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Enhancing Men's Awareness of Testicular Disorders (E-MAT) Using a Virtual Reality Intervention: A Pre-Post Pilot Study

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ABSTRACT

Background: The incidence of benign and malignant testicular disorders in on the rise. Three literature reviews and one qualitative study found that men's awareness of testicular disorders was lacking and their intentions to seek help for symptoms of testicular disease were low.

Objectives: To enhance men's awareness of testicular disorders, help seeking intentions for testicular symptoms, and intention and behavior to feel their testes.

Method: Men aged 18 to 50 years were recruited from a university and asked to engage with a 3-level educational virtual reality experience. The Medical Research Council framework guided the development and pilot testing of the intervention. Knowledge, awareness, perceived risk, implementation intentions, help seeking intentions, and behaviors were measured at pre-test (T0), immediately post-test (T1), and one month post-test (T2).

Results: Data were available from 49 participants. In comparison to T0, a significant increase in knowledge (mean difference (MD)=3.5; 95% CI 2.8 to 4.26); testicular awareness (MD=0.2; 95% CI 0.01 to 0.41); implementation intentions (MD=0.6; 95% CI 0.33 to 0.90); and help seeking intentions for testicular swelling (MD=0.3; 95% CI 0.12 to 0.51), lumpiness (MD=0.3; 95% CI 0.08 to 0.46), and pain (MD=0.6; 95% CI 0.25 to 1.01) was noted at T1. This increase was maintained at T2. Participants who expressed an intention to feel their testes at T0, were more likely to report performing this behavior at T2.

Discussion: The intervention succeeded in promoting knowledge, testicular awareness, implementation intentions, help seeking intentions, and behaviors. Therefore, a randomized controlled trial of the E-MAT intervention with a larger sample size is warranted.

Keywords: Awareness; health promotion; testicular cancer; testicular disorders; pilot study; virtual reality.

Testicular cancer (TC) is the most common solid tumor among men aged less than 50 (National Cancer Institute, 2017). The global incidence of TC doubled over the past 40 years and is expected to increase by 25% by the year 2025 (Le Cornet et al., 2014; Shanmugalingam, Soultati, Chowdhury, Rudman, & Van Hemelrijck, 2013). As for benign testicular disorders, 1 in 4,000 males aged less than 25 years are diagnosed with testicular torsion in the United States every year (Ringdahl & Teague, 2006). This disease causes severe scrotal pain and can lead to testicular necrosis if not treated within the first six hours from the onset of pain (Bayne, Villanueva , Davis, Pohl, & Rushton, 2017). Moreover, epididymitis and orchitis, often sexually transmitted, make up 1 in every 144 outpatient visits among men younger than 50 and can cause infertility and sepsis if left untreated (Trojian, Lishnak, & Heiman, 2009).

Two reviews of the literature on men's awareness of testicular disorders found that men lacked awareness of TC and testicular torsion and very few reported performing testicular self-examination (Saab, Landers, & Hegarty, 2016a, 2016c). Moreover, a qualitative study found that men's (n=29) awareness of testicular disorders was lacking and their help seeking intentions for testicular pain, swelling, and lumpiness were low (Saab et al., 2017a). These findings were attributed to the cost of healthcare, masculine social constructs, emotional factors (e.g. fear and embarrassment), and low perceived risk of testicular disorders.

TC awareness is thought to be linked to a reduced tumor size at presentation and early detection of TC is associated with a reduced cost of treatment (Aberger, Wilson , Holzbeierlein, Griebling, & Nangia, 2014; McGuinness, Obeidat, Hickerton, & Long, 2017), which stresses the need to raise men's awareness of testicular disorders and promote early help seeking for testicular symptoms. Saab et al. (2017b) interviewed 29 men about their preferred strategies for learning about testicular disorders. Overall, men recommended interventions that are brief, snappy, visually stimulating, and involving technology. These findings, coupled with the fact that men are more likely to engage with health promotion initiatives if they were involved in

the planning of such initiatives (Lefkowich, Richardson, & Robertson, 2017), helped design the E-MAT *(Enhancing Men's Awareness of Testicular disorders)* intervention.

The aim of this one-group pre-post pilot study was to enhance men's awareness of testicular disorders, help seeking intentions for testicular symptoms, and intention and behavior to feel their testes. The objectives of the present study are to test the effect of the E-MAT intervention on men's:

1. Knowledge of the normal testes and common testicular symptoms (i.e. swelling, lumpiness, and pain) and disorders (i.e. TC, epididymitis, and testicular torsion).
2. Testicular awareness (i.e. familiarity with their own testes, knowledge of what is normal versus abnormal, and ability to detect and abnormality).
3. Perceived risk for testicular diseases.
4. Intention to seek help for three testicular symptoms (i.e. swelling, lumpiness, and pain).
5. Intention to purposefully feel their own testes and advise other men to do the same.
6. Behavior pertaining to purposefully feeling their own testes and advising other men to do the same.

METHODS

Intervention Design

E-MAT was developed and pilot tested over a three-year period using the Medical Research Council (MRC) framework which offers step-by-step guidance regarding the development, pilot/feasibility testing, evaluation, reporting, and implementation of complex interventions aimed at improving health. (Craig et al., 2013). In the development step, the evidence-base pertaining to the topic of interest is reviewed. This is followed by identifying/developing an underpinning theory. Findings from the reviewed literature and

identified/developed theory are then used to design and test the intervention (Craig et al., 2013). The development step is followed by feasibility and/or pilot testing. This step is essential to determine whether the intervention can work, does work, and will work prior to conducting full-scale testing (Orsmond & Cohn, 2015).

The evidence underpinning E-MAT was identified by conducting three reviews of the literature on men's awareness of testicular disorders (Saab et al., 2016a, 2016b, 2016c), and a qualitative study exploring men's (n=29) awareness of testicular disorders, help seeking intentions for testicular symptoms, and preferred modes of learning in relation to testicular disorders and symptoms (Saab et al., 2017a, 2017b). The Preconscious Awareness to Action Framework (PAAF) was then developed to underpin the intervention (Saab et al., 2018). After which, E-MAT was developed and its feasibility and usability were established with 15 university students. The process undertaken to develop the E-MAT intervention is summarized in Table 1.

E-MAT is a brief three-level virtual reality (VR) experience delivered using a VR headset, a controller with haptic (i.e. vibrational) feedback, and over ear headphones with voiceover, which provided feedback, information, and helped transition between the levels. The first level involves a 3D space with two walnuts. Participants were encouraged to explore the virtual walnuts as the voiceover provided information about the normal testes. Next, a lump, swelling, and pain appeared consecutively and were accompanied with humorous responses from the voiceover. Participants were required to 'touch' the abnormalities using the controller. This triggered a response from the voiceover and haptic feedback from the controller.

Participants were transported to the second level, which involved moving around the surface of a 3D model of a testis. In this level, the voiceover linked the abnormalities seen in the first level to structures such as the spermatic cord and epididymis. In addition, a purple

lump appeared to indicate TC. The purpose of the third level was to reiterate the key messages from the intervention namely the importance of familiarity with one's own testes, testicular self-examination, and timely help seeking for testicular symptoms.

Theoretical Framework

This study was underpinned by the PAAF, discussed in detail elsewhere (see Saab et al., 2018). The PAAF is comprised of seven stages as follows: preconscious awareness, unconsciousness awareness, conscious awareness, unconscious appraisal, conscious appraisal, intention, and behavior (Figure 1). Individuals in the preconscious awareness stage can be either uninformed, under-informed, have relevant discrete pieces of unlinked information, or are somewhat informed but not consciously thinking about the information. As for awareness, retaining new information, combining various mental processes, and shaping behavior are not possible without conscious awareness. Moreover, conscious awareness is needed to generate a long-lasting memory of a specific behavior. Symptom appraisal is also subject to conscious and unconscious influences. Conscious symptom appraisal enables a person to accurately label, categorize, and evaluate bodily changes (Whitaker, Scott, & Wardle, 2015). The goal of the PAAF is to increase an individual's intention to perform new and healthy behaviors, in this case feeling one's own testes and seeking timely medical attention.

Study Participants

Participants eligible for inclusion were: (i) males; (ii) residing in the Republic of Ireland; and (iii) aged between 18 and 50 years since men who fall within this age bracket are at the highest risk of developing testicular disorders (National Cancer Institute, 2017; Trojian et al., 2009). Men were excluded if they reported a history of VR sickness, which is characterized by short-term symptoms (e.g. eyestrain and dizziness) that occur among 20% of VR users (Fernandes & Feiner, 2016).

Non-probability convenience and snowball sampling strategies were used to recruit study participants. Convenience sampling is commonly used in experimental nursing studies. Samples recruited using this strategy are considered to be "inexpensive, accessible, and usually less time-consuming to obtain than other types of samples" (Grove, Gray, & Burns, 2015; p. 264). Moreover, those who expressed an interest in participating were asked to invite other men to participate. This is a key feature of snowball sampling, which is known to be effective in recruiting hard-to-reach participants, in this case young and relatively healthy men (Sadler, Lee, Lim, & Fullerton, 2010).

There is no gold standard for sample size calculation in pilot studies. Sample sizes as small as 10 (Hertzog, 2008) and as large as 59 (Viechtbauer et al., 2015), have been recommended in the literature. In fact, a sample size of 59 men would have a power of 99% to detect a medium effect (f=0.25) in repeated measures analysis of variance (ANOVA) with three waves, level of significance of 0.05 and a 2-tailed test, assuming sphericity and correlations of 0.5 between waves of data (Cohen, 1992; Erdfelder, Faul, & Buchner, 1996).

Data Collection Process

Ethical approval was granted by the Clinical Research Ethics Committee. A standardized invitation letter was sent by e-mail to students and staff in a university in the Republic of Ireland and study flyers were hung in the university's sports club and on campus. Men who responded to the e-mail or flyer and expressed an interest in participating were asked to identify other men who would be potentially interested in the study. Data collection took place between February and April 2017 on a university campus.

Data were collected at three time points; at pre-test (T0), immediately post-test (T1), and one month post-test (T2). At T0, participants were provided with a study pack comprised of an information sheet, an informed consent form, a form with the contact details of free

counselling and support services, and a questionnaire. The right to full disclosure was ensured by providing the participants with information about the study and informing them that their participation was voluntary. Confidentiality was maintained by using codes instead of names on the study documents. However, a master document linking the names of the participants to their codes was essential in order to track the responses from each participant at three time points. All the study documents were kept in a locked cabinet accessed only by the main researcher. Participants were then advised about the risks and benefits of using VR. Following a full explanation of the study process and after obtaining informed consent, participants were asked to fill-out the first questionnaire.

Participants were then exposed to a brief demonstration where they could move freely in a virtual environment using the VR headset and controller. The purpose of the demonstration was to help participants become familiar with the technology and ensure that they did not experience VR sickness. The E-MAT intervention was administered following the demonstration. Participants completed a second questionnaire immediately after the intervention (T1) and a third questionnaire one month later (T2).

Data Collection Instruments

Data were collected using a sociodemographic questionnaire, a knowledge questionnaire, a testicular awareness scale, a perceived risk item, an implementation intentions scale, a general help seeking questionnaire, and a behavior questionnaire. Content Validity Index score for the instruments was 0.98, indicating excellent validity (Polit, Beck, & Owen, 2007). The constructs of the knowledge and behavior questionnaires were multi-dimensional; therefore, an overall Cronbach's alpha was not calculated for these two instruments (Toh et al., 2015). The remaining instruments were found to be reliable. A full description of these instruments is provided in Table 2.

Sociodemographic questionnaire

This questionnaire comprised 11 items as follows: age; nationality; sexual orientation; marital status; highest level of education; current occupation; personal history of testicular disorder(s); prior information about testicular disorders; plan to seek information about testicular disorders; importance of learning about testicular disorders; and prior experience with VR.

Knowledge questionnaire

A 12-item questionnaire measured the participants' knowledge of the anatomy of the testes, testicular symptoms and diseases, and testicular self-examination. Knowledge was expressed as a score ranging between 0 and 12, with higher scores indicating greater knowledge.

Testicular awareness scale

Testicular awareness was measured using a 5-item scale assessing the participants' familiarity with their own testes, knowledge of what is normal and what is not normal, and ability to differentiate between what is normal and what is not normal. The level of agreement for each item was assessed on a 5-point Likert scale. Possible scores ranged between 1 and 5, with higher scores indicating greater awareness.

Perceived risk item

Participants' perceived risk of testicular diseases was measured using a single item. The level of agreement for this item was assessed on a 5-point Likert scale. Scores ranged between 1 and 5, with higher scores indicating greater perceived risk.

Implementation intentions scale

Implementation intentions "specify the when, where, and how of responses leading to goal attainment" (Gollwitzer, 1999; p. 121). Participants' intentions to feel their own testes in

the shower/bath at least once over the coming month and their intentions to advise at least one man to do the same were assessed. The level of agreement for each item was measured on a 5-point Likert scale. Scores ranged between 1 and 5, with higher scores indicating greater implementation intentions.

General help seeking questionnaire

Wilson, Deane, Ciarrochi, and Rickwood (2005) developed this questionnaire in order to assess an individual's intentions to seek help for different problems from various sources. Participants were provided with three symptoms (i.e. testicular swelling, lumpiness, and pain) and were asked to rate the likelihood of seeking help for each of the symptoms from different sources on a 7-point Likert scale. For each symptom, the sources of help were combined into one scale. Possible scores ranged between 1 and 7, with higher scores indicating greater help seeking intentions.

Behavior questionnaire

Men's past behaviors pertaining to feeling their testes and having their testes examined by a healthcare professional were assessed at T0 using a 3-item questionnaire. Men's behaviors in relation to feeling their own testes and advising at least one man to do the same were then assessed at T2. All item responses were dichotomous (Yes/No).

Data Analysis

Data were entered into IBM SPSS Statistics. All statistical tests were two-sided and statistical significance was set at $p \leq 0.05$. Descriptive statistics were used to describe sample characteristics and key study variables. If no outliers were present and the data were normally distributed at each time point, a one-way repeated measures ANOVA was conducted to investigate if there were statistically significant changes in knowledge, awareness, implementations intentions, and help seeking intentions over the three time points. When a

statistically significant difference was found, pairwise comparisons were performed with a Bonferroni correction for multiple comparisons. Friedman's test was used to compare responses to single items, such as the perceived risk item. McNemar's test was conducted to investigate if there was a statistically significant change in behavior over time and Fisher's exact test was conducted to investigate whether the proportions of one variable (i.e. behavior at T2) were different depending on the value of the other variable (i.e. implementation intentions at T0).

RESULTS

Sample Characteristics

A total of 53 men participated in the study at T0 and T1. There were four participants lost to follow-up at T2; yielding a sample size of 49. The sociodemographic characteristics of the four participants lost to follow-up did not differ significantly from those who completed the study. Of note, a sample size of 49 men has a power of 97% to detect a medium effect (Erdfelder et al., 1996).

The median age of participants was 26 years (Interquartile Range (IQR) 21 to 33.5). The majority were Irish (79.6%, n=39), single (55.1%, n=27), and university students (56.7%, n=28). Most participants had no history of testicular disorder(s) (87.8%, n=43); did not plan to seek information about testicular disorders (57.1%, n=28); rated the importance of learning about testicular disorders as "Important" (44.9%, n=22) and "Very Important" (42.9%, n=21); and had never used VR in the past (69.4%, n=34) (Table 3).

Knowledge

Mean knowledge scores were 6.2 (SD=1.8) at T0, 9.8 (SD=1.5) at T1, and 8.9 (SD=1.8) at T2 ($p<0.001$). Pairwise comparisons showed a significant increase in mean knowledge

between T0 and T1 (95% CI 2.80 to 4.26) and between T0 and T2 (95% CI 1.95 to 3.40). However, knowledge decreased significantly between T1 and T2 (95% CI -1.57 to -0.14).

Testicular Awareness

Mean testicular awareness scores were 3.6 (SD=0.6) at T0, 3.8 (SD=0.8) at T1, and 4 (SD=0.6) at T2 ($p<0.001$). Pairwise comparisons showed a significant increase in testicular awareness between T0 and T1 (95% CI 0.01 to 0.41), T0 and T2 (95% CI 0.25 to 0.60), and T1 and T2 (95% CI 0.01 to 0.42).

Perceived Risk

Median perceived risk scores were 3 (IQR 2 to 3) at T0, 3 (IQR 2 to 3.75) at T1, and 3 (IQR 2 to 4) at T2. There was no statistically significant change in perceived risk of testicular disorders between the three time points ($p=0.146$).

Implementation Intentions

Mean implementation intentions scores were 3.6 (SD=0.9) at T0, 4.2 (SD=0.6) at T1, and 4 (SD=0.6) at T2 ($p<0.001$). Pairwise comparisons showed a significant increase in implementation intentions between T0 and T1 (95% CI 0.33 to 0.90) and between T0 and T2 (95% CI 0.15 to 0.78). The decrease in mean implementation intentions scores between T1 and T2 was not statistically significant (95% CI -0.37 to 0.06).

General Help Seeking Intentions

Mean general help seeking intentions scores for *swelling* were 3.5 (SD=0.9) at T0, 3.8 (SD=1) at T1, and 3.9 (SD=1) at T2 ($p=0.003$). Pairwise comparisons showed a significant increase in help seeking intentions for swelling between T0 and T1 (95% CI 0.12 to 0.51) and between T0 and T2 (95% CI 0.08 to 0.72) and a non-significant increase between T1 and T2 (95% CI -0.21 to 0.38).

Mean general help seeking intentions scores for *lumpiness* were 3.5 (SD=0.9) at T0, 3.8 (SD=1.1) at T1, and 3.9 (SD=1) at T2 (p=0.013). Pairwise comparisons showed a significant increase in help seeking intentions for lumpiness between T0 and T1 (95% CI 0.08 to 0.46) and between T0 and T2 (95% CI 0.02 to 0.67) and a non-significant increase between T1 and T2 (95% CI -0.22 to 0.37).

Mean general help seeking intentions scores for *pain* were 3.2 (SD=0.9) at T0, 3.8 (SD=1.3) at T1, and 3.7 (SD=1) at T2 (p<0.001). Pairwise comparisons showed a significant increase in help seeking intentions for pain between T0 and T1 (95% CI 0.25 to 1.01) and between T0 and T2 (95% CI 0.28 to 0.89). Help seeking intentions for pain decreased between T1 and T2, which was not significant (95% CI -0.38 to 0.29). Pairwise comparisons for knowledge, testicular awareness, implementation intentions, and help seeking intentions at three time points are presented in Table 4.

Behavior

At T0, 20 (40.8%) participants reported having purposefully examined their testes within the past month. This proportion doubled at T2, which was found to be statistically significant (p<0.001).

At T0, 38 (77.6%) participants were in agreement that they “intend” to feel their testes. Of the 11 (22.4%) participants who were not in agreement, 6 (54.5%) reported feeling their testes at T2 (p=0.019). As for intending to advise at least one man about the importance of feeling his own testes, 17 (34.7%) participants were in agreement at T0. Of the 32 (65.3%) participants who were not in agreement, 8 (25%) reported having advised at least one man to feel his own testes at T2 (p<0.001).

DISCUSSION

E-MAT successfully enhanced men's knowledge and awareness of the normal testes and common testicular symptoms and diseases, intentions to seek help for testicular symptoms, and intention and behavior to feel their own testes and advise other men to do the same. However, men's perceived risk of testicular disorders did not increase following the intervention.

Contradicting evidence exists regarding perceived vulnerability for TC. Muliira, Nalwanga, Muliira, and Nankinga (2012) found that perceived risk of TC was low among Ugandan men, whereas participants in the study by Rovito, Gordon, Bass, and Ducette (2011) scored high on perceived TC vulnerability. Notably, low perceived risk of cancer was identified as a barrier to early help seeking for cancer symptoms among men (Saab et al., 2017a). One explanation is that diseases of the testes often affect younger men who are relatively healthy and have limited contact with the healthcare system (Saab et al., 2016c).

Despite reporting being aware of testicular disorders, participants scored low on the knowledge questionnaire at T0. Braga, Cabral, Louro, and de Carvalho (2017) distinguished between being "aware of the TC existence" (p. 106) and knowing common TC symptoms, risk factors, and age of onset. It was found that, out of 507 men, 78% (n=399) reported being aware of TC; yet, 48.9% (n=244) did not recognize the most common symptoms of TC and only 15% (n=76) knew the at-risk age (Braga et al., 2017). While testicular awareness significantly increased between T1 and T2, knowledge significantly decreased. Knowledge decay is not uncommon in health promotion interventions and is one of the reasons why a number of organizations involved in health promotion tend to design new campaigns periodically (Nimmons, Beaudoin, & St. John, 2017).

E-MAT increased men's intentions to seek help for testicular symptoms. Similarly, a systematic review of 24 controlled studies using VR in mental health found that VR was effective in promoting help seeking for phobias, social anxiety, post-traumatic stress disorder, and eating disorders (Valmaggia, Latif, Kempton, & Rus-Calafell, 2016). However, these findings may not be transferrable to the context of testicular disorders. Healthcare professionals were identified as a key source of help for testicular symptoms. Likewise, primary care physicians have been listed as the primary source of formal help for prostate and colorectal cancer (Saab et al., 2017c). Intimate partners were also identified as an important source of informal help and can play a significant role in medical help seeking (Saab et al., 2017a). For instance, a study exploring factors influencing help seeking for cancer 'alarm' symptoms found that those who were married/partnered rather than single, were more likely to report seeking help (Whitaker, Smith, Winstanley, & Wardle, 2016).

Men's intentions and behaviors in relation to feeling their own testes and advising at least one other man to do the same significantly increased following the intervention. This finding is supported by evidence from the literature on cancer prevention and screening. An example is a study aimed at increasing colorectal screening uptake, whereby participants who received leaflets with messages written using implementation intentions statements were more likely to get screened that those who did not receive any leaflets (Orbell, Campbell, Weller, 2016).

The present study is not without limitations. Generalizability is compromised, mainly due to the small sample size and participants were recruited using non-probability sampling which reduces sample representativeness. However, this sampling strategy was effective in recruiting and retaining study participants. The high retention rate (92.5%) can also be attributed to performing timely follow-up, having a researcher from the target population

collect data, providing the contact details of free counselling and support services, and having accessible data collection sites (Yancey, Ortega, & Kumanyika, 2006).

Given the lack of a control group, it was unclear whether the changes in outcomes over the three time points were caused by the intervention, the administration of repeated measures, or unforeseeable factors. Therefore, rigor, generalizability, and sample representativeness could be enhanced by conducting a randomized controlled trial with a larger sample size across different settings and performing a cost-benefit analysis. It is also important to explore the effect of the E-MAT intervention longitudinally.

VR sickness and the cost of the technology can limit full-scale testing. However, VR is increasingly gaining popularity among youths, which has led to a significant reduction in the cost of this technology. Moreover, the number of VR users is forecast to increase by 147% in the year 2021 (Mind Commerce, 2016).

CONCLUSIONS

To the best of the authors' knowledge, VR has never been used to promote men's health, let alone enhancing their awareness of testicular disorders. Given the positive outcomes achieved and the low attrition rate, this pilot study merits full-scale testing.

From a health promotion perspective, clinicians, including nurses, are encouraged to raise men's testicular awareness and to prompt them to seek timely medical attention for testicular symptoms. This could be achieved by directing them to platforms where E-MAT is accessible. For instance, a link to E-MAT can be made available on public platforms that men can access at their own leisure such as websites of cancer organizations, universities, workplaces, and sport clubs. Furthermore, E-MAT could be used as an element of men's health campaigns such as Movember, while stressing the health rather than the social aspects (e.g. growing facial hair) of such campaigns (Jacobson & Mascaro, 2016). It is also important to

consider the needs of men at risk for health inequities. This could be achieved by making E-MAT and associated technology available in settings frequented by these men such as men's sheds and youth organizations. For those who suffer from VR sickness or have limited access to the technology, the intervention could be customized to run in a normal desktop environment. VR can also be used to raise men's awareness of a number of health topics such as sexually transmitted infections and cancer prevention.

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FIGURE LEGENDS

Figure 1. The Preconscious Awareness to Action Framework (Saab et al., 2018).

Table 1.
The steps undertaken to develop the E-MAT intervention

Steps	Methods	Key Findings
Empirical literature reviews	• Systematic review of 25 studies exploring men's knowledge, awareness, and attitudes towards testicular cancer and testicular self-examination (Saab et al., 2016c)	• Men lacked awareness of testicular cancer risk factors, signs and symptoms, and treatment. • Few men practiced self-examination with the majority not knowing what to look for. • Many reported an intention to delay help seeking for testicular symptoms.
	• Systematic review of 11 studies promoting men's awareness of testicular cancer and testicular self-examination (Saab et al., 2016b)	• 10 studies successfully raised men's awareness of testicular cancer and self-examination. • None of the studies accounted for men's preferred learning strategies or used innovative educational strategies.
	• Integrative review of four studies exploring men's awareness of benign testicular disorders (Saab et al., 2016a)	• Men's awareness of and help seeking intentions for benign testicular disorders were lacking. • No interventions promoting awareness of benign testicular disorders were identified.
Qualitative descriptive study	• To explore men's (n=29) awareness of testicular disorders, help-seeking intentions for testicular symptoms, and preferred strategies for learning about testicular disorders and symptoms (Saab et al. 2017a, b) • 12 semi-structured individual interviews and 3 focus groups conducted with men aged 18-47 years. • Data were analyzed using qualitative content analysis	• Men lacked awareness of testicular cancer; very few reported having heard of benign testicular disorders; and many intended to delay help seeking for lumpiness, swelling, and/or pain. • Barriers to awareness and help seeking included knowledge deficit, symptom misappraisal, fear, embarrassment, machoism, lack of endorsement by the health system, cost and access to care, and inability to differentiate between normal and abnormal lumps. • Men stressed the importance of raising awareness using educational interventions that are brief, visually appealing, novel, and humorous.
Theoretical literature review	• An iterative narrative review process of the theoretical literature on health promotion, symptom appraisal, and neurobehavioral psychology was undertaken (Saab et al. 2018). • Six categories of multidisciplinary theories used in health promotion were identified and helped derive the Preconscious Awareness to Action Framework.	• The aim of the Preconscious Awareness to Action Framework is to enhance an individual's awareness of a certain behavior, accurate appraisal of specific symptoms, and intentions to perform new and healthy behaviors. • The seven stage of the Preconscious Awareness to Action Framework are as follows: preconscious awareness, unconsciousness awareness, conscious awareness, unconscious appraisal, conscious appraisal, intention, and behavior.

Table 2.
Data collection instruments

Instrument	Source	Number of items	Time administered	Answer options	Scoring	Interpretation of scores	Validity and reliability
Sociodemographic Questionnaire	Researcher-designed	11	T0	Closed-ended questions	NA	NA	S-CVI=0.98 Cronbach's alpha=NA
Knowledge Questionnaire	Researcher-designed	12	T0, T1, T2	Each of the 12 items had one correct answer	0-12	Higher scores indicate greater knowledge	S-CVI=0.98 Cronbach's alpha[a]
Testicular Awareness Scale	Researcher-designed	5	T0, T1, T2	Level of agreement assessed on a 5-point Likert scale	1-5	Higher scores indicate greater awareness	S-CVI=0.98 Cronbach's alpha=0.81 at T0, 0.80 at T1, and 0.87 at T2
Perceived Risk Item	Researcher-designed	1	T0, T1, T2	Level of agreement assessed on a 5-point Likert scale	1-5	Higher scores indicate greater perceived risk	I-CVI=1 Cronbach's alpha=NA
Implementation Intentions Scale	Gollwitzer (1999	3	T0, T1, T2	Level of agreement assessed on a 5-point Likert scale	1-5	Higher scores indicate greater implementation intentions	S-CVI=1 Cronbach's alpha=0.80 at T0, 0.6 at T1, and 0.67 at T2
General Help Seeking Questionnaire	Wilson et al. (2005)	3	T0, T1, T2	Likelihood to seek help assessed on a 7-point Likert scale	1-7	Higher scores indicate greater intentions to seek help	S-CVI=1 Cronbach's alpha=0.88 at T0, 0.94 at T1, and 0.94 at T2
Behaviour Questionnaire	Researcher-designed	3	T0, T2	"Yes" and "No"-type questions	Individual items	Yes: performed the behaviour No: did not perform the behaviour	S-CVI=0.94 Cronbach's alpha[a]

[a] The constructs of the knowledge and behaviour questionnaires were multi-dimensional; therefore, an overall Cronbach's alpha was not calculated for these two instruments
I-CVI item content validity index, *NA* not applicable, *S-CVI* scale content validity index, *T0* time 0 (pre-test), *T1* time 1 (first post-test), *T2* time 2 (second post-test)

Table 3.
Sociodemographic characteristics of the study participants (n=49)

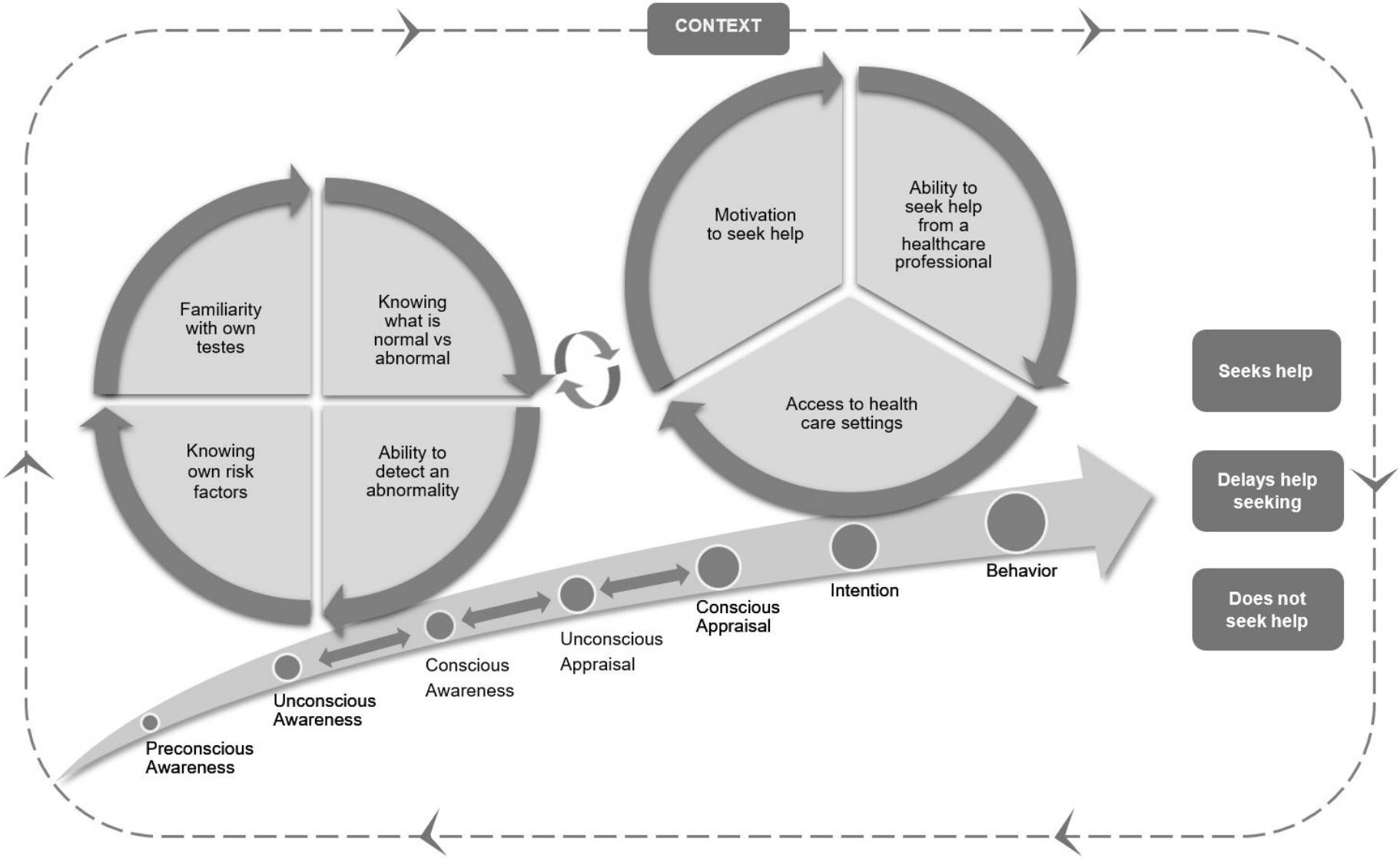
Characteristic	n (%)
Age (years)	
≤20	11 (22.5)
21-30	22 (45)
31-40	9 (18.1)
41-50	7 (14.1)
Range	18-50
Median (IQR)	26 (21-33.5)
Nationality	
Irish	39 (79.6)
Others	10 (20.1)
Sexual orientation	
Heterosexual	42 (85.7)
Gay	4 (8.2)
Bisexual	3 (6.1)
Marital status	
Single	27 (55.1)
In a relationship/partnered	17 (34.7)
Married	5 (10.2)
Highest level of education	
Primary	1 (2)
Secondary	21 (42.9)
University *(Undergraduate)*	27 (55.1)
Occupation	
Student	28 (56.7)
Employed	20 (40.8)
Unemployed	1 (2)
Personal history of a testicular disorder	
Yes	5 (10.1)
No	43 (87.8)
Unsure	1 (2)
Prior information about testicular disorders	
Yes	14 (30.5)
No	34 (69.4)
Plan to seek information about testicular disorders	
Yes	21 (42.9)
No	28 (57.1)
Importance of learning about testicular disorders	
Very Important	21 (42.9)
Important	22 (44.9)
Neutral	6 (12.2)
Prior use of VR	
Yes	15 (30.6)
No	34 (69.4)

IQR interquartile range, *VR* Virtual Reality

Table 4.
Pairwise comparisons for knowledge, testicular awareness, implementation intentions, and help seeking intentions

Outcome	n	T1 vs T0		T2 vs T0		T2 vs T1	
		Mean difference (95% CI)	p-value [a]	Mean difference (95% CI)	p-value [a]	Mean difference (95% CI)	p-value [a]
Knowledge	49	3.5 (2.8, 4.3)	<0.001	2.7 (2, 3.4)	<0.001	-0.9 (-1.6, -0.1)	0.014
Testicular Awareness	49	0.2 (0.01, 0.4)	0.038	0.4 (0.3, 0.6)	<0.001	0.2 (0.01, 0.4)	0.033
Implementation Intentions	48	0.6 (0.3, 0.9)	<0.001	0.5 (0.2, 0.8)	0.002	-0.2 (-0.4, 0.1)	0.24
Help Seeking Intentions *(Swelling)*	49	0.3 (0.1, 0.5)	0.001	0.4 (0.1, 0.7)	0.01	0.1 (-0.2, 0.4)	1
Help Seeking Intentions *(Lumpiness)*	49	0.3 (0.1, 0.5)	0.003	0.3 (0.02, 0.7)	0.04	0.1 (-0.2, 0.4)	1
Help Seeking Intentions *(Pain)*	48	0.6 (0.3, 1)	<0.001	0.6 (0.3, 0.9)	<0.001	-0.04 (-0.4, 0.3)	1

CI confidence interval, *T0* time 0 (pre-test), *T1* time 1 (first post-test), *T2* time 2 (second post-test)
[a] Pairwise comparisons with Bonferroni adjustment following repeated measures ANOVA


CONTEXT
Familiarity with own testes
Knowing what is normal vs abnormal
Knowing own risk factors
Ability to detect an abnormality
Motivation to seek help
Ability to seek help from a healthcare professional
Access to health care settings
Preconscious Awareness
Unconscious Awareness
Conscious Awareness
Unconscious Appraisal
Conscious Appraisal
Intention
Behavior
Seeks help
Delays help seeking
Does not seek help