LEA) (3)
 - ☐ How the menstrual cycle may affect mood (4)
 - ☐ What symptoms require medical assistance (5)
 - ☐ Returning to activity postpartum (6)
 - ☐ Pregnancy planning (7)
 - ☐ Menstrual cycle disorders such as PCOS or endometriosis (8)
 - ☐ Hormone replacement therapy (9)
 - ☐ Menopause/peri-menopause (10)
 - ☐ Manipulating periods with contraception (11)
 - ☐ Contraception (12)
 - ☐ The role diet plays in maintaining a normal functioning menstrual cycle (13)
 - ☐ Other (please specify) (14)
-

End of Block: Sources of information

Start of Block: Demographics

Final Block Demographic questions:

Well done for getting this far, you're almost done! You have completed all knowledge sections of the questionnaire, we just have a few questions left. This information will help us understand your background. It will also help us to identify and explain the reason/s for different responses between people.

Q31 Age

Q32 What ethnicity(s) do you associate with? (select all that apply)

☐ New Zealand European (1)

☐ Māori (2)

☐ Samoan (3)

☐ Cook Islands Māori (4)

☐ Tongan (5)

☐ Niuean (6)

☐ Chinese (7)

☐ Indian (8)

☐ Other (please specify) (9)

Q33 What is the highest level of education you have completed?

- ☐ Some secondary/high school (1)
 - ☐ Secondary/high school (2)
 - ☐ Tertiary undergraduate degree (3)
 - ☐ Tertiary postgraduate degree (4)
 - ☐ Other (please specify) (5) _____
-

Q34 At what age did you experience your first menstrual bleed (not spotting but notable menstrual bleeding)?

- ☐ Age (years) (1) _____
 - ☐ I am yet to have my first natural bleed (2)
-

Q35 Do you currently use hormonal contraception?

- ☐ Yes (1)
- ☐ No (2)

Skip To: Q37 If Do you currently use hormonal contraception? = Yes

Q36 Have you used hormonal contraception in the past?

☐ Yes (1)

☐ No (2)

Skip To: Q39 If Have you used hormonal contraception in the past? = No

Q37 What type of hormonal contraception do you and/or have you used? (select all that apply)

☐

Oral contraceptive pill (4)

☐

Hormonal IUD (5)

☐

Implanon/Implant (6)

☐

De Pro/Injection (7)

☐

Other (8) _____

Q38 Up until now, what is the total length (in years) that you have you used **any** type of hormonal contraception?

Q39 What is your main sport or physical activity/exercise?

Q40 Thinking about the last 12 months, approximately how many hours a week do you spend doing this sport/physical activity?

- ☐ less than 3 hours (1)
 - ☐ 3-4 hours (2)
 - ☐ 5-6 hours (3)
 - ☐ 7-8 hours (4)
 - ☐ 9-10 hours (5)
 - ☐ More than 10 hours (6)
-

Q41 During the last 5 years, what is the highest level at which you have participated or competed, for your main sport/physical activity?

- ☐ Local/Regional (1)
 - ☐ National (2)
 - ☐ International - age group (3)
 - ☐ International - open/elite (4)
 - ☐ Other (please specify) (5) _____
-

Q42 How many years have you been participating/competing at the highest level as described above in total?

- ☐ less than 1 year (1)
- ☐ 1-3 years (2)
- ☐ 3-5 years (3)
- ☐ 5-10 years (4)
- ☐ 10 or more years (5)

End of Block: Demographics

Start of Block: End of Survey

End of Survey Well done – you’re all finished! Thank you so much for your participation, we really appreciate you taking the time to complete this questionnaire. Your answers will help us understand current menstrual cycle knowledge and awareness. If you would like to receive updates on this research project and others in the future, then please provide your email address below (this is optional) and/or follow @flowwithdanni on instagram.

If you would like further information on the menstrual cycle then you can read our easy-to-follow guide by downloading this pdf:

[Menstrual cycle health information](#)

End of Block: End of Survey

Appendix B

Knowledge section

Category: Menstrual Cycle

Question	Knowledge explored	Phrasing logic
<u>Length:</u> In your opinion, what is the normal range of menstrual cycle length? • 21-34 days • 27-29 days • 11-21 days • 30-40 days • I don't know	The length of a menstrual cycle is commonly oversimplified to be ~28 days, whereas recent studies are beginning to show the true range, 21-24 days, in which a menstrual cycle can be depending on individual variation (Bull et al., 2019). Any cycle outside this range could potentially be abnormal. This question is testing the participants knowledge of what a normal cycle length is.	This question was initially asked as an open ended question, alongside many others. It was changed to close ended multiple choice to reduce the time it would take people to answer the questionnaire (Aday & Cornelius, 2006). When it came to creating the answer options, the survey creators wanted there to be two options that would seem obviously wrong (30-40 days & 11-21 days). The range 27-29 days was put in there to see if participants are given oversimplified information about the MC.
<u>Ovulation:</u> True or false: Ovulation is when a mature egg is released from the ovary? • True • False • I don't know How many eggs are released in one complete normal/healthy menstrual cycle? • 1 • 2+ • 3+ • 5+ • I don't know	These questions were included to understand participants knowledge of ovulation as those who are preventing or planning pregnancy should be aware of this part of their cycle (Holesh et al., 2017).	A true or false format was used for the ovulation as this seemed like a simple, clear way to ask this question and reduce the time it takes people to answer the survey overall.
<u>Primary organs:</u> What are the primary organs of the female reproductive system? (select all that apply) • Ovaries • Fallopian tubes • Uterus • Cervix	This question was incorporated to understand if participants were aware of basic female physiology/anatomy (Thiyagarajan et al., 2021).	This question was originally phrased as "the female gonads are" to see if people were aware that males weren't the only sex to have gonads. After peer review it was rephrased like this to improve readability.

• Vagina • All the above • I don't know		
<u>Phases:</u> Which is commonly known as first day (day 1) of the menstrual cycle? • Last day of bleeding • First day of bleeding • Day when ovulation occurs • Depends on person • I don't know Within the menstrual cycle, when does ovulation typically occur? • Middle of cycle • Start of cycle • End of cycle • I don't know	There are three main phases of the menstrual cycle: Follicular (which includes the menstrual bleed), Ovulatory and Luteal (Thiyagarajan et al., 2021). To understand how a menstrual cycle is measured, people need to understand what is considered to be the first day. Ovulation is a crucial point of the cycle as it begins the transition to the luteal phase. These questions were included to test participants knowledge of these two factors.	Originally this question was worded to asked participants about the specifics of the phases including the names. After peer review it was noted that it is more important for them to know when the menstrual cycle begins and when ovulation occurs, rather than being asked the definitions of the names of each phase. It was phrased in this order as the answer options flow nicely into the next part of the question. In theory, if they know the answer to the first day of the MC they should also know when ovulation occurs.
<u>Hormones:</u> For approximately two weeks in the lead up to the menstrual bleed/period, the female is in their luteal phase. The high progesterone levels in this phase help to: • Cause ovulation • Prepare inner lining of the uterus (the endometrium) for a possible pregnancy • Shed inner lining of the uterus (the endometrium) for next menstrual bleed/period • Maintain regularity of the menstrual cycle • I don't know In the follicular phase, after the menstrual bleed/period has finished, increasing levels of oestrogen helps the inner lining	Hormones are secreted throughout the menstrual cycle and are responsible for the negative/positive feedback loop that controls the cycle (Thiyagarajan et al., 2021). These three questions test the participants on their knowledge of the main hormones and their role in the functions of the menstrual cycle.	Originally the questionnaire asked participants what hormones were in the MC, however this was more definition based and lacked testing functional knowledge. After a review of these questions and after feedback from other healthcare professionals, the hormone questions were asked in a way that tested the participants on what these hormones actually do in the body when it comes to the menstrual cycle. The luteinizing hormone question was asked in a slightly different way due to the level of difficulty for the demographic.

of the uterus (endometrium) to...? • Grow thicker • Shed causing another menstrual bleed • Grow the placenta • Stop growing • I don't know High amounts of which hormone is needed for ovulation to occur? • Testosterone • Luteinizing hormone • Oestrogen • Progesterone • Cortisol • I don't know		
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Category: Menstruation

Question	Knowledge explored	Phrasing logic
<u>Long menstrual bleed:</u> If an individual is menstruating/on their period, how many days of visible bleeding would be considered a long menstrual bleed? • 1-3 days • 4-6 days • 7+ days • I don't know	Out of 600,000 females the average bleed length during the cycle is 4 ± 1.5 Days, and anything over 7 days is considered long (Bull et al., 2019). It is important for people to be aware of what is considered a normal/abnormal bleed length to know when they may need to see a doctor.	Instead of asking what a normal menstrual bleed length is, the survey creators wanted to test if the participants were aware of what would be considered a long menstrual bleed. Technically, there is a lot of variability for what can constitute a normal bleed length. However, there is a general consensus that agrees anything over 7 days is considered long and is indicative of menorrhagia.
<u>Menstrual fluid:</u> What does menstrual fluid contain? • Only contains blood • Contains blood and lining of uterus • Contains blood, lining of uterus and vaginal secretions • I don't know	This question is relatively straight forward and explores if participants know what menstrual fluid contains at a basic level.	This question was phrased so each answer option built on the first one. This was to avoid confusion and keep the options simple.

<u>Toxic shock syndrome (TSS)</u> True or false: Leaving a tampon in for too long can increase the risk of a rare bacterial infection called toxic shock syndrome (TSS)? • True • False • I don't know	This question was included to assess knowledge levels of sanitary product safety.	A true or false option was used for this question to keep simplicity.
<u>Normal/abnormal blood loss</u> Across an entire menstrual bleed/period (in one menstrual cycle), how much blood loss is considered a normal menstrual bleed? • Less than 15ml (1tbsp) • 40-60ml (3-4 tbsp, approx. ¼ cup) • More than 80ml (more than 1/3 cup) • More than 300ml (more than 1 cup) Across an entire menstrual bleed/period (in one menstrual cycle), how much blood loss is considered a heavy menstrual bleed? • Less than 15ml (1tbsp) • 40-60ml (3-4 tbsp, approx. ¼ cup) • More than 80ml (more than 1/3 cup) • More than 300ml (more than 1 cup)	Heavy menstrual bleeding is defined as losing >80ml of blood during one complete bleed (Karlsson et al., 2014). Amongst females of childbearing age, HMB is the leading indicator for iron deficiency anaemia (Beglinger & Breymann). For females to receive treatment for HMB they need to first understand what defines it. This question tests the participants knowledge surrounding this topic to see if knowledge in this area needs to be improved. Only 6% of females with HMB seek medical help for it, which insinuates knowledge levels around this topic are poor and need more resources aimed towards it (McCormick, 1995).	The original draft version of the survey didn't asked participants what a normal amount of blood loss was and only asked what was considered to be a heavy amount of blood loss. After peer review the survey creators added in the normal amount and made the questions have the same answer options. This tests the participants knowledge of two different whilst giving them the same option.
<u>Heavy menstrual bleed (HMB) risks</u> If a female has heavy menstrual bleeding they are at an increased risk of: (select all that apply) • Anaemia/iron deficiency • Calcium deficiency • Vitamin B deficiency • Protein deficiency • I don't know	Individuals with HMB feel that their quality of life is negatively affected, however the reason for this being has been correlated to anaemia (Liu et al., 2007). The greater amount of blood loss from HMB increases the susceptibility of iron deficiency. Athletes have a high prevalence of HMB (Bruinvels et al., 2016). This question was including to see if active females are aware of the increased risk of iron deficiency from HMB.	This question was phrased to ensure it was obvious to the participants that the survey creators were looking for a deficiency as the answer, rather than broadly asking what it could increase the risk of.

<u>Symptoms</u> What are the common symptoms during menstrual bleeding/the period (not necessarily your own) that are considered normal for most females? (select all that apply) • Stomach cramps • Increased tiredness/fatigue • Nausea/sickness/vomiting • Lower back pain • Thigh pain • Breast pain/tenderness • Acne/pimples • Other (text entry) • I don't know	This question wasn't included in the knowledge score for the survey and was instead a way for the survey developers to gain insight to the attitudes and beliefs of participants when it comes to menstrual symptoms. There is a fine line between symptoms being considered 'normal' and which symptoms raise concerns to visit a GP/doctor.	This question asked participants to list all that apply so the survey creators could gain insight to what beliefs people had about symptoms.
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Category: Symptoms

Question	Knowledge explored	Phrasing logic
<u>Signs/indicators</u> From the list below, which is a natural sign/indicator of ovulation? (select all that apply) • Uterine cramps • Change in cervical mucus to stretchy and raw egg white consistency • Headaches • Nausea/diarrhoea • I don't know During the second half of the menstrual cycle (the luteal phase), what effect does progesterone have on body temperature? • Increase body temperature • Nothing, estrogen is hormone that affects body temperature • Nothing, body temperature doesn't change during the menstrual cycle • Decreases body temperature • I don't know	The composition of cervical mucus changes throughout the menstrual cycle (Han et al., 2017). Prior to ovulation, mucus becomes more fluid, and after ovulation (in the luteal phase) mucus thickens. This question explores how common it may for females to observe and be aware of these changes during their cycle. After ovulation there is an increase in basal body temperature (BBT) of the female (Bull et al., 2019; Israel & Schneller, 1950). This is said to be due to the thermogenic effect of progesterone, which peaks after ovulation. Both these, cervical mucus changes and BBT increases, provide signs of where a female is at in their cycle, which can help them track their cycles more effectively. This question aims to explore how aware of these changes the general population is.	The cervical mucus change question was originally in the Menstrual Cycle category, but was moved to symptoms as it is asking for signs/indicators. The BBT question was originally asked so the participants had to choose which phase of the cycle temperature increases. The phrasing of the question was changed to what it is now to make it more functional and provide further understanding to what the participants understand.
<u>Symptoms</u> What are the most common premenstrual symptoms (PMS) (symptoms in the 3-5 days before you start menstrual bleeding), not necessarily your own that are considered normal for most females? (select all that apply)	Premenstrual syndrome is characterised by physical and behavioural symptoms that appear during the luteal phase of the menstrual cycle and often disappear within the first couple days of menstruation (Kessel, 2000; Ryu & Kim, 2015). A more	This question was originally merged with the symptoms of menstruation question, but they were split into two different questions after feedback from an expert in female health. A range of options were given for this multiple choice question for the

• Mood changes/anxiety/increased irritability • Poor concentration/problems remembering/ • Dizziness/light headedness • Disrupted sleep • Fatigue/Tiredness • Stomach cramps/pain • Breast pain/tenderness • Diarrhoea • Constipation • Food cravings • Increased appetite • Bloating/water retention • Temperature changes • Joint pain and/or muscle pain • Headaches/migraines • Other (please specify) • I don't know	severe case, which affects personal relationships and daily life is known as premenstrual dysphoric disorder (PMDD). The etiology of PMS is still unclear, but could be attributed to increased sensitivity to normal hormonal changes. Symptoms of PMS can be observed on a spectrum, whilst mild cases can be experienced by 90% of females, and cases where daily living is affected can be seen amongst 20% of females. There are a range of symptoms observed in this period before menstruation, only some of which have been included in the options for this question. What would be considered normal for individuals should be decided between them and their healthcare professional. Most of the symptoms listed would be considered normal, however it is dependent on the extremity at which these are experienced. This question wasn't included in the knowledge score, however was another tool for the survey creators to understand what attitudes and beliefs there are about symptoms during this stage of the cycle.	survey creators to gain an in depth understanding of what symptoms participants believe to be normal. Key words were bolded to ensure the participants knew what the question was asking. In particular, ensuring they understood it was about generic symptoms not necessarily their own.
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<u>Dysmenorrhea</u> True or false: If someone experiences pain during menstrual bleeding that affects/restricts their daily activities/tasks they should seek help from a medical doctor/GP?	Primary dysmenorrhea is a type of menstrual pain disorder that limits quality of life. It is often something that can be minimised or ignored by society as the belief that period pain is normal is common amongst many. This question aims to see if the participants answering this survey are aware that if pain limits daily activities then they should see a doctor/GP.	This question was originally phrased as a multiple choice question asking what people should do if they experience pain during their cycle with the options: seek help from a doctor, self-medicate, ignore it, other. It was rephrased to a true or false question to improve clarity.
<u>Amenorrhea</u> True or false: It is mostly normal and not a concern for a female (not using hormonal contraception) to lose their menstrual cycle for more than 3 months.	There are two types of amenorrhea: primary or secondary. Functional hypothalamic amenorrhea is when a female with an otherwise regular cycle loses their menses for three months (Medicine, 2004). This type of amenorrhea is either weight related, stress related and/or exercise related. This disorder has multiple health consequences on females which includes but is not limited to interfering with the skeletal system, cardiovascular system (Meczekalski et al., 2014). This question was included as survey creators wanted to test awareness about the concerns of this disorder.	Certain words in the question were bolded so it was clear what we were asking and didn't pose the potential to be misunderstood. When this question was first asked it was phrased for people to define amenorrhea. After peer review it was discussed that phrasing it like this doesn't capture functional knowledge of the participant. It wasn't necessary for someone to know the definition of amenorrhea, however it's more important they are aware that the loss of menses is a concern.

Category: Health impacts

Question	Knowledge explored	Phrasing logic
<u>Amenorrhea</u> What can cause a period to be late or missed? (tick all that apply) • Stress/anxiety (workload, training, emotional, social, etc) • Pregnancy • Excessive exercise • Excessive weight loss • Birth control/ Contraception/ Oral contraceptive pill etc • All of the above • Other (please specify) • I don't know If a female is concerned that they have lost their period, how many months (in a row) without menstrual bleeding/period should they wait before getting medical help? • 1 month • 3 months • 6 months • 12 months • I don't know	Amenorrhea is defined as the absence of abnormal cessation of menses and can be caused by an array of factors. Pregnancy would be considered as the most obvious cause for a missed period, but the other options may not be as obvious for the participants. Hypothalamic amenorrhea can be caused by severe emotional stress, starvation (either food deprivation or anorexia nervosa), and athletic training, all linked to their roles in energy balance (Stafford, 2005). This question aims to test their knowledge of factors other than pregnancy that can lead to a missed period for either the short term or long term. 3 missed periods in a row, with pregnancy excluded, is a sign that someone should seek medical help as an investigation should take place to see if they may be in an energy deficit (Medicine, 2004). The second question explores the participants knowledge of this, as it is important for females to know when a miss period may be due to something serious.	The question asking how long an individual should wait to seek medical help for a missed period wasn't included in the initial draft questionnaire. It was added to the questionnaire to test participants on their knowledge of how long it takes until a missed period is a concern.
<u>REDS/Female Athlete Triad/Functional HA</u> What effects (either on their own or combined) can high stress (e.g., workload, training, emotional, social), restricted food/caloric intake, losing large amounts of body weight, and/or large amounts of training	This is a general question which covers effects from relative energy deficiency in sport (RED-S), functional HA and the Female Athlete Triad. It aims to test participants on what effects stress, energy imbalances, and large amounts of	This question was phrased to gain a more generalised understanding on what the participants know about the functional effects of certain disorders. In the original draft questionnaire there were questions on the definition of the

have on female health? (select all that apply) • Increased menstrual disturbances/hormone imbalances • Improved immune function • Dehydration • Decreased risk of bony stress injuries • Decreased immune response (get sick often) • Increased gastrointestinal upset • Increased risk of bony stress injuries • None of the above • I don't know	weight loss can have on female health (De Souza et al., 2010; Elliott-Sale et al., 2018; Gordon et al., 2017; Mountjoy et al., 2018).	Female Athlete Triad, RED-S, inadequate energy intake, losing a period due to high training amounts, etc. This question encompasses all of these questions in one.
<u>REDS</u> If a female is not getting enough energy from the total amount of food they are eating, then they may not have enough energy for the body to maintain basic functions (e.g., the reproductive system) and daily activities. What are the effects this could have on sport, exercise, and physical activity <u>performance</u>? (Select all that apply) • Decreased coordination • Increased fatigue and decreased energy (glycogen) stores • Improved coordination • Increased strength and endurance performance • Impaired judgment and concentration • Decreased strength and endurance performance • Increased motivation • Increased coordination • None of the above • I don't know	The RED-S model encompasses 10 potential performance effects of the disorder (Mountjoy et al., 2018). This question aims to understand if the participants are aware of any of these effects. Decreased coordination, increased fatigue & decreased glycogen stores, impaired judgment & coordination and decreased strength & endurance performance are just some of the negative effects RED-S has on physical activity performance.	Initially this question was phrased as a MCQ which asked participants what RED-S is. After peer review it was rephrased to the current question to encompass a more functional level of understanding. It is arguably more important for physically active females to know what performance effects RED-S can have rather than knowing what it is defined as.
<u>Treatment of amenorrhea</u> If a female has lost their menstrual cycle, what could she do to help bring back a regular and natural menstrual cycle (select all that apply)? • Assess changes in life stressors (e.g., workload,	Anyone suffering from HA should seek help from health professionals. There are two main factors which need to be controlled in order to regain a natural cycle: correct the energy	This question was initially phrased as a MCQ which asked "if a female becomes amenorrhoeic, how long will it remain absent for?" and the correct option was "however long the

training, emotional, social) and seek support for stress management • Consume more protein in their diet • Seek support from health professionals for their food intake to improve energy balance • Stay active and lose weight • Start taking supplements (e.g., primrose oil, fish oil, magnesium) to support your menstrual cycle • Get a prescription for oral contraceptives to help get a regular menstrual cycle • Reduce the amount of physical activity/exercise • None of the above • I don't know	imbalance to improve the hypothalamic-pituitary-ovarian (HPO) axis function and receive psychological support for stress management (Gordon et al., 2017). The treatment of HA is crucial for the long-term health of the individual. This question aims to explore the participants awareness levels of how it can be treated. This question also inadvertently tests their knowledge on what could potentially cause HA to occur in the first place. If they are aware that restoring energy balance is needed to treat it, this could also show they are aware that an energy imbalance is what can cause it.	individual remains unsupported for stress management and dietary intake". It was rephrased to the current question as it offers a deeper understanding of the importance of bringing back a cycle. The option "get a prescription for oral contraceptives to help get a regular cycle" was added to a) see if participants think the period on OC is natural and b) see if they know the importance of getting out of an energy deficit to regain a cycle.
<u>Hypothalamic amenorrhea long term health consequences</u> What are the health consequences if a female loses their menstrual cycle for more than 3 months, or has not started menstruating/getting a period by 16 years of age: (select all that apply) • Increase in bone mineral density • Poor muscle recovery • Declines in bone mineral density • Poor lipid/cholesterol levels in a blood test/s • Decreases in cardiovascular (heart and blood vessel) health • Increased diagnosis of iron deficiency • Increased depression and anxiety • Improved in body weight • Increased resting metabolism • I don't know	Estrogen deficiency due to the cessation of the menstrual cycle in premenopausal females can occur due to the suppression of the HPO axis. The longer this is left untreated, the higher the risk of developing long term health consequences. These include heart, bone and psychological impacts (Shufelt et al., 2017). The aim of this question is to test participants on their knowledge of the long term health consequences of losing their cycle. Being aware of health consequences can increase motivation for disorders to be treated. It also provides athletes in particular with the tools to advocate for their own health.	This question was phrased to test functional knowledge of what health impacts can occur in the long term if hypothalamic amenorrhea (HA) is left untreated. This question initially asked participants to define amenorrhea. After peer review, it was discussed that it isn't important for active females to know how to define a medical term, but to be aware of the health consequences. With this in mind the terminology of HA was left out of the question and it was changed to ask participants what health impacts could be observed if a female doesn't have a period.

Sources of information section

Question	Information sources explored	Phrasing justification
Where do/did you receive most of your MC information from? <u>And</u> Who or where do you find to be the most trustworthy information source/s regarding the MC? • Doctor/GP • Parent/caregiver • Sibling • Healthcare professionals (please specify: dietitian, physiotherapist, etc) • Friends • Internet search engine (google, yahoo, etc) • Social media (please specify: Tiktok, Instagram, Facebook, Reddit, etc) • Sex education/health class in school • Health/fitness mobile applications (please specify) • Television shows (please specify) • Blogs (please specify) • Magazines (please specify) • University • Menstrual cycle or health specific education course/resource (please specify) • Artificial intelligence (Chat GPT or similar) • Other (please specify)	The researchers came up with multiple potential sources that active females may receive their MC information from.	These two questions were asked as the researchers wanted to know where information is mainly sourced from and which of these sources is deemed most trustworthy. Previous studies asking similar questions found that the most common sources are not necessarily the most trustworthy (Warzecha et al., 2019). Both questions provided the same options to choose from where participants were able to select multiple answers. An 'other' option was included in case the researchers had missed more specific sources participants may have received information from.
What areas regarding the MC would you like to know more about? • Menstrual cycle tracking • Training and the menstrual cycle • RED-S/Female Athlete Triad, Low Energy Availability (LEA)	This was included as the researchers were curious to know what themes were common among interest areas for active females. No previous studies had asked this question.	This was originally an open ended question, however, researchers changed it to a closed multiple choice question to prompt participants. An 'other' option was provided so they could add in their own interest topic if it had not

• How the menstrual cycle may affect mood • What symptoms require medical assistance • Returning to activity postpartum • Pregnancy planning • Menstrual cycle disorders such as PCOS or endometriosis • Hormone replacement therapy • Menopause/peri-menopause • Manipulating periods with contraception • Contraception • The role diet plays in maintaining a normal functioning menstrual cycle • Other (please specify)		been included in the options provided. Check boxes rather than drop-down lists were used to enable multiple responses (Couper, 2008). This allowed researchers to gauge what the most common interest themes are whilst simultaneously seeing the range of interests.
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- Abraham, C., & Sheeran, P. (2015). The health belief model. *Predicting health behaviour: Research and practice with social cognition models*, 2, 30-55.
- Aday, L. A., & Cornelius, L. J. (2006). *Designing and conducting health surveys: a comprehensive guide*. John Wiley & Sons.
- Agarwal, S. K., Chapron, C., Giudice, L. C., Laufer, M. R., Leyland, N., Missmer, S. A., Singh, S. S., & Taylor, H. S. (2019). Clinical diagnosis of endometriosis: a call to action. *American journal of obstetrics and gynecology*, 220(4), 354. e351-354. e312.
- Allen, K. R., & Goldberg, A. E. (2009). Sexual activity during menstruation: A qualitative study. *Journal of Sex Research*, 46(6), 535-545.
- Armour, M., Dahlen, H. G., & Smith, C. A. (2016). More than needles: the importance of explanations and self-care advice in treating primary dysmenorrhea with acupuncture. *Evidence-Based Complementary and Alternative Medicine*, 2016.
- Armour, M., Ee, C. C., Naidoo, D., Ayati, Z., Chalmers, K. J., Steel, K. A., de Manincor, M. J., & Delshad, E. (2019). Exercise for dysmenorrhoea. *Cochrane Database of Systematic Reviews*(9).
- Armour, M., Ferfolja, T., Curry, C., Hyman, M. S., Parry, K., Chalmers, K. J., Smith, C. A., MacMillan, F., & Holmes, K. (2020). The prevalence and educational impact of pelvic and menstrual pain in Australia: A national online survey of 4202 young women aged 13-25 years. *Journal of pediatric and adolescent gynecology*, 33(5), 511-518.
- Armour, M., Hyman, M. S., Al-Dabbas, M., Parry, K., Ferfolja, T., Curry, C., MacMillan, F., Smith, C. A., & Holmes, K. (2021). Menstrual health literacy and management strategies in young women in Australia: a National Online Survey of young women aged 13-25 Years. *Journal of pediatric and adolescent gynecology*, 34(2), 135-143.
- Armour, M., Parry, K., Manohar, N., Holmes, K., Ferfolja, T., Curry, C., MacMillan, F., & Smith, C. A. (2019). The prevalence and academic impact of dysmenorrhea in 21,573 young women: a systematic review and meta-analysis. *Journal of women's health*, 28(8), 1161-1171.

- Armour, M., Parry, K. A., Steel, K., & Smith, C. A. (2020). Australian female athlete perceptions of the challenges associated with training and competing when menstrual symptoms are present. *International Journal of Sports Science & Coaching*, 15(3), 316-323.
- Armour, M., Sinclair, J., Ng, C. H., Hyman, M. S., Lawson, K., Smith, C. A., & Abbott, J. (2020). Endometriosis and chronic pelvic pain have similar impact on women, but time to diagnosis is decreasing: an Australian survey. *Scientific reports*, 10(1), 1-9.
- Ayoola, A. B., Zandee, G. L., & Adams, Y. J. (2016). Women's knowledge of ovulation, the menstrual cycle, and its associated reproductive changes. *Birth*, 43(3), 255-262.
- Azurah, A. G. N., Sancı, L., Moore, E., & Grover, S. (2013). The quality of life of adolescents with menstrual problems. *Journal of pediatric and adolescent gynecology*, 26(2), 102-108.
- Baatard, G. (2012). A technical guide to effective and accessible web surveys.
- Balık, G., Üstüner, I., Kağıtçı, M., & Şahin, F. K. (2014). Is there a relationship between mood disorders and dysmenorrhea? *Journal of pediatric and adolescent gynecology*, 27(6), 371-374.
- Banikarim, C., Chacko, M. R., & Kelder, S. H. (2000). Prevalence and impact of dysmenorrhea on Hispanic female adolescents. *Archives of pediatrics & adolescent medicine*, 154(12), 1226-1229.
- Barrack, M. T., Gibbs, J. C., De Souza, M. J., Williams, N. I., Nichols, J. F., Rauh, M. J., & Nattiv, A. (2014). Higher incidence of bone stress injuries with increasing female athlete triad-related risk factors: a prospective multisite study of exercising girls and women. *The American journal of sports medicine*, 42(4), 949-958.
- Barrington, D. J., Robinson, H. J., Wilson, E., & Hennegan, J. (2021). Experiences of menstruation in high income countries: a systematic review, qualitative evidence synthesis and comparison to low-and middle-income countries. *PloS one*, 16(7), e0255001.
- Beglinger, C., & Breymann, C. Treatment of iron deficiency. 2010. In.
- Brown, N., Knight, C. J., & Forrest, L. J. (2021). Elite female athletes' experiences and perceptions of the menstrual cycle on training and sport performance. *Scandinavian Journal of Medicine & Science in Sports*, 31(1), 52-69.
- Bruinvels, G., Burden, R., Brown, N., Richards, T., & Pedlar, C. (2016). The prevalence and impact of heavy menstrual bleeding (menorrhagia) in elite and non-elite athletes. *PloS one*, 11(2), e0149881.
- Bull, J. R., Rowland, S. P., Scherwitzl, E. B., Scherwitzl, R., Danielsson, K. G., & Harper, J. (2019). Real-world menstrual cycle characteristics of more than 600,000 menstrual cycles. *NPJ digital medicine*, 2(1), 83.
- Chandra-Mouli, V., & Patel, S. V. (2020). Mapping the knowledge and understanding of menarche, menstrual hygiene and menstrual health among adolescent girls in low-and middle-income countries. *The Palgrave handbook of critical menstruation studies*, 609-636.
- Chen, C. X., Groves, D., Miller, W. R., & Carpenter, J. S. (2018). Big data and dysmenorrhea: what questions do women and men ask about menstrual pain? *Journal of women's health*, 27(10), 1233-1241.
- Chen, C. X., Kwekkeboom, K. L., & Ward, S. E. (2016). Beliefs about dysmenorrhea and their relationship to self-management. *Research in nursing & health*, 39(4), 263-276.
- Clarke, A., Govus, A., & Donaldson, A. (2021). What male coaches want to know about the menstrual cycle in women's team sports: Performance, health, and communication. *International Journal of Sports Science & Coaching*, 16(3), 544-553.
- Couper, M. P. (2008). *Designing effective Web surveys*. Cambridge University Press.
- Daniels, S. E., Paredes-Díaz, A., An, R., Centofanti, R., & Tajaddini, A. (2019). Significant, long-lasting pain relief in primary dysmenorrhea with low-dose naproxen sodium compared with acetaminophen: a double-blind, randomized, single-dose, crossover study. *Current Medical Research and Opinion*, 35(12), 2139-2147.

- Dave, S. C., & Fisher, M. (2022). Relative energy deficiency in sport (RED-S). *Current Problems in Pediatric and Adolescent Health Care*, 101242.
- De Souza, M. J., Miller, B., Loucks, A., Luciano, A., Pescatello, L., Campbell, C., & Lasley, B. (1998). High frequency of luteal phase deficiency and anovulation in recreational women runners: blunted elevation in follicle-stimulating hormone observed during luteal-follicular transition. *The Journal of Clinical Endocrinology & Metabolism*, 83(12), 4220-4232.
- De Souza, M. J., Toombs, R., Scheid, J., O'Donnell, E., West, S. L., & Williams, N. I. (2010). High prevalence of subtle and severe menstrual disturbances in exercising women: confirmation using daily hormone measures. *Human reproduction*, 25(2), 491-503.
- De Villiers, M. R., De Villiers, P. J., & Kent, A. P. (2005). The Delphi technique in health sciences education research. *Medical teacher*, 27(7), 639-643.
- DeMaria, A. L., Delay, C., Sundstrom, B., Wakefield, A. L., Naoum, Z., Ramos-Ortiz, J., Meier, S., & Brig, K. (2020). "My mama told me it would happen": menarche and menstruation experiences across generations. *Women & Health*, 60(1), 87-98.
- Diorio, J. A., & Munro, J. A. (2000). Doing harm in the name of protection: Menstruation as a topic for sex education. *Gender and Education*, 12(3), 347-365.
- Dipti, S., & Chandra, K. (2011). Awareness and health seeking behaviour of adolescent school girls on menstrual and reproductive health problems. *Asian Journal of Home Science*, 6(2), 150-153.
- Elliott-Sale, K. J., Tenforde, A. S., Parziale, A. L., Holtzman, B., & Ackerman, K. E. (2018). Endocrine effects of relative energy deficiency in sport. *International journal of sport nutrition and exercise metabolism*, 28(4), 335-349.
- Findlay, R. J., Macrae, E. H., Whyte, I. Y., Easton, C., & Forrest, L. J. (2020). How the menstrual cycle and menstruation affect sporting performance: experiences and perceptions of elite female rugby players. *British journal of sports medicine*, 54(18), 1108-1113.
- Fitzpatrick, K., & Burrows, L. (2017). Critical health education in aotearoa New Zealand. *Sport, Education and Society*, 22(5), 552-568.
- Garside, R., Britten, N., & Stein, K. (2008). The experience of heavy menstrual bleeding: a systematic review and meta-ethnography of qualitative studies. *Journal of advanced nursing*, 63(6), 550-562.
- Gillbanks, L., Mountjoy, M., & Filbay, S. R. (2022). Insufficient knowledge and inappropriate physiotherapy management of Relative Energy Deficiency in Sport (RED-S) in lightweight rowers. *Physical Therapy in Sport*, 54, 8-15.
- Gordon, C. M., Ackerman, K. E., Berga, S. L., Kaplan, J. R., Mastorakos, G., Misra, M., Murad, M. H., Santoro, N. F., & Warren, M. P. (2017). Functional hypothalamic amenorrhea: an endocrine society clinical practice guideline. *The Journal of Clinical Endocrinology & Metabolism*, 102(5), 1413-1439.
- Greene, R., Stratton, P., Cleary, S. D., Ballweg, M. L., & Sinaii, N. (2009). Diagnostic experience among 4,334 women reporting surgically diagnosed endometriosis. *Fertility and sterility*, 91(1), 32-39.
- Group, E. C. W. (2014). Simultaneous prevention of unintended pregnancy and STIs: a challenging compromise. *Human reproduction update*, 20(6), 952-963.
- Hamdanieh, M., Ftouni, L., Al Jardali, B., Ftouni, R., Rawas, C., Ghotmi, M., El Zein, M. H., Ghazi, S., & Malas, S. (2021). Assessment of sexual and reproductive health knowledge and awareness among single unmarried women living in Lebanon: a cross-sectional study. *Reproductive Health*, 18(1), 1-12.
- Han, L., Taub, R., & Jensen, J. T. (2017). Cervical mucus and contraception: what we know and what we don't. *Contraception*, 96(5), 310-321.
- Harmanli, O., Ilarslan, I., Kirupanathan, S., Knee, A., & Harmanli, A. (2014). Women's perceptions about female reproductive system: a survey from an academic obstetrics and gynecology practice. *Archives of Gynecology and Obstetrics*, 289(6), 1219-1223.

- Hennegan, J., Winkler, I. T., Bobel, C., Keiser, D., Hampton, J., Larsson, G., Chandra-Mouli, V., Plesons, M., & Mahon, T. (2021). Menstrual health: a definition for policy, practice, and research. *Sexual and Reproductive Health Matters*, 29(1), 31-38.
- Holesh, J. E., Bass, A. N., & Lord, M. (2017). Physiology, ovulation.
- Höök, M., Bergström, M., Sæther, S. A., & McGawley, K. (2021). "Do Elite Sport First, Get Your Period Back Later." Are Barriers to Communication Hindering Female Athletes? *International Journal of Environmental Research and Public Health*, 18(22), 12075.
- Israel, S. L., & Schneller, O. (1950). The thermogenic property of progesterone. *Obstetrical & gynecological survey*, 5(4), 532-533.
- Johnston-Robledo, I., Sheffield, K., Voigt, J., & Wilcox-Constantine, J. (2007). Reproductive shame: Self-objectification and young women's attitudes toward their reproductive functioning. *Women & Health*, 46(1), 25-39.
- Jowett, S., & Poczwadowski, A. (2007). Understanding the coach-athlete relationship.
- Karlsson, T. S., Marions, L. B., & Edlund, M. G. (2014). Heavy menstrual bleeding significantly affects quality of life. *Acta obstetrica et gynecologica Scandinavica*, 93(1), 52-57.
- Kessel, B. (2000). Premenstrual syndrome: Advances in diagnosis and treatment. *Obstetrics and gynecology clinics of North America*, 27(3), 625-639.
- Kilfoyle, K. A., Vitko, M., O'Connor, R., & Bailey, S. C. (2016). Health literacy and women's reproductive health: a systematic review. *Journal of women's health*, 25(12), 1237-1255.
- Koltun, K. J., Strock, N. C., Southmayd, E. A., Oneglia, A. P., Williams, N. I., & De Souza, M. J. (2019). Comparison of Female Athlete Triad Coalition and RED-S risk assessment tools. *Journal of Sports Sciences*, 37(21), 2433-2442.
- Larsen, B., Morris, K., Quinn, K., Osborne, M., & Minahan, C. (2020). Practice does not make perfect: A brief view of athletes' knowledge on the menstrual cycle and oral contraceptives. *Journal of Science and Medicine in Sport*, 23(8), 690-694.
- Liu, Z., Doan, Q. V., Blumenthal, P., & Dubois, R. W. (2007). A systematic review evaluating health-related quality of life, work impairment, and health-care costs and utilization in abnormal uterine bleeding. *Value in health*, 10(3), 183-194.
- Lodge, M. T., Ackerman, K. E., & Garay, J. (2022). Knowledge of the Female Athlete Triad and Relative Energy Deficiency in Sport Among Female Cross-Country Athletes and Support Staff. *Journal of Athletic Training*, 57(4), 385-392.
- Marjoribanks, J., Ayeleke, R. O., Farquhar, C., Proctor, M., Gynaecology, C., & Group, F. (1996). Nonsteroidal anti-inflammatory drugs for dysmenorrhoea. *Cochrane Database of Systematic Reviews*, 2015(7).
- Marván, M. L., Ramírez-Esparza, D., Cortés-Iniestra, S., & Chrisler, J. C. (2006). Development of a new scale to measure beliefs about and attitudes toward menstruation (BATM): Data from Mexico and the United States. *Health Care for Women International*, 27(5), 453-473.
- Marván, M. L., Vázquez-Toboadá, R., & Chrisler, J. C. (2014). Ambivalent sexism, attitudes towards menstruation and menstrual cycle-related symptoms. *International Journal of Psychology*, 49(4), 280-287.
- McCormick, A. (1995). Morbidity statistics from general practice. Fourth national study 1991-1992. *Office of population censuses and surveys*.
- McGawley, K., Sargent, D., Noordhof, D., Badenhorst, C., Julian, R., & Govus, A. D. (2023). Improving menstrual health literacy in sport. *Journal of Science and Medicine in Sport*.
- Meczekalski, B., Katulski, K., Czyzyk, A., Podfigurna-Stopa, A., & Maciejewska-Jeske, M. (2014). Functional hypothalamic amenorrhea and its influence on women's health. *Journal of endocrinological investigation*, 37(11), 1049-1056.
- Medicine, P. C. o. t. A. S. f. R. (2004). Current evaluation of amenorrhea. *Fertility and sterility*, 82, 33-39.
- Mikhael, S., Punjala-Patel, A., & Gavrilova-Jordan, L. (2019). Hypothalamic-pituitary-ovarian axis disorders impacting female fertility. *Biomedicine*, 7(1), 5.

- Morassutto, C., Monasta, L., Ricci, G., Barbone, F., & Ronfani, L. (2016). Incidence and estimated prevalence of endometriosis and adenomyosis in Northeast Italy: a data linkage study. *PloS one*, 11(4), e0154227.
- Mountjoy, M., Ackerman, K. E., Bailey, D. M., Burke, L. M., Constantini, N., Hackney, A. C., Heikura, I. A., Melin, A., Pensgaard, A. M., & Stellingwerff, T. (2023). 2023 International Olympic Committee's (IOC) consensus statement on Relative Energy Deficiency in Sport (REDs). *British journal of sports medicine*, 57(17), 1073-1097.
- Mountjoy, M., Sundgot-Borgen, J., Burke, L., Ackerman, K. E., Blauwet, C., Constantini, N., Lebrun, C., Lundy, B., Melin, A., & Meyer, N. (2018). International Olympic Committee (IOC) consensus statement on relative energy deficiency in sport (RED-S): 2018 update. *International journal of sport nutrition and exercise metabolism*, 28(4), 316-331.
- Nunes, R. A. (2019). Women athletes in the Olympic Games. *Journal of Human Sport and Exercise*, 14(3), 674-683.
- Nutbeam, D., & Lloyd, J. E. (2021). Understanding and responding to health literacy as a social determinant of health. *Annu Rev Public Health*, 42(1), 159-173.
- Paasche-Orlow, M. K., & Wolf, M. S. (2007). The causal pathways linking health literacy to health outcomes. *American journal of health behavior*, 31(1), S19-S26.
- Roberts, T.-A. (2004). Female trouble: The menstrual self-evaluation scale and women's self-objectification. *Psychology of Women Quarterly*, 28(1), 22-26.
- Roberts, T.-A., Goldenberg, J. L., Power, C., & Pyszczyński, T. (2002). "Feminine protection": The effects of menstruation on attitudes towards women. *Psychology of Women Quarterly*, 26(2), 131-139.
- Ryu, A., & Kim, T.-H. (2015). Premenstrual syndrome: A mini review. *Maturitas*, 82(4), 436-440.
- Shufelt, C. L., Torbati, T., & Dutra, E. (2017). Hypothalamic amenorrhea and the long-term health consequences. *Seminars in reproductive medicine*.
- Singh, M. M., Devi, R., & Gupta, S. (1999). Awareness and health seeking behaviour of rural adolescent school girls on menstrual and reproductive health problems. *Indian Journal of Medical Sciences*, 53(10), 439-443.
- Solli, G. S., Sandbakk, S. B., Noordhof, D. A., Ihalainen, J. K., & Sandbakk, Ø. (2020). Changes in self-reported physical fitness, performance, and side effects across the phases of the menstrual cycle among competitive endurance athletes. *International journal of sports physiology and performance*, 15(9), 1324-1333.
- Spadaro, G., d'Elia, S. R., & Mosso, C. O. (2018). Menstrual knowledge and taboo TV commercials: Effects on self-objectification among Italian and Swedish women. *Sex roles*, 78(9), 685-696.
- Stafford, D. E. (2005). Altered hypothalamic-pituitary-ovarian axis function in young female athletes: implications and recommendations for management. *Treatments in Endocrinology*, 4, 147-154.
- Subasinghe, A. K., Hapoo, L., Jayasinghe, Y. L., Garland, S. M., & Wark, J. D. (2016). Prevalence and severity of dysmenorrhoea, and management options reported by young Australian women. *Australian family physician*, 45(11), 829-834.
- Sykes, S., & Wills, J. (2018). Challenges and opportunities in building critical health literacy. *Global health promotion*, 25(4), 48-56.
- Thiyagarajan, D. K., Basit, H., & Jeanmonod, R. (2021). Physiology, menstrual cycle. In *StatPearls [Internet]*. StatPearls Publishing.
- Tiggemann, M. (2011). Mental health risks of self-objectification: A review of the empirical evidence for disordered eating, depressed mood, and sexual dysfunction.
- Torstveit, M. K., & Sundgot-Borgen, J. (2005). The female athlete triad: are elite athletes at increased risk? *Medicine & Science in Sports & Exercise*, 37(2), 184-193.
- Volck, W., Ventress, Z. A., Herbenick, D., Hillard, P. J. A., & Huppert, J. S. (2013). Gynecologic knowledge is low in college men and women. *Journal of pediatric and adolescent gynecology*, 26(3), 161-166.

- von Rosen, P., Ekenros, L., Solli, G. S., Sandbakk, Ø., Holmberg, H.-C., Hirschberg, A. L., & Fridén, C. (2022). Offered support and knowledge about the menstrual cycle in the athletic community: a cross-sectional study of 1086 female athletes. *International Journal of Environmental Research and Public Health*, 19(19), 11932.
- Wang, X., Shi, J., & Kong, H. (2021). Online health information seeking: a review and meta-analysis. *Health Communication*, 36(10), 1163-1175.
- Warzecha, D., Szymusik, I., Pietrzak, B., Kosinska-Kaczynska, K., Sierdzinski, J., Sochacki-Wojcicka, N., & Wielgos, M. (2019). Sex education in Poland—a cross-sectional study evaluating over twenty thousand polish women's knowledge of reproductive health issues and contraceptive methods. *BMC public health*, 19(1), 1-8.
- White, L. R. (2013). The function of ethnicity, income level, and menstrual taboos in postmenarcheal adolescents' understanding of menarche and menstruation. *Sex roles*, 68(1), 65-76.
- Winkler, I. T. (2020). Introduction: menstruation as fundamental. *The Palgrave handbook of critical menstruation studies*, 9-13.
- Wong, L. P. (2011). Attitudes towards dysmenorrhoea, impact and treatment seeking among adolescent girls: A rural school-based survey. *Australian Journal of Rural Health*, 19(4), 218-223.
- Wong, W. C., Li, M. K., Chan, W. Y. V., Choi, Y. Y., Fong, C. H. S., Lam, K. W. K., Sham, W. C., So, P. P., Wong, K., & Yeung, K. H. (2013). A cross-sectional study of the beliefs and attitudes towards menstruation of Chinese undergraduate males and females in Hong Kong. *Journal of Clinical Nursing*, 22(23-24), 3320-3327.
- Wood, J. M., Koch, P. B., & Mansfield, P. K. (2007). Is my period normal? How college-aged women determine the normality or abnormality of their menstrual cycles. *Women & Health*, 46(1), 41-56.

Appendix C

Survey changes:

Thursday 19th January:

First questionnaire draft completed and sent for review by medical experts.

February 2023:

Category: *Demographics*:

Pre-screening Q was changed from 'do you have endometriosis or PCOS? Y/N' to offer a broader range of gynaecological conditions and a 'select all that apply' option.

Added: An International Physical Activity Questionnaire to get a good understanding of how active the individual is.

Category: *Menstrual cycle*

Changed: Question asking about typical duration of a complete menstrual cycle to a fill in the blanks rather than open ended question. Decided open ended questions would increase survey difficulty and length so reworded as many of these as possible.

Changed: Questions asking about signs of ovulation, what oestrogen and progesterone are responsible for, what the endometrium is and the role of luteinizing hormone to multiple choice questions instead of open-ended questions. Same reason as above.

Added: 'The female gonads are:' Researchers were curious to know the answer for this.

Added: 'A females menstrual cycle that is longer than 35 days is...'.

Removed: What are the 4 phases of the menstrual cycle (fill in the graph)

Removed: Reproductive questions (where fertilization is likely to occur, it is possible to conceive on your period, true or false – an egg can live for one day however a sperm can live for 5-7 days). These questions were asking about reproduction more than the menstrual cycle itself so decided they weren't needed in the questionnaire.

Category: *Menstruation*

Changed: Wording of a question asking about the typical duration for menstrual blood flow to what duration would be considered long.

Changed: MCQ options for a question asking what menstrual fluid contains. Similar options but made it more concise.

Added: Heavy menstrual bleeding is defined as: with MCQ answers offered. Heavy menstrual bleeding can cause increased iron losses which can increase risk of iron deficiency.

Removed: Menstrual hygiene questions such as duration of tampon and pad wearing. Decided these weren't relevant.

Category: *Symptoms*

Changed: Wording of period pain question so it is asking what someone should do if they experience severe pain on their cycle. The way it was worded in the draft questionnaire was leading.

Changed: Question asking about common symptoms of menstruation. The amount of options offered for MCQ was increased.

Changed: Questions asking about how a female may feel during different phases of their cycle. Changed the wording of the question and the options provided.

Removed: A question asking which symptoms are abnormal and kept the symptoms that are normal. Didn't think this question was necessary as it is technically repeating the question above.

Removed: Question asking about what symptoms may occur due to the changing hormone levels during the menstrual cycle. Very individualised and no evidence to support this.

Removed: What is a pap smear question. Not relevant.

Category: *Training/exercise*

Changed: Question asking about the definition of amenorrhea to a MCQ instead of a open ended answer. This was to decrease the level of difficulty.

Changed: Question asking for health consequences from an open-ended question asking them to 'name as many as they can' to a 'select all that apply' option.

Removed: Open ended question asking what would happen if a female overtrained in their given sport or exercise. Wasn't too broad.

Removed: What is the main cause of RED-S. Decided there are too many factors which can play into this rather than one specific answer.

Category: *Source of information*

Added: "What areas regarding the menstrual cycle would you like to know more about?"

Wednesday 12th April:

Questionnaire was sent off for peer review by demographic being questioned. Feedback from 10 people was collated and the following changes were made to the questionnaire. The consensus was the questionnaires' difficulty was too high, particularly the section about the menstrual cycle. Most changes made were to help decrease the level of difficulty so it gives people a better chance of doing well.

Category: *The Menstrual Cycle*

Added explanations: Explanation about how the menstrual cycle is split into 4 different phases and the definition for hormones. The questions asking about hormones and phases may be quite difficult for someone who hasn't studied science at tertiary level of education.

Added: When does ovulation typically occur (MCQ) in the section about phases.

Changed: Multiple choice answers for what the main female reproductive hormones are. The first options included all the female reproductive hormones but we changed this so it included oestrogen and progesterone (the correct answers) and then included other hormones that aren't included in female reproduction.

Removed: The role/effect of hormones (estrogen, progesterone, and luteinizing hormone). These questions were particularly difficult and wouldn't provide a fair overview of public knowledge.

Removed: Question asking about an oligomenorrheic cycle.

Removed: The fill in the blanks option for length/duration of a natural menstrual cycle and kept it as an open-ended question instead.

Category: *Menstruation*

Added: 'Normal menstrual bleeding is defined as' as well as the heavy menstrual bleeding.

Category: *Symptoms*

Moved: Natural sign and symptoms question moved from the Menstrual Cycle category to this category.

Changed: The wording for the common symptoms of menstruation to ensure participants know it's not asking about their own menstruation – this wasn't clear to some readers.

Changed: The wording for the side effects of low estrogen and progesterone question and added in definition for osteoporosis.

Changed: The wording for symptoms of low estrogen and progesterone to focus on the phases instead of the hormones. This will make it easier for the reader to understand what is being asked.

Changed: Question asking about severe pain was noted multiple times in the feedback. One response mentioned adding in a 'self-medicating' option. Still unsure on wording of this question and flagged it to bring up with supervisors.

Category: *Training/exercise*

Changed: RED-S & the Female Athlete Triad questions to MCQ rather than open-ended questions. This simplifies the survey and will give a better idea about knowledge surrounding these two areas.

Changed: Split the true or false question asking whether it is concerning/normal for a female to lose their period into two different questions.

Added: 3 more true or false questions – different phases and impact on training, calories and exercise, myth about the Female Athlete Triad. Feedback suggested including more questions in this section as the main demographic being tested is physically active females.

Removed: The word ‘menopause’ in the question asking how long a menstrual cycle may remain absent for. Feedback stated the use of that word made the question confusing.

Category: *Source of Information*

Bolded key words “receive” and “trustworthy” as questions were similar and wanted to lessen confusion.

Thursday 27th April:

Final session with supervisors to go over changes made from peer review feedback.

Category: *Demographics*

Moved: This entire section to the end (after the questionnaire has been completed) to encourage participants to complete questionnaire and not be put off by the large demographic section.

Removed: The validated International Physical Activity Questionnaire (IPAQ). Feedback stated it was too in depth and didn’t need to compare physical activity levels to other studies as this isn’t the focus of this study.

Changed: Added in options for hours spent doing physical activity per week

Changed: Wording of the education question so it doesn’t imply their level of education is low

Changed: At what age did they experience first menstrual bleed question to allow for text entry or option of not experiencing it yet

Category: *The Menstrual Cycle*

Changed: Wording of the explanation of the menstrual cycle to mention 2 phases instead of 4

Changed: Wording of day 1 of the menstrual cycle and ovulation to make it clearer for the reader.

Category: *Menstruation*

Changed: Wording for heavy and normal menstrual bleed questions so it is clear it’s asking about total blood loss in one cycle only.

Category: *Symptoms*

Removed: Question regarding side effects of low estrogen and progesterone. Wasn’t relevant.

Removed: Question asking about symptoms of the phases (follicular and luteal) of the menstrual cycle due to a lack of evidence and cycle individuality surrounding this.

Changed: Severe pain question to a true or false instead of MCQ.

Category: *Training/Exercise*

Changed: Merged two true or false question regarding the loss of a period and if this is concerning. Also moved to symptoms section.

Removed: Three true or false questions due to a lack of evidence. These asked about the different phases, low energy availability and female athlete triad.

Tuesday 9th May:

After feedback from High Performance Sport New Zealand, the following changes were made to the questionnaire.

Category: *The Menstrual Cycle*

Changed: Wording of the explanation of the menstrual cycle phases. Joined the hormone explanation to the end of this explanation.

Changed: The answer options for the typical duration of one menstrual cycle from open ended to MCQ.

Changed: Female gonads question to ask what the primary reproductive organs of the female reproductive system are in a MCQ format.

Changed: Two questions which asked the participants to name the menstrual cycle phases to asking about functional changes that occur during these phases instead. The questions now ask about what happens to the endometrium during the follicular phase and

Changed: Two main female hormones in reproduction to what hormone is needed for ovulation to occur.

Category: *Menstruation*

Changed: Heavy and normal menstrual bleed definitions in the amount of blood lost and changed the order in which they're asked.

Category: *Symptoms*

Changed: Resting body temp question to ask what effect progesterone has on body temperature.

Changed: Wording of pain question

Category: *Training/exercise*

Changed: RED-S from asking the definition to asking what performance consequences can happen if an athlete has RED-S.

Changed: Female athlete triad question to asking about stress

Added: Question asking about reversing amenorrhea

Removed: Question asking for the definition of Amenorrhea. Replaced it with a question asking about health risk of heavy menstrual bleeding.

Removed: Question asking how long a period would be absent for if someone had functional hypothalamic amenorrhea. Replaced it with a question asking how many missed periods in a row should a female wait until they get medical help.

Category: *Demographics*

Changed: Type of contraception to multi choice answers

Added: Further questions to clarify the use of hormonal contraception

Tuesday 9th May:

More feedback from high performance sport New Zealand.

Category: *Symptoms*

Added: work, emotional and social next to 'stress'

Category: *Training and exercise*

Changed: wording of the RED-S question to be more general and not just related to exercise

Changed: wording of question asking about effects stress, restricted intake, etc can have on female health to ensure it infers it could be one or multiple factors.

Thursday 18th May:

Feedback from supervisors for finalising survey.

General changes: Simplified wording of questions. Also changed the wording around for the statements.

Category: *Menstruation*

Changed: Wording of normal and heavy menstrual bleeding options/order.

Tuesday 23rd May:

Feedback from high performance sport New Zealand.

Category: *The Menstrual Cycle*

Moved: Explanation to the beginning of the section

Changed: Progesterone question wording and the answer options.

Category: *Menstruation*

Added: An explanation for this section.

Category: *Symptoms*

Changed: Moved menstruation symptoms question to the menstruation section and then added a PMS symptoms question in this section.

Added: An explanation for this section

Category: *Training/Exercise* → *renamed Health outcomes*

Added: An explanation for this section