UNIVERSITY OF BAHRAIN

College of Health
and Sport Sciences

Effect of Home-Based Pelvic Floor Muscle Rehabilitation on Severity, Frequency, and Volume of Urinary Leakage among Women with Incontinence

A Thesis Submitted in Partial Fulfillment of the Requirements for the Master of Science Degree in Physiotherapy

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November 2024

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☐ **Without making any changes to the thesis.**

☑ **After making the modifications attached with this decision.**

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Abstract

Introduction: Urinary incontinence (UI) is a prevalent condition affecting women's Quality of Life (QoL) worldwide. Physiotherapy, particularly Home-Based Pelvic Floor Muscle Rehabilitation (HB-PFMR), has shown promise in managing UI symptoms.

Aim: This study aimed to assess the effectiveness of HB-PFMR in reducing the severity, frequency, and volume of urinary leakage among women with UI in the Kingdom of Bahrain. Further objectives are to investigate the HB-PFMR's effect on the QoL among women with UI.

Method: The study employed a quasi-experimental design with pre-test and post-test assessments to evaluate the impact of the intervention on the targeted outcomes. A convenient sample of 62 women with UI who met the inclusion criteria were randomly assigned to the study group receiving HB-PFMR (n=32) and the control group receiving the routine Kegel exercise (n=30). Initially participants of both groups were assessed for the type of UI by using 3-Incontinence questionnaire (3IQ), severity by using the incontinence severity index (ISI), frequency and volume of urinary leakage by using International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF), and QoL by using King's Health Questionnaire (KHQ). The study group underwent HB-PFMR, consisting of five different Kegel exercises and five functional approach exercises performed daily, which were selected based on established physiotherapy guidelines and evidence from previous studies demonstrating their efficacy in improving pelvic floor muscle strength and function. In contrast, the control group performed routine Kegel exercises twice daily, with 25 repetitions per session. Both groups participated twice weekly and had live training sessions for over a month. Women were monitored through log sheets and daily communication. Both groups were reassessed for UI severity, frequency, volume, and QoL after the intervention using the same validated tools employed at baseline. Data were analyzed using statistical methods, including paired t-tests and ANOVA, to compare pre-test and post-test outcomes within and between groups, ensuring the reliability and validity of the results

Results: Overall, the study group demonstrated significant improvements in managing UI. A substantial reduction in the severity of urinary leakage was noted, decreasing from 34.4% at baseline to just 3.1% post-study. Moreover, a significant improvement was observed in the frequency of urinary leakage among women who practiced HB-PFMR. The percentage of women reporting no urinary incontinence increased from 0% at baseline to 53.1% after the intervention, whereas no improvement was observed in the control group. The study group also experienced a reduction in leakage volume from 18.8% reporting large amounts of leakage pre-intervention to 0% post-intervention. Additionally, 56.2% of the study group reported no bladder problems post-intervention, compared to only 13.3% in the control group ($p=0.003$).

Conclusion: It is concluded that HB-PFMR is an effective non-pharmacological intervention in reducing the severity, frequency, and volume of urinary leakage among women with UI and their overall QoL. This study highlights the need for integrating physiotherapy interventions like HB-PFMR into standard care as an evidence-based practice for women with UI, potentially improving healthcare strategies and decision-making in the Kingdom of Bahrain.

Keywords: Women's Health, Quality of Life, Pelvic Floor Disorder, Exercise Training, Urinary incontinence

Scientific Contributions

Turab, F. (2023, December 8). Effect of home-based pelvic floor muscle rehabilitation on severity, frequency, and volume of urinary leakage among women with incontinence. In Professor Diaa Rizk (Chair), *Basic Multi-disciplinary Urogynecology Course: Pathogenesis and Management of Female Pelvic Floor Dysfunctions.* Symposium conducted at the Arabian Gulf University, Manama, Bahrain.

Turab, F. (2024, May 7). Effect of home-based pelvic floor muscle rehabilitation on severity, frequency, and volume of urinary leakage among women with incontinence. In Dr. Priya (Chair), *Postgraduate Symposium.* Symposium conducted at the University of Bahrain, Manama, Bahrain.

Dedication

I dedicate this thesis to my family, whose unwavering support, encouragement, and sacrifices have been my constant source of strength. To my professors and mentors, whose guidance and knowledge have been invaluable throughout my academic journey. And to all those who inspired me to pursue this research, your influence and impact will always be remembered.

Acknowledgment

First and foremost, I am deeply grateful to ALLAH, whose boundless grace and guidance were instrumental in the successful completion of this work.

I extend my sincere gratitude to my supervisor, Dr. Mohamed Abdulla, from the University of Bahrain, for his invaluable guidance, encouragement, and patience throughout this research journey. His expertise and insights have been a cornerstone of this study.

A special and heartfelt thanks to my co-supervisor, Dr. Zohour Rashwan, from the University of Bahrain, for her exceptional support, dedication, and extensive contributions. Her constant encouragement and valuable feedback were crucial in shaping and refining this work.

My appreciation also goes to the staff and colleagues at Ibn AlNafees Hospital for providing a supportive environment and for their continued assistance during my research.

Finally, I would like to express my deepest gratitude to my family and friends for their unwavering support and encouragement throughout this journey.

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List of Abbreviations

3IQ	3 Incontinence Questionnaire
APTA	American Physical Therapy Association
DAM	Deep anterolateral abdominal muscles
EMG	Electromyography
FI	Fecal incontinence
GMS	Genitourinary syndrome of menopause
HBFA	Home-based functional approach
HB-PFMR	Home-Based Pelvic Floor Muscle Rehabilitation
IAP	Intra-abdominal pressure
ICI	International Consultation on Incontinence
ICIQ-UI SF	The International Consultation on Incontinence Questionnaire Urinary Incontinence Short Form
ICS	International continence society
INH	Ibn Al-Nafees Hospital
ISI	Incontinence severity index
ISSS	Integration of the Spinal Stabilizing System
KHQ	King's Health Questionnaire
MUI	Mix UI
OAB	Overactive bladder
PF	Pelvic floor
PFD	Pelvic floor dysfunction
PFM	Pelvic floor muscle
PFMT	Pelvic floor muscle training

POP	Pelvic Organ Prolapse
PROM	Patient-Reported Outcome Measure
QoL	Quality of Life
SAM	Superficial Anterolateral Abdominal Muscles
SMC	Salmaniya Medical Complex
SPSS	Statistical Package for Social Sciences
SUI	Stress UI
TM	Thoracic Muscles
TrA	Transversus Abdominis
UI	Urinary Incontinence
UUI	Urge UI
WCPT	World Confederation for Physical Therapy

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Chapter One

Introduction

1.1 Background

1.2 Research problem

1.3 Research aim and objective

1.4 Research hypotheses

Chapter One
Introduction

1.1. Background

The incidence of pelvic floor dysfunction (PFD) in women has been observed to increase gradually with age. This global phenomenon negatively impacts the lives of numerous women worldwide (Chen, 2007). PFD is a general term for conditions that affect the female urinary and fecal continence system and the support of the pelvic organs (Johnston, 2019). Statistics indicate that approximately one in every four women will experience PFD at some point in their lives. Recent research indicates that PFD is prevalent among women, with urinary incontinence affecting 55.8%, fecal incontinence 10.4%, uterine prolapse 14.0%, and pelvic pain 18.7%. Factors such as advancing age, higher BMI, increased number of vaginal births, and postmenopausal status are strongly associated with these conditions (Peinado-Molina et al., 2023).

The International Continence Society (ICS) defined urinary incontinence (UI) as the involuntary loss of urine caused by PFD (López-Liria et al., 2019). The global prevalence of UI has been estimated at approximately 200 million people, and it is projected to increase to over 423 million by 2018 (Norton & Brubaker, 2006). Moderate to severe UI affects 7% of women in the age range 20-39, 17% affect women in the age range 40-59, 23% affect women in the age range of 60-79, and more than 32% involve women older than 80 years of age (Biswas et al., 2017). These numbers might be lower than actual cases because not all women report their cases to their healthcare providers (Limpawattana et al., 2015). The UI is classified into stress, urge, or mixed

incontinence based on the symptoms (Lawson & Sacks, 2018), 40% of women older than 40 years old have UI dysfunction (Good & Solomon, 2019). Furthermore, women with weak pelvic floor muscle (PFM) strength have a higher chance of developing UI within 5 to 10 years post-normal delivery (Badillo, 2020; Javanmardifard et al., 2022).

Physiotherapy interventions play a critical role in managing PFM dysfunction, which is a significant contributor to UI. These interventions include pelvic floor muscle training (PFMT), biofeedback, electrical stimulation, and behavioural therapies, all aimed at restoring PFM strength, endurance, and coordination (Badillo, 2020; Wang et al., 2024). Such approaches not only improve bladder control but also reduce the severity and frequency of urinary leakage, thereby enhancing functional independence and overall well-being (Curillo-Aguirre & Gea-Izquierdo, 2023).

The concept of quality of life (QoL) in the context of UI refers to the physical, emotional, and social dimensions affected by the condition. Women with UI often experience limitations in daily activities, psychological distress, embarrassment, and diminished social engagement, leading to a substantial decline in QoL (Corrado et al., 2020; T. Y. Kim et al., 2018). Studies have highlighted the negative impact of UI on QoL, emphasizing the importance of addressing these issues through targeted interventions like physiotherapy (Chaiyawat et al., 2021). Evidence-based approaches such as PFMT have demonstrated significant improvements in QoL by alleviating symptoms and empowering women with self-management strategies (Dumoulin et al., 2020).

Women's health physiotherapy, which emerged in 1977 with a focus on the peripartum period, has since evolved to address broader health challenges, including UI and PFM dysfunction. The American Physical Therapy Association (APTA) recognized the importance of specialized care in this

domain, approving board certification in women's health physical therapy in 2006. This specialization underscores the critical role physiotherapy plays in improving QoL for women facing UI and related conditions (American Physical Therapy Association, 2020)

Dr. Arnold Kegel was the first to report positive results from pelvic floor muscle training (PFMT) in women who had Stress UI (SUI) symptoms in 1948 (Kegel, 1948). Subsequent studies have further established the efficacy of PFMT in reducing the morphological, functional, and symptomatic aspects of various forms of incontinence while also enhancing PFM coordination and decreasing urine leakage (Cavkaytar et al., 2015; Madill et al., 2013). Recently, Chaiyawat et al. (2021) found that a home-based functional approach (HBFA) had superior outcomes compared to the traditional Kegel exercise in improving QoL and SUI symptoms.

The economic cost of UI patients in the United States exceeds $20 billion each year, with the bulk ascribed to resources spent for incontinence treatment or regular care that patients pay out-of-pocket for absorbent pads, protection, and laundry (Subak et al., 2008). The estimates for annual costs range significantly from $50 to $1000 per patient annually and increase with the severity of UI (Subak et al., 2014).

In the Kingdom of Bahrain, Al-Najjar et al. (2014) conducted a study to identify the risk factors for UI among patients attending the Urogynaecology clinic at Salmaniya Medical Complex (SMC). Their research involved the recruitment of 259 participants, and the reported numbers indicate a concerning upward trend over the years, emphasizing the significance of this issue and warranting further investigation into the prevalence of UI in the Kingdom of Bahrain.

Al-Najjar et al. (2014) concluded that age, BMI, parity, vaginal delivery, menopause, and chronic pulmonary illnesses were all identified as significant risk factors for UI. UI profoundly affects women's lives, impacting them physically, psychologically, and socially. Physically, women with UI experience limitations in daily activities, including work, exercise, and routine household tasks, due to the fear of leakage. Psychologically, the condition often leads to embarrassment, low self-esteem, anxiety, and depression, as highlighted in studies exploring its emotional toll. Socially, women may face isolation, strained interpersonal relationships, and reduced participation in recreational or intimate activities. These multifaceted impacts ultimately diminish QoL, as the physical limitations and psychological burden hinder women from living fulfilling lives.

To address these concerns, Al-Najjar et al. (2014) recommended the implementation of a pelvic floor rehabilitation program for all postnatal patients to mitigate the risk of pelvic floor weakness and subsequent UI. Additionally, they emphasized the need for more comprehensive studies to guide the optimal management of patients dealing with UI. These findings not only highlight the critical need for effective interventions but also establish a foundation for this study's exploration of innovative strategies to address UI and improve QoL. Consequently, the current research aims to examine the role of physiotherapy interventions in managing UI, enhancing QoL, and ultimately contributing to better patient care and outcomes.

1.2. Research problem

UI is a serious health issue that has a negative influence on women's QoL, which is impacting 25% of the world's population and 45% of females

in some countries (Roch et al., 2021). In middle-aged or elderly women, the prevalence of UI ranges between 30% and 60% and rises with age (López-Liria et al., 2019). UI affects 7% to 37% of females aged 20 to 39 years, and daily UI affects 9% to 39% of females over 60 (Tran & Puckett, 2022). Many women with UI do not visit a doctor because they are embarrassed or ignore it and think that it is a normal process after giving birth or aging. Besides, some women do not know that this condition can be treated, which leads to an undiagnosed condition that affects their QoL in terms of physical, social, sexual, and psychological sectors (Oliveira et al., 2017). Furthermore, anxiety and sadness are more common in women with SUI; they also have lower levels of sexual pleasure, lower levels of physical activity involvement, and lower self-rated health (Badillo, 2020).

In Bahrain, there is limited documentation and reporting on the prevalence of UI cases in many hospitals, which creates challenges in understanding the true burden of the condition and effectively addressing it. While physiotherapy has proven effective in managing urinary incontinence (UI), there is a lack of standardized and universally validated physiotherapy programs specifically designed for UI patients. As a result, many physiotherapists rely on their prior clinical experience or seek additional training, such as enrolling in specialized women's health courses, to develop tailored treatment plans. A systematic review by Dumoulin et al. (2018) found variability in the implementation of pelvic floor muscle training (PFMT), a key intervention for UI, emphasizing the need for standardized protocols to ensure consistent and effective care. There have been no studies conducted in the Kingdom of Bahrain on the treatment provided to UI patients and the effect of the treatment on patient QoL, severity, frequency, and volume of urinary leakage among women.

This research identified the most dominant type of UI in the Kingdom of Bahrain. Furthermore, the study investigated the effect of bundling both HBFA and PFM rehabilitation programs in the experimental group compared to routine Kegel exercises in the control group. The exercises were easy, accessible, and cost-free methods that could be done at home. Additionally, the study measured the impact of UI on overall activities pre- and post-intervention.

Finally, this study will establish the physiotherapist's role in improving the overall activities of women with UI in the Kingdom of Bahrain. Women with SUI have an excellent therapeutic option in Australian clinical settings with physiotherapy management (Neumann et al., 2005).

1.3. Research aim and objective

This study aimed to assess the effectiveness of Home-Based Pelvic Floor Muscle Rehabilitation (HB-PFMR) on the severity, frequency, and volume of urinary leakage among women with UI. Further objective includes measuring the effect of the HB-PFMR on the QoL among women with UI.

1.4. Research hypotheses

- Women with UI who receive HB-PFMR exhibit lower severity, frequency, and urinary leakage volume than those who receive the routine Kegel exercise.
- Women with UI who receive HB-PFMR exhibit better QoL than those who receive the routine Kegel exercise.

Chapter Two

Literature review

2.1 Literature review

2.2 Literature Review Key Points

Chapter Two
Literature review

2.1 Literature review

This chapter reviews the literature on UI and pelvic floor disorders (PFD), focusing on their prevalence, associated risk factors, and physiotherapy-based management. The literature review was conducted using PubMed, Cochrane Library, Scopus, and Google Scholar. Keywords included "urinary incontinence," "pelvic floor muscle training," "physiotherapy interventions," "pelvic floor dysfunction," "Kegel exercises," "home-based exercise programs," and "functional exercise." Studies published between 2014 and 2024 were included to ensure the relevance of findings.

The inclusion criteria targeted peer-reviewed studies examining the prevalence and risk factors for UI, as well as those evaluating physiotherapy interventions such as PFMT and Kegel exercises. Non-peer-reviewed articles, editorials, and studies before 2014 (unless considered seminal) were excluded.

The review highlighted several key findings. UI is a multifactorial condition with risk factors including age, childbirth, menopausal transitions, and higher BMI. Physiotherapy interventions, particularly PFMT, have consistently demonstrated efficacy in reducing UI symptoms and improving QoL. Kegel exercises were shown to enhance pelvic floor muscle strength, reducing stress and urgency UI when performed regularly. Additionally, home-based exercise programs have been found to improve adherence and accessibility, contributing to long-term symptom management. Despite these

advancements, gaps remain in standardizing physiotherapy protocols and evaluating their long-term outcomes. These findings underscore the need for further research to optimize management strategies and improve care delivery.

2.2.1 Common Pelvic Floor Dysfunctions

The PFDs represent a significant and widespread public health concern, substantially impacting the well-being of millions of women across all age demographics worldwide (Gyhagen et al., 2015; Arbuckle et al., 2019). Notably, the prevalence of PFDs is increasing among older women (Johnston, 2019). From the gynecological standpoint, one in ten women suffers from PFD, which necessitates warranted surgical interventions (DeLancey, 2005). These dysfunctions encompass POP, fecal incontinence (FI), and UI. Alarming statistics indicate that approximately 47% of women suffer from one or more PFDs, which may include chronic pelvic pain, UI, and POP (Roch et al., 2021). A substantial cohort of women in the USA, numbering between 300,000 and 400,000, are affected by PFDs to the extent that surgical intervention becomes necessary. Remarkably, reoperations account for approximately 30% of all surgical procedures related to managing these conditions (DeLancey, 2005).

The North American Menopause Society created the term genitourinary syndrome of menopause (GMS) in 2014 to represent the strong effect of hormones on genitourinary function. This hormonal change includes the reduction of estrogen and other sex steroids (Johnston, 2019). The GMS syndrome is commonly experienced by peri-menopausal women and is associated with diverse symptoms, including sexual dysfunction, vaginal pain, and POP. The American College of Obstetrics and Gynecology underwent a significant change in its Committee

Statement document in 2018, proposing a fresh approach highlighting the crucial nature of the fourth trimester. This emphasis underscores the need for comprehensive care and support during the postpartum period, recognizing the various physiological and emotional challenges facing women after childbirth. In fact, PDF affects all age groups, including puberty, peripartum, and menopause (Badillo, 2020).

The pelvis is essential in several fundamental human functions, including development, reproduction/sexual function, digestion, and excretion (Badillo, 2020). Dysmenorrhea affects 50%-90% of adolescent females, causing severe pelvic pain before and during menstruation (Azagew et al., 2020). During the peripartum stages, 56-72% of pregnant women experience low back and pelvic girdle pain, with some continuing to have pain post-delivery (Badillo, 2020). Women after menopause may experience coital dysfunction and overactive bladder (OAB) syndrome due to atrophic changes, leading to symptoms like painful intercourse and urinary issues (Johnston, 2019). These issues highlight the importance of understanding and addressing pelvic health throughout a woman's life (Badillo, 2020; Azagew et al., 2020; Johnston, 2019).

Injuries resulting from vaginal childbirth are one of the most common risk factors contributing to PFD. The physical toll of vaginal deliveries on the mother's pelvic bones and soft tissues often leads to musculoskeletal damage. Mainly, ninety percent of women at higher risk of experiencing levator ani damage include those who undergo prolonged second stages of labor, older mothers, and those who suffer from anal tears (Johnston, 2019). Additionally, during the second phase of vaginal labor, when the fetus is moving through the birth canal and exerting pressure on adjacent nerves, specifically the pudendal nerve. There is a risk of straining or rupture in the

perineal region, puborethral fascia, and rectovaginal septum during this phase of labor (Ptak et al., 2019). As well as various bone and muscle injuries, such as pubic bone edema, subcortical fractures, levator ani muscle edema, and tears, are frequently observed after vaginal deliveries (Johnston, 2019).

Perineal lacerations are also common in vaginal childbirth, occurring in 53% to 79% of cases. In more severe instances, these lacerations can extend into or through the anal sphincter, resulting in obstetric anal sphincter injuries. Women with such injuries face a higher risk of developing bowel and urinary incontinence, which may persist for several years after childbirth (Badillo, 2020). Damage to the muscles, ligaments, fascia, and peripheral nerves of the pelvic floor during pregnancy and vaginal birth can lead to postpartum dysfunction (Åhlund et al., 2013).

Multiple pregnancies, advanced maternal age, pre-existing UI before or during pregnancy, elevated body mass index during pregnancy, vaginal delivery, perineal or anal sphincter injuries during delivery, and high fetal birthweight are all risk factors for post-delivery UI (Javanmardifard et al., 2022). Furthermore, other risk factors include constipation, chronic respiratory diseases resulting in persistent coughing, and a history of prior gynecological surgical procedures (Wyndaele & Hashim, 2020; Aoki et al., 2017).

The subsequent sections will delve into the clinical manifestations and prevalence of UI, presenting evidence-based insights into its classification and distribution among various populations. Therapeutic management strategies, including physiotherapy interventions such as Kegel exercises, PFMT, and home-based exercise programs, will be discussed in detail. Additionally, these sections will explore the pathophysiological changes associated with UI, the economic implications of its treatment, and its profound impact on quality of

life. This review will provide a detailed understanding of UI and its management to support the study's exploration of innovative approaches to improve outcomes for women with UI.

2.2.2 Urinary Incontinence

- Clinical Manifestations and Prevalence

Among female health issues related to PF, UI is the most common dysfunction (Johnston, 2019; Khandelwal & Kistler, 2013). The UI is defined as the lack of bladder control characterized by involuntary or abnormal urination. This condition is typically accompanied by lower urinary tract symptoms, encompassing difficulties related to storage and voiding. The condition can also be described based on the patient's clinical presentation and symptoms (Demaagd & Davenport, 2012; Johnston, 2019; Lawson & Sacks, 2018; Oliveira et al., 2017).

There are five different types of UI, including Stress UI (SUI), Urge UI (UUI), Mix UI (MUI), overflow UI, and functional UI (Pizzol et al., 2021). The SUI is characterized by the involuntary leakage of urine, which happens when there is an increase in IAP due to weakness of the urethral sphincter or PFM. Sneezing, coughing, exertion, or physical effort can trigger SUI (Tran & Puckett, 2022; Lawson & Sacks, 2018). This condition is associated with the relationship between physical effort and urinary loss, where increased physical effort leads to elevated intra-vesical pressure, resulting in SUI due to reduced detrusor muscle contraction caused by increased intra-urethral pressure. This pathophysiology has two mechanisms: intrinsic deficiency of the urethral sphincter and hypermobility of the urethra and bladder neck (Oliveira et al., 2017).

Likewise, the UUI or OAB is involuntary leakage of urine, where the patient feels a sense of urinary urgency because of detrusor overactivity (Demaagd & Davenport, 2012). These contractions can result from bladder irritation or loss of neurological control and may be asymptomatic in some cases (Tran & Puckett, 2022). Triggers for UUI can be as diverse as hearing running water, coming home, removing clothing to urinate, spotting a bathroom sign, being exposed to cold, or drinking a lot of fluid. Additionally, the use of certain medications, such as diuretics and cholinesterase inhibitors, can also contribute to the occurrence of UUI. Moreover, it is essential to know that UUI may coexist with a condition known as detrusor hyperactivity with impaired contractility. In this coexisting condition, bladder contractions fail to fully empty its contents, resulting in a substantial postvoid residual urine volume (Davis et al., 2020). Furthermore, UUI can be divided into two subgroups: sensory type and neurological type. The Sensory type originates from bladder irritation, inflammation, or infection. In contrast, the neurologic type is primarily caused by the loss of cerebral inhibition over detrusor contractions (Khandelwal & Kistler, 2013).

Taken together, the MUI is an involuntary leakage of urine combining features of both SUI and UUI. This condition is more prevalent and severe in elderly women (Tran & Puckett, 2022; Davis et al., 2020; Lawson & Sacks, 2018). The three previously mentioned types of UI are the most common (Wyndaele & Hashim, 2020).

The fourth type is the overflow UI, which is an involuntary leakage of urine resulting from an overdistended and overfilled bladder. It typically occurs in impaired detrusor contractility or/and bladder outlet obstruction. Neurological disorders such as spinal cord injuries, multiple sclerosis, and diabetes can cause detrusor impairments, while external compression by

abdominal or pelvic masses, as well as POP, can lead to bladder outlet obstruction (Davis et al., 2020Tran & Puckett, 2022).

Lastly, the functional UI entails involuntary urine leakage because of physical, cognitive, or environmental difficulties hindering the individual from accessing the restroom. Another name for this type of UI is called toileting difficulty. Table 2.1 contains UI types (Davis et al., 2020; Tran & Puckett, 2022).

Type	Underlying Abnormality	Characteristics
Urgency	Bladder overactivity	• Strong, uncontrolled urgency prior to urine leakage • Large-volume urine loss • Urinary frequency • Nocturia (two or more times) • Nocturnal enuresis
Stress	Urethral underactivity	• Urine leakage with physical exertion (coughing, sneezing, laughing, lifting, changing positions, exercise) • Small amounts of urine loss
Mixed	Bladder overactivity and urethral underactivity	• Urine leakage associated with both urgency and physical exertion
Related to chronic retention of urine (or overflow incontinence)	Bladder underactivity or bladder outflow obstruction	• Difficulty starting urine stream • Weak or intermittent urine stream • Postvoid dribbling • Prolonged voiding • May have urinary frequency • Voiding a small amount • Feeling of incomplete bladder emptying
Functional	None	• Urine leakage associated with mobility, manual dexterity, cognitive impairment, or environmental factors that make it difficult to reach a toilet or urinal or to disrobe in time

Table 2.1: Types of Urinary Incontinence/Characteristics (Davis et al., 2020)

Studies have shown that UI varies by ethnicity, with Caucasians having the highest prevalence at 7.3 per 100 person-years, Asians at 5.7, and African-Americans at 4.8 per 100 person-years (Demaagd & Davenport, 2012). Approximately 26% of women aged 30–59 experience SUI, with the highest prevalence between 40 and 49 (Sugumar et al., 2020). Up to 60% of pregnant women experience UI during pregnancy, and post-pregnancy rates range from 9% to 45% (Lawson & Sacks, 2018). The prevalence of undiagnosed UI

harms their QoL, including physical health, social interactions, sexual health, and psychological sector (Oliveira et al., 2017; Badillo, 2020). Prevalence rates of UI among women can reach as high as 45% in some countries, making it a primary worldwide health concern that negatively affects QoL for about 25% of the world's population (Oliveira et al., 2017).

Epidemiological studies have revealed that in 2018, about 300 to 420 million women and 120 million men will experience UI globally (Radzimińska et al., 2018). About half of all adult women experience UI: 49% SUI, 15% UUI, and 34% MUI (Wyndaele & Hashim, 2020). A US survey from 2005 to 2018 found SUI at 45.9%, UUI at 31.1%, and MUI at 18.1% prevalence (Abufaraj et al., 2021). Among reproductive-age women, UI rates range from 30% to 60%, with a higher prevalence in older women. In ages 20-39, 7% to 37% experience UI annually, and in ages 60 and above, 9% to 39% experience daily UI (Tran & Puckett, 2022; López-Liria et al., 2019). Surgical procedures dedicated to UI treatment number around 400,000 annually in the USA (Bozkurt et al., 2014).

The prevalence of PFD is expected to increase by 35% over the next two decades, with around 1.6 million annual visits for management and treatment by 2030 (Sugumar et al., 2020). In the USA, it's projected that by 2050, 28.4 million women will experience UI, up from 18.3 million in 2010 (Aoki et al., 2017). Globally, UI affects millions, with women constituting 85% of cases, underscoring its widespread impact and potential for severe consequences (Khandelwal & Kistler, 2013). Table 2.2 shows the prevalence rate of UI (Khandelwal & Kistler, 2013).

Type	*Prevalence*	*Pathophysiology*
Stress	24 to 45 percent in women older than 30 years	Sphincter weakness (urethral sphincter and/or pelvic floor weakness)
Urge	9 percent in women 40 to 44 years of age 31 percent in women older than 75 years 42 percent in men older than 75 years	Detrusor overactivity (uninhibited bladder contractions) caused by irritation within the bladder or loss of inhibitory neurologic control of bladder contractions
Mixed	20 to 30 percent of patients with chronic incontinence	Combination of stress and urge incontinence
Overflow (urinary retention)	5 percent of patients with chronic incontinence	Overdistention of the bladder caused by impaired detrusor contractility or bladder outlet obstruction; leads to urine leakage by overflow
Functional	Uncertain	Variable leakage of urine, usually caused by environmental or physical barriers to toileting

Table 2.2: Prevalence rate of UI (Khandelwal & Kistler, 2013).

2.2.3 Pathophysiological Changes

Most of the time, the primary role of the lower urinary tract is to store urine, which happens more than 99% of the time (Wyndaele & Hashim, 2020). During this phase, the ureters gradually fill the bladder with urine, which adapts to the increased volume without a significant rise in bladder pressure (Christopher & Chapple, 2008). The sympathetic nervous system takes the lead during the storage phase and ensures continence by functioning through the paravertebral ganglia, along with the hypogastric nerves and hypogastric plexus (Aoki et al., 2017). The capacity of the bladder to relax and take in urine is known as "compliance," which is influenced by several factors: (1) elasticity of the bladder wall, (2) the ability of smooth muscle to maintain a constant tension over a wide range of stretching, and (3) the neural reflexes that control the tension of the detrusor muscle during filling (Christopher & Chapple, 2008a; Wyndaele & Hashim, 2020).

The urethra and sphincteric mechanisms remain in a "closed" position during the storage phase, resulting in the maintenance of a high outlet pressure and the establishment of continence (Christopher & Chapple, 2008). The voiding phase is coordinated by the parasympathetic system, using the sacral plexus and pelvic nerves S2-S4 (Aoki et al., 2017). During the voiding phase, the pressure gradient shifts, prompting the detrusor muscle to contract instead of the bladder relaxing. This contraction causes the urethra and sphincteric mechanisms to "open," leading to a reduction in outlet pressure, allowing the expulsion of urine from the bladder (Christopher & Chapple, 2008; Wyndaele & Hashim, 2020).

An examination into the correlation between UI and age revealed that as individuals age, there's a decline in maximum urethral closure pressures. Notably, this decline becomes significant after the age of 36 years, with a documented 2-4% reduction in urethral efficiency upon crossing the age of 40 years (Price et al., 2010). Pathophysiological mechanisms underlying this condition have been extensively debated over the years, reflecting the subject's complexity. Regardless of the complexities involved, experts in the field generally agree that the condition progresses via two primary pathways. Both mechanisms are interconnected components within a continuum of alteration rather than existing as entirely distinct entities.: 1) urethral hypermobility and 2) intrinsic sphincter deficiency (Aoki et al., 2017; Lasak et al., 2018; Wyndaele & Hashim, 2020).

2.2.4 Cost of Treating Urinary Incontinence Patients

The economic impact of UI in the United States exceeds $20 billion annually, primarily due to expenses related to incontinence treatment,

absorbent products, and laundry, which can range from $50 to $1,000 per patient and increase with the severity of UI (Subak et al., 2014). Approximately 29.5 million Americans are affected by UI, contributing to an estimated financial burden of around $26.4 billion annually in the United States (Castro et al., 2008).

Research highlights the significant financial burden associated with UI. Women spend an average of $750 annually on incontinence care, impacting their QoL and their willingness to invest up to $1,400 per year in effective treatment options (Subak et al., 2008). Moreover, direct annual costs for managing UI patients aged 65 and older in the United States are estimated at roughly $25 billion (Demaagd & Davenport, 2012). Across five European countries, expenses for individuals aged 40 and above were projected to increase from 4.2 billion euros in 2000 to 5.2 billion euros by 2020, representing a 26% increase (Milsom et al., 2014).

The UI expenses include direct costs like incontinence pads (63% of per-patient annual fees), as well as indirect costs like lost wages, reduced productivity, and associated health challenges (Corrado et al., 2020; Datar et al., 2022; Milsom et al., 2014). Intangible costs include pain, suffering, and social withdrawal due to UI (Datar et al., 2022; Milsom et al., 2014).

2.2.5 Impact of UI on the Quality of Life

QoL encompasses various dimensions of well-being, including physical, psychological, economic, and spiritual aspects (T. Y. Kim et al., 2018). UI is a complex issue that affects personal hygiene and psychosocial well-being, often leading to social isolation and feelings of depression. It impacts multiple facets of life, such as family dynamics, work relationships,

and sexual function, ultimately lowering overall QoL (Corrado et al., 2020; T. Y. Kim et al., 2018).

A comprehensive analysis involving 23 research investigations, and 24,983 participants found a significant association between UI and reduced QoL Pizzol et al., (2021). Dealing with UI can be difficult for those affected, impacting personal privacy, sexuality and causing discomfort related to feeling "wet," "unclean," or "odorous." This discomfort results in avoidance of social and physical activities, contributing to issues like low self-esteem, negative body image, social stigma, and depression (Chaiyawat et al., 2021; Corrado et al., 2020).

Furthermore, the consequences of UI extend beyond the physical implications and resemble the effects of other chronic conditions like diabetes mellitus or cardiovascular disease (Christopher & Chapple, 2008). Negative coping mechanisms, such as self-blame and pessimistic worldviews, are linked to lower QoL in UI patients Corrado et al., (2020).

The research underscores UI's role in reducing QoL, affecting mental well-being and social engagement (Aoki et al., 2017). Persistent UI nature leads to substantial financial and psychosocial burdens (Chaiyawat et al., 2021). Additionally, UI profoundly impacts various aspects of individuals' lives, particularly women, leading to significant challenges across economic, cultural, religious, and social dimensions (Castro et al., 2008; Javanmardifard et al., 2022).

In severe cases, UI disrupts daily activities, causing individuals to interrupt tasks for restrooms frequently (Corrado et al., 2020). Women with UI often experience anxiety and sadness, lower levels of sexual pleasure, reduced physical activity, and lower self-rated health (Badillo, 2020; Pizzol et al., 2021). Furthermore, UI impact extends to the patient's social network,

including caregivers and family members. Partners may face challenges in maintaining sexual satisfaction due to feelings of embarrassment and shame associated with UI (Corrado et al., 2020).

2.2.6 Therapeutic Management

-Intervention Strategies for UI Management

In the context of addressing UI, the selection of appropriate treatment and care strategies depends on the specific UI subtype. These options encompass conservative, pharmaceutical, minimally invasive procedures, and surgical approaches (Wyndaele & Hashim, 2020; Wallace et al., 2004). They recommended progression from less invasive interventions to more advanced ones as dictated by individual needs. It's noteworthy that individuals facing UI may potentially encounter various complications, such as urinary tract infections, pressure ulcers, adverse effects from medications, psychological distress, and social isolation, among other challenges (Tran & Puckett, 2022).

The ICS advocates the prioritization of physical therapy as a primary treatment modality for managing UI in women. This approach has demonstrated notable positive outcomes, including a reduction of up to 80% in the frequency of incontinence episodes, along with a cure rate of up to 50% for affected women. Remarkably, certain participants even opted to forego conventional medical treatment in favor of this effective conservative therapy (McLean et al., 2013).

PFMT offers a conservative avenue not only for addressing UI but also for tackling issues like constipation, POP, and sexual dysfunction. By enhancing the coordination and strength of PFM, this therapeutic approach effectively provides support to the bladder and urethra, minimizing visceral

movement during instances of heightened IAP, such as instances of coughing, sneezing, or laughter. Furthermore, it concurrently elevates urethral pressure, thus effectively counteracting the leakage of urine (Zoorob & Anderson, 2019).

2.2.7 The Role of Physiotherapist Toward Managing Women's Health Dysfunctions

Physiotherapy has been practiced by great physicians such as Hippocrates and Galen since 460 BC (Tipton, 2015). The growth and development of physiotherapy experienced a significant boost during periods such as the First World War and the polio pandemic, primarily due to the surge in disabilities. Integral to healthcare, physiotherapists play a pivotal role in accelerating patient recovery, reducing hospitalization durations, facilitating better rehabilitation, and ensuring enhanced QoL (Dash, 2019). The essence of their practice lies in employing evaluative and therapeutic techniques to alleviate pain, augment mobility, deter disabilities, rejuvenate body functions and coordination, rectify musculoskeletal and postural discrepancies, and improve overall well-being (Badillo, 2020).

Focusing on specialized areas, pelvic floor physiotherapy specifically targets the multifaceted components of the pelvic girdle, including muscles, nerves, ligaments, connective tissue, lymphatic system, and joints, intending to improve mobility and function (Lawson & Sacks, 2018). A comprehensive history centered on female-specific aspects is paramount when approaching treatment, especially in women's health, which encompasses age, reproductive health, contraception usage, obstetric/gynecological backgrounds, sexual activity, bowel and bladder functions, bone-related disorders, and any other relevant symptoms or information (Badillo, 2020; Rodas & García-Perdomo,

2018). An entire body neuromusculoskeletal examination should be performed, including lumbopelvic hip function and movement, because of its relationship to the PFM, special tests and dermal examinations are essential for addressing pelvic girdle pain, dysfunction, and diastasis recti abdominis (Badillo, 2020; Krishna Dass et al., 2013; Eickmeyer, 2017).

Women's health physiotherapy encompasses a vast range of treatments. Some prevalent applications include postpartum recovery, pain management post perineal or cesarean section surgeries, addressing dyspareunia, aiding the recommencement of intimate relations, guiding weight management, and facilitating a secure return to physical exertions. The tailored treatment strategies are contingent upon individual symptoms, manifestations, and desired outcomes. For instance, Table 2.3 delineates interventions for desired outcomes. For instance, Table 2.3 delineates interventions for addressing diverse women's health issues (Badillo, 2020).

PT procedure	Modalities/techniques	Purpose
Neuromuscular Reeducation	• Pelvic floor muscle training • Deep core muscle training • Biofeedback (sEMG[1], RTUS[2]) • Functional mobility training • Gait training • Postural retraining • Neuromuscular electrical stimulation	• Improve control through awareness and proprioception • Restore normal, efficient movement, and muscle tone • Pain management
Manual Therapy	• Soft tissue mobilization • Myofascial release • Joint mobilization • Connective tissue manipulation • Visceral manipulation • Vaginal dilation	• Restore normal muscle tone and soft tissue mobility/extensibility • Pain management • Normalize sensation of pelvic structures/tissues • Increase ROM and flexibility • Encourage blood flow
Therapeutic Exercise	• Pelvic floor muscle exercise • ROM/stretching • Muscle strengthening/conditioning	• Improve strength • Increase endurance • Increase mobility
Behavioral Training/Self-Care	• Bladder retraining • Bowel retraining	• Improve bladder and bowel continence and function • Establish healthy toileting habits

[1] *sEMG* surface electromyography
[2] *RTUS* real-time musculoskeletal ultrasound

Table 2.3 Interventions for women's health disorders (Badillo, 2020)

Bladder training for UI includes lifestyle adjustments, regulating liquid consumption, and strengthening the PFM with the guidance of a physiotherapist. Using delay and distraction techniques can also enhance the condition's management, as Kim et al. (2014) noted. The initial approach to managing SUI involves PFMT and lifestyle changes (Krishna Dass et al., 2013). Bladder training is frequently utilized in both general and specialized healthcare settings, as well as in community facilities, to manage UI dysfunction (Wallace et al., 2004). Moreover, Kegel exercises are a prominent non-invasive technique to strengthen the PFM (Park & Kang 2014). Kegel exercises notably enhance the strength of the PFM, diminish the intensity of UI, and markedly boost the QoL for women experiencing UI (Ismail et al., 2019).

2.2.8 Kegel Exercises

Kegel Exercises have a rich history and a wide range of applications in contemporary healthcare. The widespread adoption of Kegel for UI treatment has roots tracing back to 1948, following the work of Arthur Kegel, an American obstetrics and gynecology professor. Initially, Kegel exercises were primarily designed to address and treat PFD in women, particularly those experiencing UI and POP (Price et al., 2010; Rodas & García-Perdomo, 2018).

Dr. Kegel's innovative approach aimed to strengthen the PFM, which is crucial in supporting the pelvic organs, controlling urinary and fecal continence, and contributing to sexual function. In his article titled "Progressive Resistance Exercise in the Functional Restoration of the Perineal Muscles," he observed the effectiveness of Kegel exercises over 64

individuals with PFDs, including UI patients (Kegel, 1948; Price et al., 2010; Rodas & García-Perdomo, 2018).

Kegel exercises are targeted PFM exercises aimed at improving PFM tone and strength, ultimately preventing potential dysfunctions, such as POP and UI. Their regular practice contributes to the enhancement of bladder and bowel control. Kegel exercises represent a non-surgical and non-pharmacological approach to addressing UI, POP, and PFD (Nisa et al., 2020). These exercises are simple yet highly effective, offering minimal risks and without associated complications. Their effectiveness lies in their ability to counter UI symptoms by enhancing the weakened PFM and promoting adaptability (Park & Kang, 2014).

Kegel exercises are performed by a conscious inward and upward squeeze of the PFM region, as shown in Figure 2.6, entailing regular contractions that bolster strength, provide perineal support and enhance muscular tone. Research suggests a variation in the recommended contraction repetitions, ranging from 8 to 12 contractions thrice daily to 20 contractions quartet times daily, with the 'hold and squeeze' duration varying from 4 seconds to between 30 and 40 seconds (Curillo-Aguirre & Gea-Izquierdo, 2023). Furthermore, evidence suggests that the advised length for the entire training protocol varies significantly, ranging from one week to six months (Dumoulin et al., 2018; Price et al., 2010). What makes Kegel exercises particularly appealing is their accessibility and adaptability. These exercises can be tailored to individual needs and can be performed discreetly without the need for special equipment or a dedicated exercise space (Terzoni et al., 2021).

The justification for Kegel exercises rests on dual principles: enhancing urethral resistance and supporting pelvic visceral, including urethral support.

This is achieved by amplifying the strength of voluntary PFM and prompting the PFM to contract voluntarily ahead of a rise in IAP. An effective Kegel exercise protocol would modify the muscle structure and position, facilitating instinctive contraction, a mechanism commonly observed in women who maintain continence (Bertotto et al., 2017; Krishna Dass et al., 2013).

Furthermore, Kegel exercises are not confined to a specific age group. They are accessible to both young and older individuals. Younger individuals may use them as a preventive measure, maintaining strong PFM to mitigate future disorders (Cho & Kim, 2021). For older individuals, Kegel exercises can be a valuable tool for managing and improving conditions associated with aging, such as UI and pelvic floor weakness, which can significantly enhance the QoL (Dumoulin et al., 2018).

Kegel exercises are often advocated as the primary treatment for UI, and substantial evidence supports its efficacy (Badillo, 2020; Biswas et al., 2017). As per the European Association of Urology, there's Level 1 proof highlighting the Kegel exercise's effectiveness in improving UI and QoL in instances of SUI and MUI relative to no intervention. The Canadian

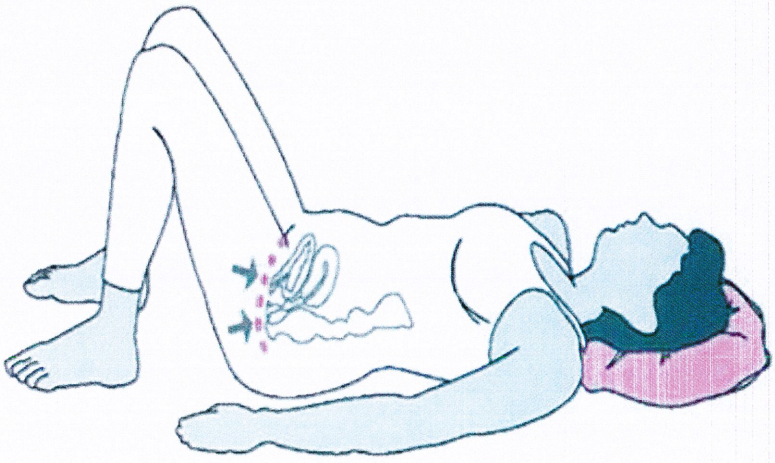


Figure 2.1: Demonstrating Kegel Exercise

Urological Association, alongside the European Association of Urology, both extend Grade A accolades to Kegel exercises as the foremost treatment choice for UUI (Syan & Brucker, 2016).

2.2.9 Pelvic Floor Muscle Training

Effective muscle training relies on three core principles: overload, specificity, and reversibility. Overload entails subjecting the muscle to increased workloads, fostering physiological adaptations like enhanced mitochondrial activity, improved enzyme function, increased glycogen levels, and muscle growth, even within the PFM. Specificity emphasizes training the muscle with activities closely mirroring functional movements. Reversibility underscores that exercise benefits can diminish if not incorporated consistently into daily routines. Hence, maintaining a regular exercise regimen is crucial to sustaining improvements in UI achieved through PFMT (Lasak et al., 2018; Laycock, 2008; A. Marques et al., 2010; Rodas & García-Perdomo, 2018).

The PFMT is suggested as the first-line therapy for UI, in contrast to Kegel exercises, which predominantly target the compromised PFM without addressing the comprehensive core structures essential for modulating IAP and enhancing spinal sagittal stability (Åhlund et al., 2013). Promoting PFMT involves the coordinated engagement of core muscles, specifically the diaphragm, TrA, multifidus, and PFM (E. Y. Kim et al., 2012). Together, they ensure the effective preservation of urinary continence by modulating IAP and stabilizing the spinal sagittal position (Kobesova & Kolar, 2014). The Integral Theory System for PFMT closely emulates natural muscle movements and

offers more extensive symptom improvement compared to traditional Kegel exercises (Biroli, 2007).

Simultaneously, the activation of trunk-stabilizing muscles, such as the TrA, enhances PFM contraction by generating IAP and managing trunk load during daily activities (Bø et al., 2009; Junginger et al., 2014). However, this mechanism is often compromised in cases of UI. Thus, reconditioning of core muscles and IAP adjustment have emerged as potent therapeutic modalities for women presenting with UI. The training encompassed contractions of the PFM in multiple positions (supine, prone, sitting, and standing), along with exercises aimed at strengthening the abdominal muscles and stabilizing the trunk (Chaiyawat et al., 2021; E. Y. Kim et al., 2012; Lasak et al., 2018).

The functionality of PFM is intricately linked with other synergistic muscles, including the abdominal muscles, thigh adductors, and the gluteus maximus muscle, depending on the physical strain. This interplay involves simultaneous activity during tension (Lasak et al., 2018; Ptak et al., 2017). Additionally, the synergistic interaction with the TrA, which shares biomechanical and anatomical characteristics with PFM, naturally activates the TrA, further increasing tension, especially during Maximum voluntary contraction when other muscles like the external oblique muscle and rectus abdominis muscle may also come into play. In summary, conservative PFMT significantly improves the QoL for UI patients. Both PFMT with additional exercises for synergistic muscles and isolated PFMT show positive effects. However, the regimen with added TrA exercises excels in effectiveness, suggesting its consideration as the primary intervention approach in future studies. (Ptak et al., 2017; Rodas & García-Perdomo, 2018).

In a study by Bø, (2004), PFMT was highlighted as an uncomplicated, impactful, and non-invasive method for treating patients with PFD. The

research emphasized the multiple advantages of the PFMT for UI management, as supported by numerous studies. The benefits include enabling women to consciously contract their PFM prior to and during an elevation in IAP to mitigate leakage, enhancing muscle endurance, which in turn provides structural stability, and indirectly fortifying the PFM by training the abdominal muscles.

2.2.10 Home-based functional approach

The HBFA demonstrated superior outcomes in enhancing QoL, reducing the intensity of incontinence, decreasing leakage volume, regulating micturition frequency, and bolstering sagittal stability. In contrast, Kegel exercises primarily showed efficacy in elevating QoL alone (Chaiyawat et al., 2021). A significant majority of participants, comprising 80%, indicated substantial improvements in their UI following a HBFA, reporting that their condition was "much better" or "very much better" (Bernard et al., 2021).

A physiotherapist instructs functional training, which involves a specialized exercise regimen that simulates everyday activities and situations related to incontinence. Its purpose is to empower individuals to instinctively manage these scenarios without encountering incontinence issues (Berghmans & Seleme, 2020).

The functional approach, anchored in developmental kinesiology, reflects the stabilizing patterns observed in a healthy infant where core stabilizers are reflexively and subconsciously activated. They adhere to foundational principles like the ideal respiratory pattern, IAP regulation, the integration of the Spinal Stabilizing System (ISSS), and joint centration. This approach accentuates the harmonized engagement of the diaphragm, PFM,

and deep abdominals to support IAP regulation (Chaiyawat et al., 2021; Kobesova & Kolar, 2014; Lasak et al., 2018; Sharma & Yadav, 2020).

Several studies utilizing a global reeducation approach have investigated training involving the abdominal-lumbar-pelvic complex to improve PFM function and alleviate associated symptoms. The abdominopelvic kinesiotherapy program effectively enhances PFM strength and reduces urinary symptoms, offering valuable clinical applications (Botelho et al., 2015).

Moreover, exercises within the functional approach emulate positions commonly assumed during everyday activities, simplifying routine tasks and enhancing QoL. Enhanced motor performance is typically evident when the intervention or practice aligns closely with the actual functional activity (Chaiyawat et al., 2021; Sharma & Yadav, 2020). A kinesiotherapy program encompassing abdominopelvic exercises in five functional positions, including supine, seated on the floor, sitting on a gym ball, squatting, and a standing position, demonstrated remarkable efficacy in enhancing PFM strength and alleviating symptoms of UI (Botelho et al., 2015). Hence, among women diagnosed with UI, physical therapists might lean towards the HBFA as their primary therapeutic intervention(Chaiyawat et al., 2021; Sharma & Yadav, 2020).

2.2 Literature Review Key Points:

- The PF increasing incidence is observed with age, affecting a significant proportion of women worldwide. PFD refers to conditions impacting the female urinary and fecal continence system, including the support of pelvic organs (Chen, 2007; Johnston, 2019; Wu et al., 2014).

- Roughly one in every four women experience PFD at some point in their lives, with an estimated 17% suffering from it due to factors like age, body weight, number of childbirths, and history of hysterectomy (Biswas et al., 2017; Limpawattana et al., 2015; Norton & Brubaker, 2006).
- UI is characterized as involuntary urine loss caused by PFD. Globally, around 200 million people are affected by UI, with projections indicating a significant increase (Badillo, 2020; Good & Solomon, 2019; López-Liria et al., 2019).
- UI is identified as the most common dysfunction in women, with five different types, each with unique characteristics and triggers (Demaagd & Davenport, 2012; Johnston, 2019; Khandelwal & Kistler, 2013).
- Studies show variations in UI prevalence by ethnicity and age, with certain ethnic groups having higher prevalence rates (M. Oliveira et al., 2017; Sugumar et al., 2020).
- UI extensively affects personal hygiene, psychosocial well-being, leading to social isolation, depression, and lowered overall QoL (Christopher & Chapple, 2008a; Corrado et al., 2020; T. Y. Kim et al., 2018).
- Assessment Techniques for PFM include visual inspection, digital palpation, electromyography, manometry, and ultrasound. Digital palpation with specific scoring systems is preferred for clinical evaluation (Cho & Kim, 2021; Laycock & Jerwood, 2001).
- Treatment Modalities for UI encompass a range of strategies, from conservative to surgical approaches, with physical therapy as a primary modality (Wallace et al., 2004; Wyndaele & Hashim, 2020).

- PFMT offers a conservative method for addressing UI, enhancing coordination and strength of PFM, while Kegel exercises focus on strengthening the PFM to prevent dysfunctions like POP and UI (Price et al., 2010; Zoorob & Anderson, 2019).
- HBFA demonstrates superior outcomes in improving QoL and managing UI symptoms compared to traditional methods (Berghmans & Seleme, 2020; Chaiyawat et al., 2021).

Chapter Three

Methods and Procedures

3.1. Research Design

3.2. Clinical Setting

3.3. Population and Sampling

3.4. Outcome Measures

3.5. Data collection/ procedure

3.6. Ethical Consideration

3.7. Statistical Analysis

Chapter Three

Methods and Procedures

3.1 Research Design

A quasi-experimental pre-test post-test, two groups research design was used to determine the causal effect of a Home-Based Pelvic Floor Muscle Rehabilitation (HB-PFMR) program on the target population (Females with UI). This design was selected due to its practicality and alignment with the study's objectives of assessing intervention efficacy in a controlled yet feasible manner.

The pre-test post-test structure allows for the measurement of baseline conditions and subsequent changes within and between the groups following the intervention, offering robust evidence of its effectiveness. The two-group setup enables comparison between the HB-PFMR program and a control group performing routine Kegel exercises. The quasi-experimental design was particularly suitable for this study as it facilitated the inclusion of naturally occurring groups while maintaining a focus on assessing the intervention's real-world applicability and outcomes.

3.2 Clinical Setting

The study was conducted at Ibn Al-Nafees Hospital (INH) in Manama, Bahrain. This setting is one of the medical institutions equipped with modern facilities to provide a comprehensive array of medical services in various specialties. It also has a well-equipped physiotherapy department that provides a wide range of specialized rehabilitation services for all kinds of

physical therapy cases, including PFMT for females with UI referred by many healthcare providers.

3.3 Population and Sampling

3.3.1 Target Population

The study population comprises females experiencing UI types, including stress, urge, and mixed UI, referred by Urological or Gynecological healthcare professionals.

3.3.2 Sample Size

The study commenced with the enrollment of 199 individuals. Of these, 125 were excluded—109 for not meeting the inclusion criteria and 16 for declining participation—leaving 74 participants. The sample size was estimated using the EBI-info program (version 10) using the following parameters: A population size (N) of 74 clients with UI, a confidence coefficient of 95%, an anticipated frequency of 50%, and an acceptable error of 5%. The minimum sample size is 62 participants.

3.3.3 Eligibility Criteria

- Inclusion Criteria

This study's inclusion criteria encompass adult female patients aged 35 to 55 years diagnosed with Stress UI, Urge UI, and Mix UI based on the the 3-incontinence questionnaire (3IQ) criteria (including 3-months symptoms) and able to read and respond to the English version of the questionnaire.

-Exclusion Criteria

These exclusion criteria have been implemented to minimize the threats to the study's internal validity.

- Females with a sudden onset of UI
- Females who have undergone surgeries related to the pelvic floor
- Multiple PFD
- Terminal illness
- Cognitive impairment
- Physical disabilities
- Verbal communication impairment
- Current pregnant were excluded from the study.

To identify the eligible participants, the 3-incontinence questionnaire (3IQ) was distributed, and the type of UI (stress, urge, or mixed UI) was determined. However, respondents with other types of UI were excluded.

3.3.4 Recruitment and Assignment

Electronic medical records were frequently accessed to obtain the required sample size and determine the referred women diagnosed with UI. Subsequently, the eligible individuals who had visited the Urology and Gynecology department at INH throughout the study period received an invitation link to participate. This link included an overview of the study's objectives, outlined through a social networking website (What's App). The use of WhatsApp was selected for its widespread accessibility and familiarity

among the target population, facilitating effective and timely communication. To ensure the confidentiality and security of this approach, all messages were sent individually, and no personal information was shared publicly or with unauthorized parties. Participants were also informed of their right to voluntary participation, including the freedom to withdraw at any stage without any consequences. These measures ensured that the recruitment process was conducted responsibly, with respect for participant privacy and data protection standards.

3.3.5 Participant Recruitment and Random Assignment

An initial meeting was held in the consultation room of the INH physiotherapy department, where the researcher thoroughly explained the study's objectives, expected duration, potential risks, and benefits to the participants. The session also emphasized the importance of urinary incontinence (UI) management, following the guidelines set by the "Continence Foundation of Australia." Recommendations included reducing frequent coughing, avoiding heavy lifting, addressing obesity-related weight issues, and making dietary adjustments, among other strategies (Continence Foundation of Australia, 2024). Participants who agreed to take part in the study provided written informed consent during this session.

Data collection took place from February to August 2023, beginning with the enrollment of 199 individuals. Of these, 125 were excluded—109 for not meeting the inclusion criteria and 16 for declining participation—leaving 74 participants. These participants were randomized into two groups. Once referred by a physician (urologist or gynecologist), the first participant was

assigned to the study group, followed by the next participant being assigned to the control group. The final analysis included 32 participants in the study group and 30 in the control group, with data visually summarized using a CONSORT 2010 Flow Diagram (Figure 3).

The study sample consisted of 62 women with UI who met the inclusion criteria. They were randomly divided into two groups: the study group (n=32), which received home-based pelvic floor muscle rehabilitation (HB-PFMR), and the control group (n=30), which followed routine Kegel exercises. Figure 3.1 provides a detailed consort diagram illustrating the study's flow.

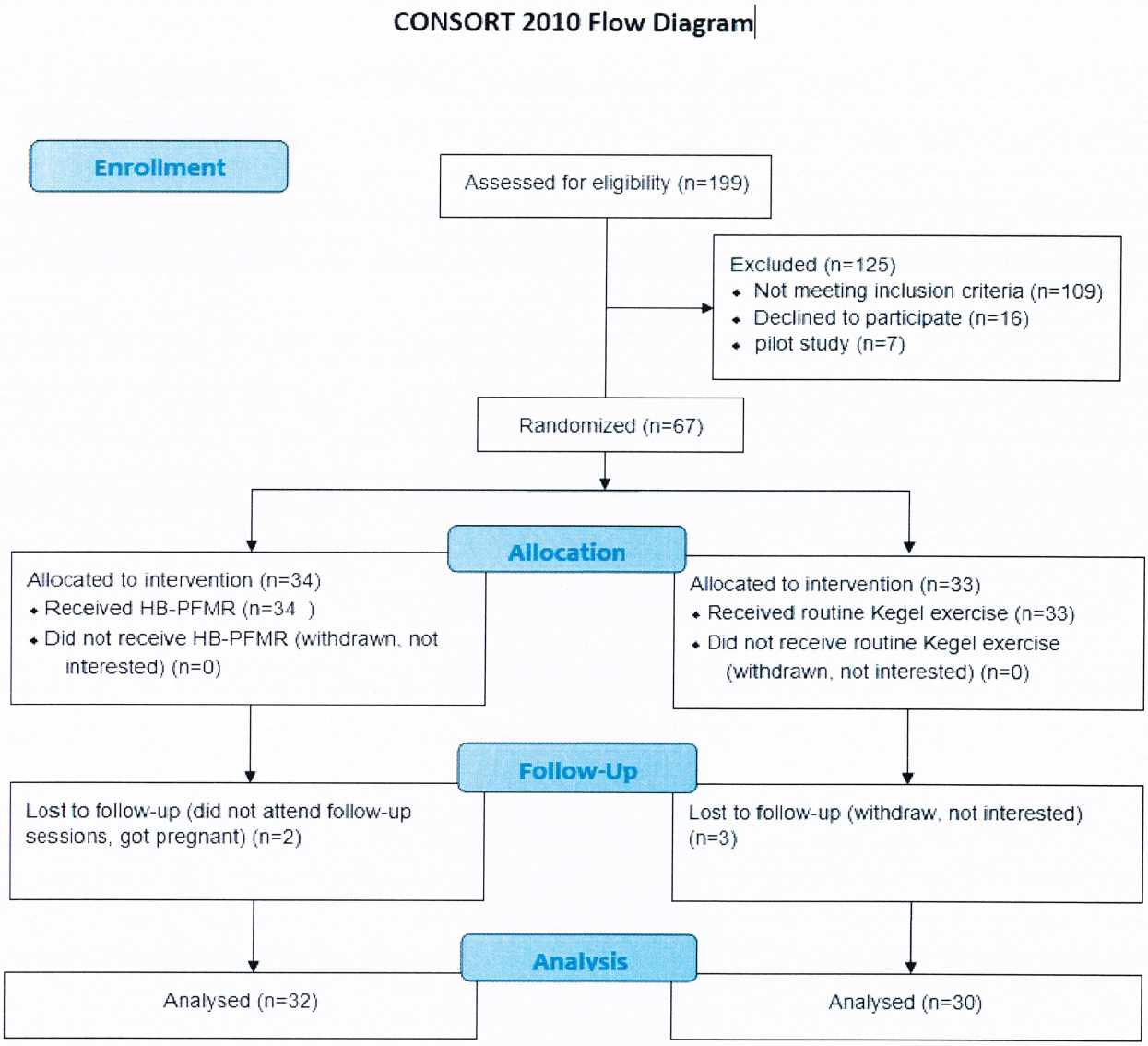


Figure 3.1 Consort Flow Diagram

3.4 Outcome Measures

This study employed a comprehensive array of data collection tools to ensure the acquisition of pertinent information. These tools were thoughtfully selected to address a broad spectrum of factors. The instruments utilized for

data collection included demographic information, the 3-incontinence questionnaire (3IQ), the incontinence severity index (ISI), the International Consultation on Incontinence Questionnaire Urinary Incontinence Short Form (ICIQ-UI SF), and the King's Health Questionnaire (KHQ).

The initial assessment, framed by these data collection tools, encompassed an exhaustive evaluation of the participants' socio-demographic characteristics and obstetrical clinical data. Socio-demographic attributes included age, level of educational, working status and occupation's intensity. Furthermore, obstetrical clinical data including the nature of the menstrual cycle, pregnancy status, history of miscarriages, number of pregnancies, normal deliveries, cesarean (c-section) deliveries, presence of UI, interventions related to UI, the presence of other PFD, history of medication intake within the last month, and previous surgeries associated with pelvic or abdominal issues.

- **Tool I: The 3 Incontinence Questionnaire (3IQ)**

The 3IQ is a self-administered questionnaire developed in 2006 by Brown et al. (2006)to identify the presence of UI and classify its type. The tool consists of 3 questions; the first confirms that incontinence has happened during the last three months. The second and third questions assess the condition associated with UI. Accordingly, the UI type is identified depending on the answer to question three. The responses to these questions are multiple-choice, allowing individuals to select the option that best describes their experience.

The 3IQ has undergone validation in multiple studies, demonstrating strong reliability and validity in identifying types of UI. Brown et al. (2006)

reported that the 3IQ has a sensitivity of 86% and a specificity of 79% in distinguishing between stress urinary incontinence (SUI) and urge urinary incontinence (UUI) in primary care settings. Similarly, Tran & Puckett (2022) highlighted the instrument's high specificity of up to 92% in predicting UI, affirming its utility as a diagnostic tool. These findings underscore the reliability of the 3IQ as a validated instrument for use in clinical and research settings.

A comprehensive review of literature from January 1965 to October 2005 uncovered seven relevant studies examining the efficacy of questionnaires in classifying incontinence types. Contrasted with the 3IQ, six surveys identified were considerably longer (5 to 18 items), necessitated score calculations, and were evaluated within specialized, single-location clinic populations. These findings accentuated the utility of the 3IQ in assisting primary care physicians in effectively diagnosing and managing incontinence in women.

Several international studies, including those by Dogan et al., 2015; Hess et al., 2013; Khan et al., 2018; Madill et al., 2013, have successfully employed the 3IQ. This brief, validated, and reproducible questionnaire proficiently distinguishes between UUI and SUI, underscoring its reliable long-term use in guiding UUI treatment for women. The emerging data affirming the safety and efficacy of the 3IQ for determining incontinence types bolsters the conviction that a streamlined diagnostic and treatment approach for UUI is plausible. Such an approach is anticipated to yield enhanced clinical outcomes for community-dwelling women devoid of significant health issues. By facilitating easier access to treatment in primary

care environments, the 3IQ holds the potential to significantly enhance the QoL for women experiencing UI (Hess et al., 2013). (appendix 1)

- **Tool II: The Incontinence Severity Index (ISI)**

The ISI questionnaire was initially developed by Sandvik et al. (1993) to assess the severity of UI. It includes two questions regarding the frequency and the amount of urinary leakage. For frequency of urine leakage, the participant will rate their response on 5 points as follows: 0 = never, 1 = less than once a month, 2 = one or several times a month, 3 = one or several times a week, 4 = every day and/or night. Regarding the amount of urine loss, the participants will rate their responses as follows: 0= = never, 1 = drops or little, 2 = more. The severity index scoring is created by multiplying the result of questions 1 and 2. The ISI categorizes UI into no UI 0, slight 1-2, moderate 3-6, severe 8-9, and very severe 12. The ISI showed good construct validity (Hanley et al., 2001; Sandvik et al., 2006).

Bhagwan et al. (2022) have noted that the implementation of ISI is both cost-effective and time-efficient, rendering it suitable even for resource-limited settings. Over the years, the ISI has been instrumental in a myriad of epidemiological and clinical UI studies, as exemplified by research from (Chaiyawat et al., 2021; Wikander et al., 2022;Bhagwan et al., 2022) Notably, the ISI has garnered the highest commendation from both the second and third International Consultation on Incontinence (ICI), further attesting to its significance in the field (Sandvik et al., 2006). (appendix 2)

- **Tool III: International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF)**

During the first Scientific Meeting of the International Consultation on Incontinence Committee in 1998, the patient-reported outcome measure (PROM) for UI patients was initially drafted. In 1999, the ICIQ-UI SF was developed to evaluate UI frequency, severity, and impact on the females' QoL.

This questionnaire is a self-reported survey and screening tool for UI. It includes four main items out of six total questions that ask for a rating of symptoms in the past four weeks. Aiming to gather information on demographics, frequency of urination, quantity of urine leakage, and the effect of UI on QoL (Al-Shaikh et al., 2013), as illustrated in table No 3.1.

Table 3.1 International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF) questions.

Questions 1 and 2	Demographic data (date of birth and gender).
Question 3	How often do you leak urine?
Question 4	How much urine do you usually leak (whether you wear protection or not)?
Question 5	Overall, how much does leaking urine interfere with your everyday life?
Question 6	When does urine leak? The timing of urine leakage is evaluated in eight sub-questions, which are not included in the scoring portion of the questionnaire (self-diagnostic items)

The sum of questions 3+4+5 are calculated for the score. The scoring scale is 0–21. The higher the score, the greater the indication of impaired UI. Four scoring classifications: slight (1-5), moderate (6-12), severe (13-18), and

very severe (19-21) (International Consultation on Incontinence Questionnaire - Short Form, 2012).

The ICIQ-UI SF questionnaire has been widely translated into over 60 languages and is accessible through the website www.iciq.net since 2004. Over 3700 articles have used the "ICIQ" as of October 2019. (appendix 3)

- **Tool IV: King's Health Questionnaire (KHQ)**

The KHQ was developed in 1997 by researchers at King's College Hospital in London (Kelleher, 1997). It is used to assess the impact of UI on an individual's QoL (Viana et al., 2015). It includes nine areas comprising 21 items and an independent scale with nine items to evaluate the severity of the symptoms, as illustrated in table No 3.2.

Table 3.2 King's Health Questionnaire (KHQ) domains and scoring calculations

Domains	No. of Items	Cluster of items	Scoring
General health perception	1	1	= (Score of Q1) –1 ÷4 * 100
Incontinence impact	1	2	= (Score of Q2) – 1 ÷3 * 100
Role limitations	2	3a-3b	= (Score of Q3a+Q3b) –2 ÷6 * 100
Physical limitations	2	4a-4b	= (Score of Q4a+Q4b) –2 ÷6 * 100
Social limitations	2	4c-4d	If Q5≥ 1 = (Score of Q4c+Q4d+ Q5c) –3 ÷9 * 100 If Q5c = 0 = (Score of Q4c+Q4d) –2 ÷6 * 100
Personal relationships	3	5a-5b-5c	If Q5a+Q5b≥ 2 = (Score Q5a+Q5b) – 2 ÷6 *100 If Q5a+Q5b= 1 = (Score Q5a+Q5b) – 1 ÷3 *100

			If Q5a+Q5b =0, Treat it as a missing value
Emotions	3	6a-6b-6c	= (Score of Q6a+Q6b+Q6c) –3 ÷9 * 100
Sleep/energy	2	7a-7b	= (Score of Q7a+Q7b) –2 ÷6 * 100
Severity measures	5	8a-8b-8c-8d-8e	= (Score of Q8a+Q8b+Q8c+Q8d+Q8e) – 5 ÷15 *100

A five-point Likert scale was used to measure general health perceptions, and a four-point Likert scale, including a "not applicable" option, was used for evaluating personal relationships. Furthermore, a four-point Likert scale is used across seven other domains, and a three-point Likert scale is utilized for the symptom severity scale.

Scoring is derived by adding the scores across all domains, where lower scores indicate best conditions. A higher score signifies a greater detrimental effect on the individual's QoL. The symptom severity scale measures 0 (indicating the best condition) to 30 (reflecting the worst condition). Similarly, domain scores range from 0 (representing the best) to 100 (indicating the worst). According to Kelleher (1997), the KHQ stands as a robust, valid, and reliable tool for such assessments. (appendix 4)

3.5 Data Collection Procedures

3.5.1 Pilot Study

A pilot study was conducted, and seven patients (10%) were selected from the previously mentioned setting. The primary aim of this pilot study was to evaluate the feasibility, applicability, and overall clarity of the research tools employed, as well as to gauge the time required for their completion. It

is essential to note that participants involved in this initial pilot study were subsequently excluded from the overall study sample.

The study protocol was found to be suitable for the research aim and the participants. It effectively addressed the research objectives and was well received by the participants, who found the procedures clear and manageable. The feedback gathered during this pilot phase indicated that the research tools were appropriate and that the time required for completion was reasonable, ensuring the participant's willingness to engage fully in the main study.

3.5.2 Assessment Phase

In the Assessment Phase, both the study and control groups underwent a comprehensive data collection process to establish a robust baseline. It involved the acquisition of demographic and obstetric clinical data, the assessment of UI severity using Tool II, the evaluation of UI frequency and volume using Tool III, and a thorough investigation of participants' QoL through the utilization of Tool IV.

3.5.3 Preparation Phase

The Preparation Phase was dedicated to ensuring the systematic execution of research intervention. Here, the researcher prepared the treatment area, ensuring all required equipment was readily available and properly arranged. Additionally, a structured schedule for the upcoming training sessions was established to ensure a continuous and well-organized research process.

3.5.4 Intervention Phase

-Group I - Experimental Group: Home-Based Pelvic Floor Muscle Rehabilitation Intervention (HB-PFMR)

The experimental group underwent HB-PFMR, as outlined in the works of Chaiyawat et al., 2021; Madill et al., 2013. To ensure clarity and practical training, the researcher played a pivotal role by providing a comprehensive explanation and demonstration of the training program. Participants who had expressed their commitment to the training program subsequently engaged in practical demonstrations, reinforcing their understanding of the prescribed exercises.

The intervention had two parts: (a) 5 different Kegel exercises and (b) 5 different functional approach exercises, as shown in Tables no 3.3 and 3.4.

- **Part I: Kegel exercises**

Participants were directed to engage in the HB-PFMR intervention once daily for four weeks. This intervention was structured as a systematic and progressive program, with specific positions assigned for each week. The participants were instructed to perform the following PFM contractions:

Table 3.3: Pelvic Floor Muscle rehabilitation program (4 weeks program)

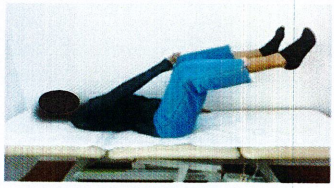
Exercise	Description	Week 1 (Crook Lying)	Week 2 (Sitting)	Week 3 (Standing)	Week 4 (Four-Point Kneeling)
Maximum PFM Contractions	Participants maximally contract and hold their PFMs while maintaining their breath by counting loudly.	1 set 6 repetitions 6 sec. hold	1 set 8 repetitions 8 sec. hold	1 set 10 repetitions 10 sec. hold	1 set 12 repetitions 12 sec. hold
Flicks	Participants maximally contract their PFMs and then perform four rapid PFM contractions (flicks) superimposed on the initial contraction without relaxing in between.	1 set 4 rapid flicks (6 sec each)	1 set 4 rapid flicks (8 sec each)	1 set 4 rapid flicks (10 sec each)	1 set 4 rapid flicks (12 sec each)
Knack	Participants contract their PFMs and hold the contraction while coughing forcefully.	3 sets, 3 repetitions	3 sets, 3 repetitions	3 sets, 3 repetitions	3 sets, 3 repetitions
Podium	Participants moderately contract their PFMs (to about half their maximum), increase the contraction to their maximum, relax back to moderate contraction, and finally relax completely.	Moderate, max, moderate, relax (each 6 sec)	Moderate, max, moderate, relax (each 8 sec)	Moderate, max, moderate, relax (each 10 sec)	Moderate, max, moderate, relax (each 12 sec)
Rapid Repeated PFM Contractions	Participants maximally contract and then relax their PFMs repeatedly, taking about 1 second to contract and 1 second to relax.	1 sec contract, 1 sec relax	1 sec contract, 1 sec relax	1 sec contract, 1 sec relax	1 sec contract, 1 sec relax

Throughout the program, participants diligently adhered to the prescribed schedule, as detailed in the accompanying Table no 3.3, ensuring a systematic progression in the duration of Maximum PFM contractions and overall adherence to the intervention strategy. This phased approach aimed to gradually build strength and control in the PFM, contributing to the overall effectiveness of the HB-PFMR intervention.

- Part II: Functional Approach Exercise

The Functional Approach Exercise constitutes the second phase of the intervention and comprises five different exercises. Participants were asked to perform these exercises thrice weekly for four weeks (every other day), as seen in Table 3.4.

Table 3.4: Functional Exercises (4 weeks program)(appendix 7-consent form)

Exercises	Description	Picture
Exercise One	To maintain intra-abdominal pressure, the chest and pelvis are in a parallel position (supine position). The therapist maintains the participant's leg at 90–90 degrees (hip & knee) with minor abduction and external rotation. When participants gain control, they maintain their legs by themselves. Participants then inhaled while bringing their hips and knees to 90-90 degrees and exhaled while lowering them.	
Exercise Two	This exercise is done with the upper extremity movement. The starting position is like the first exercise. The participant is asked to inhale while moving one hand toward the opposite knee without any chest movement and exhale while moving the same hand back to its initial position. This will be repeated for both sides.	
Exercise Three	This exercise is done with the lower extremity movement. The starting position is like the first and second exercises. Without moving the spine and pelvis, the participants should inhale while abducting one leg and exhale while returning it to the starting position. This will be repeated on the other side.	
Exercise Four	The participant starts in the standing position. The participant is asked to inhale and squat simultaneously, then exhale while returning to standing.	

Exercise Five	The participant begins in a standing position with both feet on the same level and the pelvis apart. The participant is then asked to raise both hands to the level of their shoulders (90 degrees) and slightly flex their knees. Then, inhale, step forward with one leg, and exhale while returning the leg to the starting position. This will be repeated on the other side.	

Participants were instructed to repeat each exercise 10 times, combining close-to-maximum PFM contractions with a 3-second hold and a subsequent 3-second relaxation. Throughout the execution of these exercises, participants were guided to use diaphragmatic breathing techniques, contributing to the precision and effectiveness of each movement. Participants were asked to complete these exercises thrice weekly for four weeks (every other day- complete set).

-Group II - The Control Group: Routine Kegel Exercise

Participants in the control group were instructed to perform the routine Kegel exercises only. The prescribed Kegel Exercise regimen involves participants assuming a supine position, lying on their backs with knees bent. This exercise was asked to be performed twice daily, encompassing 25 repetitions during each session. Each contraction will be held for 3 seconds, followed by a 3-second relaxation period, in line with the established guidelines elucidated in the study by Chaiyawat et al. (2021).

3.5.5 Follow-up and Evaluation Phase

In the follow-up phase, consistency and participant engagement remain a priority for both groups. The researcher conducted a live training session

twice a week, spanning one month, equating to eight sessions per participant. To reinforce exercise compliance and track progress, each participant had a log sheet documenting their exercise routines. Additionally, daily communication with participants was established through social networking websites.

Following the one-month intervention period, a comprehensive evaluation was scheduled for participants in both the study and control groups. This evaluation included reassessing UI severity using Tool II and analyzing the frequency and volume of UI documented through Tool III. Participants' QoL was also re-evaluated using Tool VI.

3.6 Ethical consideration

The study was executed with rigorous adherence to ethical principles and standards. Prior to commencing the study, necessary approvals were diligently obtained from the management of the study setting (Dated 5 January 2023) (Appendix 5). Final approvals were obtained from the Deanship of Graduate Studies and the University Council (Decision 28/2 2023). Written informed consent was obtained from the participants after explaining the aim and objectives of the study (Appendix 6). The researcher also obtained informed consent from a volunteer female participant, allowing the use of her photographs in the research paper and for academic purposes (Appendix 7). Participation in the study was entirely voluntary. The right to refuse, participate, or withdraw from the study was emphasized. Confidentiality of the data obtained was assured, and participants' anonymity was respected.

3.7 Statistical Analysis

The Statistical Package for Social Sciences (SPSS) version 26 was utilized for data analysis. Descriptive statistics included numbers, percentages, mean and standard deviations to describe demographic characteristics, severity, frequency, volume of UI, and participants' QoL. Data were tested for normality using the Kolmogorov-Smirnov test. For Inferential statistics, the Chi-square test was used to compare the experimental and control groups regarding severity, frequency, and urinary leakage volume among women with UI. The statistical differences between the experimental and control groups were tested using a t-test for normally distributed variables or Mann-Whitney (Z) tests for the non-normally distributed test variables. All the statistical analyses were considered significant at $p < 0.05$

Chapter four

Results

4.1. Result of Sample Characteristics

4.2. 3-Incontinence Questionnaire (3IQ)

4.3. Incontinence Severity Index (ISI)

4.4. International Consultation on Incontinence Questionnaire Urinary Incontinence Short Form (ICIQ-UI SF)

4.5. King Health Questionnaire (KHQ)

Chapter Four

Results

This chapter presents the findings of the study, focusing on the effectiveness of the HB-PFMR program for managing UI in women. The results are structured to provide a detailed analysis of socio-demographic and obstetric characteristics, as well as pre- and post-intervention outcomes in UI severity, frequency, volume, and QoL. Comparative analyses between the study and control groups are provided, supported by statistical data to illustrate significant differences and improvements. The findings are presented in alignment with the study objectives to offer a clear understanding of the intervention's efficacy.

4.1 Sample Characteristics

4.1.1 Socio-Demographic Characteristics

The results revealed that 46.9% of women in the study group and 53.3% of women in the control group had 35 to less than 40 years, with mean ages of 43.74±6.18 and 40.36±4.08 years for the study and control groups, respectively. It was also noticed that 12.5% of women in the study group were aged 51 years and older compared to none in the control group (p=0.03). Most of the study and control group participants hold bachelor's degrees (62.5% and 70.0%). Moreover, 40.6% of women in the study group are engaged in high-intensity occupations compared to 46.6% of women in the control group, with no significant statistical difference between the study and control group regarding the educational level and work intensity (Table 4.1).

Table 4.1: Socio-Demographic Characteristics of Women

	Study Group (n=32)	Control Group (n=30)	p
	n (%)	n (%)	
Age			
35<40	15 (46.9)	16 (53.3)	F^{ET} = 8.300
40-≤45	6 (18.7)	12 (40.0)	p =.031*
45-≤50	7 (21.9)	2 (6.7)	
51 & more	4 (12.5)	0 (0.0)	
Mean ±SD	43.74±6.18	40.36±4.08	Z^{MW}=-2.115, p =.034*
Educational level			
High School	7 (21.9)	2 (6.7)	F^{ET}=2.977
Bachelor	20 (62.5)	21 (70.0)	p =.092
Postgraduate	5 (15.6)	7 (23.3)	
Occupation Intensity			
Low	4 (12.5)	6 (20.0)	F^{ET}=7.299
Moderate	7 (21.9)	8 (26.7)	p =.071
High	13 (40.6)	14 (46.6)	
Currently not working	8 (25.0)	2 (6.7)	

Notes: F^{ET}, Fisher's Exact Test, Z^{MW} Mann Whitney, Significant at p ≤ 0.05

4.1.2 Obstetric History Characteristics

Most women in both the study and control groups had regular menstrual cycles (78.1% and 76.7% respectively). Approximately one-quarter of women in both groups reported having three pregnancies (25.0% and 26.7%). Table 4.2 presents the obstetric history of women with urinary incontinence. As for

childbirth methods, the number of normal deliveries was higher than C-sections in both groups (81.4% in the study group compared to 87.7% in the control group) (Table 4.2).

Table 4.2 Obstetric History of Women

		Study Group (n=32)	Control Group (n=30)	p
		n (%)	n (%)	
Menstrual cycle	Regular	25 (78.1)	23 (76.7)	F^{ET}= 2.00
	Irregular	5 (15.6)	7 (23.3)	p = .473
	Menopause	2 (6.2)	0 (0.0)	
Number of miscarriages	None (zero)	29 (90.6)	26 (86.7)	
	One	1 (3.1)	3 (10.0)	F^{ET}= 1.404
	Two	2(6.2)	1(3.3)	p = .604
Number of pregnancies	None (zero)	4(12.5)	4(13.3)	
	One	7(21.9) 7	9(30.0) 9	F^{ET}= 1.847
	Two	7(21.9) 14	6(20.0) 12	p = .966
	Three	8(25.0) 24	8(26.7) 24	
	Four	5(15.6) 20	3(10.0) 12	
	Five	1(3.1) 5	0(0.0) 0	
Mode of delivery	Normal	57 (81.4)	50 (87.7)	F^{ET}= 0.955
	C-Section	13 (8.6)	7 (8.3)	p = .959

Notes: F^{ET}, Fisher's Exact Test, Z^{MW} Mann Whitney, Significant at $p \leq 0.05$

4.2 3-Incontinence Questionnaire (3IQ)

When asked about the circumstances under which urine leakage occurred most often, 75.0% of women in the study group reported that UI is mainly caused by physical activities such as coughing, sneezing, and lifting, compared to 93.3% of women in the control group. Additionally, 25.0% of women in the study group and 6.7% of women in the control group reported leakage about as often with physical activities accompanied by a sense of urgency (Table 4.3).

Table 4.3: Scores of 3-incontinence questionnaires among women in the Study and Control Groups

	Study Group (n=32)		Control group (n=30)		Testing of Sig. Fisher's Exact Test
	n	(%)	n	(%)	
During the last three months, have you leaked urine					
- Yes	32	100.00%	30	100.00%	Not available
- No	0	0.0	0.0	0.0	
If yes, during the last three months, did you leak urine most often					
A) When you are performing some physical activities, such as coughing, sneezing, lifting, or exercise?	24	75.00%	28	93.30%	
B) When you had the urge or feeling that you needed to empty your bladder, but you could not get to the toilet fast enough?	0	0.0	0.0	0.0	F^{ET} =3.847 p =.83
C) Without physical activity or a sense of urgency?	0	0.0	0.0	0.0	
D) About equally as often with physical activities as with a sense of urgency?	8	25.00%	2	6.70%	

Notes: F^{ET} Fisher's Exact Test; * Significant at $p \leq 0.05$

4.3 Incontinence Severity Index (ISI)

4.3.1 Urinary Incontinence Severity

Pre-intervention, all women reported some level of urinary leakage. Post-intervention, over half of the women in the study group reported complete cessation of urinary leakage, 53.1% signifying a substantial improvement (p=0.008). In comparison, only 13.3% of the control group reported no leakage, highlighting the intervention's effectiveness (Table 4.4).

The study group also showed marked improvements in leakage frequency, with a significant reduction in those experiencing leakage from daily to a few times a week or less. Similarly, the volume of urine loss improved, with most women in the study group reporting only drops and none reporting more than small splashes 53.1% (p=0.001). The control group's improvements were less pronounced, with some reduction in leakage frequency and volume (13.3%) but not to the extent observed in the study group (Table 4.4). Table 4.4 illustrates the changes in the severity of urinary incontinence.

Table 4.4: The incontinence severity index among women in the Study and Control Groups at pre, and post-intervention

	Pre-test			Post-test		
	Study Group n (%)	Control Group n (%)	p	Study Group n (%)	Control Group n (%)	p
1.Frequency of urinary leakage						
a. Never, I do not leak urine	0 (0.00)	0 (0.00)		17 (53.1)	4 (13.3)	
b. Less than once a month	1 (3.13)	0 (0.00)	F^{ET}=8.206,	3 (9.4)	2 (6.7)	F^{ET}
c. A few times a month	1 (3.13)	7 (23.30)	p =.023*	5 (15.7)	11 (36.7)	=12.862
d. A few times a week	19 (59.37)	10 (33.30)		6 (18.7)	9 (30.0)	p =.008*
e. Every day and/or night	11 (34.37)	13 (43.40)		1 (3.1)	4 (13.3)	
2.Amount of urine lose time						
a. None, I do not leak urine	0 (0.00)	0 (0.00)		17 (53.1)	4 (13.3)	
b. Drops	14 (43.7)	13 (43.3)	F^{ET}=0.063,	10 (31.2)	8 (26.6)	F^{ET}=17.28,
c. Small splashes	12 (37.5)	12 (40.0)	p =.969	5 (15.6)	12 (40.0)	p <0.001*
d. More	6 (18.8)	5 (16.7)		0 (0.0)	6 (20.0)	

Notes: F^{ET} Fisher's Exact Test, * Significant at p≤0.05

4.3.2 Levels of Incontinence

Initially, none of the participants in the study or control groups were free from incontinence. Post-intervention, a significant improvement was observed, with 53.1% of the study group reporting no incontinence, compared to 13.3% in the control group (p=.003) (Table 4.5).

Pre-intervention, most of the study group had moderate incontinence 59.4%, which was reduced to 18.7% post-intervention. The control group showed less improvement, with the moderate category still encompassing 40.0% post-intervention. Severe incontinence decreased markedly in the study group from 18.7% to 3.1%, and very severe incontinence was completely alleviated. In contrast, the control group slightly reduced severe incontinence to 6.7%, and very severe incontinence remained at 13.3%. (Table 4.5).

The results indicate a statistically significant reduction in incontinence severity in the study group post-intervention, suggesting the effectiveness of the intervention in managing incontinence (Table 4.5)

Table 4.5: Levels of Incontinence among women in the Study and Control Groups at pre, and post-intervention

	Pre-test			Post-test		
	Study group	Control Group	p	Study group	Control Group	p
	n (%)	n (%)		n (%)	n (%)	
Levels of Incontinence						
None	0 (0.00)	0 (0.00)		17 (53.1)	4 (13.3)	
Slight (1-2)	2 (6.2)	7 (23.3)		8 (25.0)	8 (26.6)	
Moderate (3-6)	19 (59.4)	10 (33.3)	F^{ET}= 5.703, p =.122	6 (18.7)	12 (40.0)	F^{ET}= 14.258, p =.003*
Severe (8-9)	6 (18.7)	8 (26.7)		1 (3.1)	2 (6.7)	
Very severe (12)	5 (15.6)	5 (16.6)		0 (0 .0)	4 (13.3)	

Notes: F^{ET} Fisher's Exact Test, Significant at *p≤0.05

4.4 International Consultation on Incontinence Questionnaire Urinary Incontinence Short Form (ICIQ-UI SF)

4.4.1 Comparative Levels Pre-Post intervention for frequency, amount, and impact of UI in both groups

Pre-intervention, no individuals in either the study or control groups reported never leaking urine. Post-intervention, the intervention group showed a marked improvement, with 53.1% reporting no leakage, whereas the control group had a smaller improvement at 13.3% (p=0.009) (Table 4.6).

The reduction in the frequency of urine leakage was also notable. While 56.3% of the study group reported leaking about once a day pre-intervention, this decreased to 18.8% post-intervention. The control group showed minimal change, with a slight decrease from 36.7% to 33.3% reporting about once-a-day leakage (Table 4.6).

In terms of quantity, post-intervention improvements in the study group were significant, with 53.1% reporting no leakage and only 15.6% reporting a moderate amount. The control group had less pronounced changes, with 40.0% reporting a moderate amount post-intervention ($p<0.001$) (Table 4.6).

The mean interference score of urine leakage with daily life also improved remarkably from 5.75±1.96 to 1.18±0.67 in the study group, indicating less impact on daily activities, whereas the control group experienced a smaller improvement from 5.33±3.09 to 3.33±1.86 ($p<0.001$) (Table 4.6).

Further analysis of when urine leaked revealed significant improvements, particularly in situations like coughing or sneezing, where the study group's reports decreased from 59.38% to 31.25%. In contrast, the control group reported a decrease to 53.33% from 60.00%. Leakage during physical activities also reduced in the study group from 90.63% to 18.75%, compared to a reduction from 73.33% to 36.67% in the control group. These findings suggest that the intervention was markedly effective in reducing the frequency, amount, and impact of urinary incontinence in the study group compared to the control group, as demonstrated by the significant post-intervention improvements (Table 4.6).

Table 4.6: International Consultation on Incontinence Questionnaire-Urinary Incontinence

	Pre-Test			Post-Test		
	Study Group n (%)	**Control Group n (%)**	**p**	**Study Group n (%)**	**Control Group n (%)**	**p**
How often do you leak urine?						
Never	0 (0.0)	0 (0.0)		17 (53.1)	4 (13.3)	
About once a week or less often	1 (3.1)	0 (0.0)	F^{ET}=6.252,	3 (9.4)	2 (6.7)	F^{ET}=12.672,
Two or three times a week	1 (3.1)	6 (20.0)	p =.127	5 (15.6)	10 (33.3)	p =.009*
About once a day	18 (56.3)	11 (36.7)		6 (18.8)	10 (33.3)	
Several times a day	11 (34.4)	12 (40.0)		1 (3.1)	4 (13.3)	
All the time	1 (3.1)	1 (3.3)		0 (0.0)	0 (0.0)	
How much urine do you usually leak						
None	0 (0.0)	0 (0.0)		17 (53.1)	4 (13.3)	
2. A small amount	14 (43.7)	13 (43.3)	F^{ET}=0.063,	10 (31.2)	8 (26.7)	F^{ET}=17.288,
4. A moderate amount	12 (37.5)	12 (40.0)	p =.969	5 (15.6)	12 (40.0)	p <0.001*
6. A large amount	6 (18.8)	5 (16.7)		0 (0.0)	6 (20.0)	
Leaking urine interfere with your everyday life						
Mean±SD	5.75±1.96	5.33±3.09	Z^{MW}=-.429 p =.0668	1.18±0.67	3.33±1.86	Z^{MW}=-3.511, p <0.001*

When does urine leak						
Never – urine does not leak	0 (0.00)	0 (0.00)		17 (40.63)	4 (23.33)	
Leaks before you can get to the toilet	10 (93.75)	6 (90.00)		3 (18.75)	5 (36.67)	
Leaks when you cough or sneeze	23 (59.38)	25 (60.00)		8 (31.25)	19 (53.33)	
Leaks when you are asleep	0 (0.00)	0 (0.00)	F^{ET}=13.215,	0 (0.00)	0 (0.00)	F^{ET}=16.606,
Leaks when you are physically active/exercising	22 (90.63)	26 (73.33)	p =.107	6 (18.75)	20 (36.67)	p =.009*
Leaks when you have finished urinating and are dressed	4 (3.13)	5 (6.67)		1 (3.13)	6 (3.3)	
Leaks for no obvious reason	2 (6.25)	0 (0.00)		0 (0.00)	0 (0.00)	
Leaks all the time	0 (0.00)	0 (0.00)		0 (0.00)	0 (0.00)	

Notes: F^{ET} Fisher's Exact Test, Z^{MW}= Mann-Whitney, * Significant at p≤0.05

4.4.2 Comparative Levels of Incontinence Severity

Following the intervention, 53.1% of individuals in the study group reported no incontinence, an increase from 0%, suggesting a substantial impact of the treatment. This improvement markedly exceeded that of the control group, which reported an increase to 13.3%. Additionally, the intervention group exhibited a reduction in moderate incontinence from 59.4% to 18.7%, and the severe category declined to 3.1%. Notably, very severe incontinence was completely alleviated in the study group, in contrast to the control group, which showed no change in this most severe category (Table 4.7).

Table 4.7: Levels of Incontinence among women in the Study and Control Groups at pre, and post-intervention

	Pre-test			Post-test		
	Study Group	Control Group		Study Group	Control Group	
	n (%)	n (%)	p	n (%)	n (%)	p
Levels of Incontinence						
None (0)	0 (0.0)	0 (0.0)		17 (53.1)	4 (13.3)	
Slight (1-5)	2 (6.2)	6 (20.0)		8 (25.00)	8 (26.6)	
Moderate (6-12)	19 (59.4)	11 (36.7)	F^{ET}=4.283, p =0.22	6 (18.7)	12 (40.0)	F^{ET}=10.55, p=.005*
Severe (13-18)	6 (18.8)	8 (26.7)		1 (3.1)	2 (6.7)	
Very severe (19-21)	5 (15.6)	5 (16.7)		0 (0.0)	4 (13.3)	

Notes: F^{ET} Fisher's Exact Test, *Significant at p≤0.05

4.5 King Health Questionnaire (KHQ)

4.5.1 General Health

Table 4.8 compares health outcomes between the study and control groups pre- and post-intervention. Notably, there was a significant increase in the percentage of participants reporting "Very Good" health in the intervention group, 59.3% compared to the control group 26.7% (p=.012). Furthermore, the intervention group showed a significant decline in bladder problems, with 56.2% having no issues after the intervention, in contrast to 13.3% in the control group (p=.003) (Table 4.8).

Table 4.8 KHQ General health

	Pre-Study group	Control Group		Post-Study group	Control Group	
	n (%)	n (%)	p	n (%)	n (%)	p
Health At Present						
Very good	2 (6.2)	2 (6.7)	F^{ET} =1.153 p = 0.8	19 (59.3)	8 (26.7)	$\chi2$=6.738 p =.012*
Good	30 (93.8)	27 (90.0)		13 (40.6)	22 (73.3)	
Fair	0 (0.0)	1 (3.3)		0 (0.0)	0 (0.0)	
Bladder Problem						
Not at all	0 (0.0)	0 (0.0)	F^{ET} =0.499 p =.853	18 (56.2)	4 (13.3)	F^{ET} =13.438 p = .003*
A little	2 (6.2)	3 (10.0)		7 (21.9)	11 (36.7)	
Moderately	21 (65.6)	20 (66.7)		6 (18.7)	10 (33.3)	
A lot	9 (28.1)	7 (23.3)		1 (3.1)	5 (16.7)	

Notes: $\chi2$ Chi-square Test, F^{ET} Fisher's Exact Test, * Significant at p≤0.05

4.5.2 Role Limitation

Table 4.9 illustrates a comparative analysis of role limitations between women in a study and control groups, both pre- and post-intervention. Notably, post-intervention, a significant reduction in role limitations due to bladder problems was observed. In household tasks, the proportion of women experiencing no limitations in the study group increased to 53.1%, in contrast to the 20% in the control group (p = .013). Similar improvements were seen in daily activities outside the home, with "not at all" reported limitations in 53.1% of the study group compared to 20% of the control post-intervention, which was statistically significant (p=.008) (Table 4.9).

Table 4.9 KHQ Role Limitation

	Pre-Study Group	Control Group		Post Study Group	Control Group	
	n (%)	n (%)	p	n (%)	n (%)	p
Bladder Problem Affect Your Household Tasks						
Not at all	0 (0.0)	0 (.0)	F^{ET} =1.503 p =.485	17 (53.1)	6 (20.0)	F^{ET} =9.714 p = .013*
Slightly	12 (37.5)	15 (50.0)		10 (31.2)	13 (43.3)	
Moderately	17 (53.1)	14 (46.7)		4 (12.5)	11 (36.7)	
A lot	3 (9.4)	1 (3.3)		1 (3.1)	0 (0.0)	
Job, Or Normal Daily Activities Outside the Home						
Not at all	0 (0.0)	0 (0.0)	F^{ET} =1.503 p =0.485	17 (53.1)	6 (20.0)	$\chi 2$=9.818 p =.008*
Slightly	12 (37.5)	15 (50.0)		12 (37.5)	13 (43.3)	
Moderately	17 (53.1)	14 (46.7)		3 (9.3)	11 (36.7)	
A lot	3 (9.4)	1 (3.3)		0 (0.0)	0 (0.0)	

Notes: $\chi 2$ Chi-square Test, F^{ET} Fisher's Exact Test, * Significant at $p \leq 0.05$

4.5.3 Physical and Social Limitations

The study group showed significant progress in bladder problem impacts on physical activities, with 53.1% reporting "not at all" post-intervention (p= .003). The control group, in contrast, showed only 13.3% reporting "not at all". (Table 4.10)

In the post-intervention phase, both the ability to travel and social life limitations reported improvements in the study group, with 62.5% reporting "not at all" in both categories, marking significant progress. The control group also showed increases, with 46.7% in the ability to travel and 40.0% in social life showing no limitations, but these changes were not statistically significant. (Table 4.10)

A significant increase was shown in the study group's ability to see and visit friends without limitations, rising from 0% to 68.7% post-intervention (p= .026). The control group also showed an increase, but only to 36.7% (Table 4.10).

Table 4.10 KHQ Physical / Social Limitation

	Pre-Study group	Control Group		Post Study group	Control Group	
	n (%)	n (%)	p	n (%)	n (%)	p
Does your bladder problem affect your physical activities (e.g., going for a walk, run, sport, gym, etc.)?						
Not at all	0 (0.0)	0 (0.0)	F^{ET} =3.161 p =.225	17 (53.1)	4 (13.3)	F^{ET} =12.463 p =.003*
Slightly	4 (12.5)	9 (30.0)		8 (25.0)	9 (30.0)	
Moderately	22 (68.7)	18 (60.0)		6 (18.7)	15 (50.0)	
A lot	6 (18.8)	3 (10.0)		1 (3.1)	2 (6.7)	
Ability To Travel						
Not at all	7 (21.9)	10 (33.3)		20 (62.5)	14 (46.7)	

Slightly	13 (40.6)	11 (36.7)	F^{ET}	11 (34.4)	10 (33.3)	F^{ET}
Moderately	11 (34.4)	5 (16.7)	=4.488	1 (3.1)	4 (13.3)	=4.328
A lot	1 (3.1)	4 (13.3)	p=.222	0 (0.0)	2 (6.7)	p=0.186
Limit Social Life						
Not at all	0 (0.0)	0 (0.0)	$\chi2$=0.3	20 (62.5)	12 (40.0)	F^{ET}
Slightly	13 (40.6)	14 (46.7)	5	8 (25.0)	11 (36.7)	=4.166
Moderately	12 (37.5)	11 (36.6)	p=.896	4 (12.5)	5 (16.7)	p=0.21*
A lot	7 (21.9)	5 (16.7)		0 (0.0)	2 (6.6)	
Limit ability to see/visit friends						
Not at all	0 (0.0)	0 (0.0)	$\chi2$=0.3	22 (68.7)	11 (36.7)	F^{ET}
Slightly	13 (40.6)	10 (33.3)	62	8 (25.0)	10 (33.3)	=8.096
Moderately	14 (43.7)	15 (50.0)	p=0.89	2 (6.2)	7 (23.3)	p=0.026*
A lot	5 (15.6)	5 (16.7)		0 (0.0)	2 (6.7)	

Notes: $\chi2$ Chi-square Test, F^{ET} Fisher's Exact Test, Significant at [a] $p \leq 0.05$

4.5.4 Personal Relationship

Post-intervention, 59.4% of the study group felt their bladder problem did not affect their relationship with their partner. The control group showed a slight increase from 30.0% pre-intervention to 40.0% post-intervention, with no statistical significance (p=.173). (Table 4.11)

In the study group, 65.6% of women reported no impact on sex life post-intervention, up from 28.1% pre-intervention, which is a notable improvement. The control group's "not at all" category also increased from 33.3% to 46.7% but did not reach statistical significance (p=.188). (Table 4.11)

There was a significant change in the study group's family life, with 71.8% reporting no impact at all post-intervention compared to none pre-intervention (p = .011). The control group reported 33.3% of post-intervention not at all affected, compared to none pre-intervention. (Table 4.11)

Table 4.11 KHQ Personal Relationship

Notes: $\chi 2$ Chi-square Test, F^{ET} Fisher's Exact Test, Significant at $p \leq 0.05$

	Pre-Study group	Control Group		Post-Study group	Control Group	
	n (%)	n (%)	p	n (%)	n (%)	p
Does your bladder problem affect your relationship with your partner?						
Not Applicable	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	F^{ET} =4.88 p=0.173
Not at all	7 (21.9)	9 (30.0)	F^{ET} =1.691 p=0.649	19 (59.4)	12 (40.0)	
Slightly	5 (15.6)	7 (23.3)		8 (25.0)	7 (23.3)	
Moderately	15 (46.9)	10 (33.3)		5 (15.6)	8 (26.7)	
A lot	5 (15.6)	4 (13.3)		0 (0.0)	3 (10.0)	
Sex life						
Not Applicable	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	
Not at all	9 (28.1)	10 (33.3)	F^{ET} =0.862 p=.852	21 (65.6)	14 (46.7)	F^{ET} =4.738 p=.188
Slightly	5 (15.6)	6 (20.0)		6 (18.7)	5 (16.7)	
Moderately	14 (43.7)	10 (33.3)		5 (15.6)	8 (26.6)	
A lot	4 (12.5)	4 (13.3)		0 (0.0)	3 (10.0)	
Family life						
Not Applicable	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	
Not at all	0 (0.0)	0 (0.0)	$\chi 2$=0.603 p=.841	23 (71.8)	10 (33.3)	F^{ET} =10.055 p=.011*
Slightly	14 (43.7)	16 (53.3)		6 (18.7)	11 (36.7)	
Moderately	11 (34.4)	9 (30.0)		3 (9.4)	6 (20.0)	
A lot	7 (21.8)	5 (16.7)		0 (0.0)	3 (10.0)	

4.5.5 Emotions

The emotional impact of bladder problems on the study group revealed significant improvements after the intervention. Initially, no one in the study group was free from depressive symptoms, but post-

intervention, 59.4% of the study group reported not feeling depressed at all. Whereas the control group had 40.0% of its women reported no depressive symptoms post-intervention. (Table 4.12)

In regard to feeling anxious or nervous, the study group showed a significant reduction, with those not experiencing these feelings increasing from 0% to 62.5% post-intervention. The control group also observed an increase, with women not feeling anxious or nervous going from none to 26.7% (p = .018). (Table 4.12)

The study group experienced a substantial increase in positive self-perception, with 75.0% reporting not feeling bad about themselves after the intervention, compared to none before, which was statistically significant (p = .017). The control group also showed notable progress, with the proportion of participants not feeling bad about themselves rising from 0% to 40.0% post-intervention. (Table 4.12).

Table 4.12 KHQ Emotions

	Pre-Study Group	Control Group		Post-Study Group	Control Group	
	n (%)	n (%)	p	n (%)	n (%)	p
Make you feel depressed						
Not at all	0 (0.0)	0 (0.0)		19 (59.4)	12 (40.0)	
Slightly	12 (37.5)	9 (30.0)	$\chi2$=0.733	8 (25.0)	7 (23.3)	F^{ET} =4.880
Moderately	15 (46.9)	14 (46.7)	p=0.71	5 (15.6)	8 (26.7)	p=0.173
Very much	5 (15.6)	7 (23.3)		0 (0.0)	3 (10.0)	
Feel anxious or nervous						
Not at all	0 (0.0)	0 (0.0)		20 (62.5)	8 (26.7)	
Slightly	14 (43.7)	10 (33.3)	$\chi2$=0.936 p=0.602	8 (25.0)	12 (40.0)	F^{ET} =9.266 p=0.018*
Moderately	13 (40.6)	13 (43.3)		4 (12.5)	7 (23.3)	

Very much	5 (15.6)	7 (23.3)		0 (0.0)	3 (10.0)	
Feel bad about yourself						
Not at all	0 (0.0)	0 (0.0)		24 (75.0)	12 (40.0)	F^{ET}
Slightly	11 (34.4)	10 (33.3)	$\chi 2$=0.416	7 (21.8)	11 (36.7)	=9.132
Moderately	15 (46.8)	16 (53.3)	p=0.839	1 (3.1)	6 (20.0)	p=0.017*
Very much	6 (18.7)	4 (13.3)		0 (0.0)	1 (3.3)	

Notes: $\chi 2$ Chi-square Test, F^{ET} Fisher's Exact Test, Significant at $p \leq 0.05$

4.5.6 Sleep and Energy

In the area of sleep and energy, the study group revealed that prior to the intervention, 46.9% reported that their bladder problem never affected their sleep, which increased to 75.0% post-intervention. In the control group, the percentage of those reporting "never" affected sleep was initially higher at 56.7%, and post-intervention, there was an increase to 63.3%. (Table 4.13)

In regard to feeling worn out or tired, the study group who never felt this way jumped from 43.7% to 81.2% post-intervention, marking a statistically significant improvement ($p = .002$). The control group also saw improvement, with the "never" category increasing from 40.0% to 43.3%, but this change was not statistically significant. (Table 4.13)

Table 4.13 KHQ Sleep/Energy

	Pre-Study group	Control Group		Post-Study group	Control Group	
	n (%)	n (%)	p	n (%)	n (%)	p
SLEEP/ENERGY						
Does your bladder problem affect your sleep?						
Never	15 (46.9)	17 (56.7)	F^{ET} =3.807 p=0.292	24 (75.0)	19 (63.3)	F^{ET} =3.066 p=0.234
Sometimes	9 (28.1)	11 (36.7)		5 (15.6)	10 (33.3)	
Often	6 (18.7)	2 (6.6)		3 (9.4)	1 (3.3)	
All the time	2 (6.2)	0 (34.5)		0 (0.0)	0 (0.0)	
Do you feel worn out/tired?						
Never	14(43.7)	12(40.0)	F^{ET} =0.762 p=0.782	26(81.2)	13(43.3)	F^{ET} =10.787 p=0.002 *
Sometimes	13(40.6)	15(50.0)		4(12.5)	15(50.0)	
Often	5(15.6)	3(10.0)		2(6.2)	2(6.7)	
All the time	0(0.0)	0(0.0)		0(0.0)	0(0.0)	

Notes: $\chi 2$ Chi-square Test, F^{ET} Fisher's Exact Test, Significant at $p \leq 0.05$

4.5.7 Effects of Self-Management

The effects of self-management behaviors for bladder problems showed the following:

- **Wearing Pads to Keep Dry**:

Pre-intervention, the study group reported high usage of pads, with none saying "never", 21.9% saying "often", and a notable 78.1% saying "all the time". Post-intervention, the number of participants needing to wear pads "all the time" decreased to 25.0%, while those reporting "never" using pads increased to 31.2%. (Table 4.14). The control group showed a minor change from 66.7% to 46.6% for "all the time" and from 0% to 6.7% for "never". (Table 4.14)

- **Being Careful with Fluid Intake:**

Initially, only 6.2% of the study group reported "never" being careful with how much they drank, which significantly increased to 56.2% post-intervention ($p = 0.001$). (Table 4.14). In the control group, those who reported "never" being careful increased from 13.3% to 26.7%. (Table 4.14)

- **Changing Underclothes When Wet:**

The study group showed a decrease in the frequency of changing underclothes due to wetness, with those never doing so increasing from 9.4% to 56.2% post-intervention. (Table 4.14). The control group's figures for changing underclothes when wet showed little change, with the percentage of participants reporting "never" having to do this slightly increasing from 2.7% to 26.7%. (Table 4.14)

- **Worrying About Smell:**

The study group showed a large improvement in those who never worried about smelling due to bladder problems, which rose dramatically from 12.5% to 62.5%. (Table 4.14). Conversely, the control group showed a slight increase from 20.7% to 33.3% in those who never worry. (Table 4.14)

- **Getting Embarrassed Because of Bladder Problems:**

In the study group, those who never felt embarrassed because of their bladder problem saw an increase from 18.8% pre-intervention to 75.0% post-intervention. (Table 4.14). The control group experienced an increase in the "never" feeling embarrassed category, going from 23.3% pre-intervention to 46.7% post-intervention. (Table 4.14)

The study demonstrates significant improvements in the self-management behaviors of individuals in the study group, with a notable decrease in behaviors such as wearing pads and worrying about smell, indicating a positive impact from the intervention. The control group's changes were less pronounced and generally not statistically significant. (Table 4.14). In the KHQ, the first section, which addressed the severity of symptoms, was optional, and none of the women responded to it.

Table 4.14 KHQ The effects on self-management behaviors for bladder problems

Do you do any of the following? If so how much?	Pre-Study group	Control Group		Post-Study group	Control Group	
	n (%)	n (%)	p	n (%)	n (%)	p
Wear pads to keep dry?						
Never	0 (0.0)	0 (0.0)	$\chi2$=1.022	10 (31.2)	2 (6.7)	$\chi2$=12.162-8
Sometimes	0 (0.0)	0 (0.0)	p=0.397	9 (28.1)	3 (10.0)	p=0.006*
Often	7 (21.9)	10 (33.3)		5 (15.6)	11 (36.7)	
All the time	25 (78.1)	20 (66.7)		8 (25.0)	14 (46.6)	
Be careful how much fluid you drink						
Never	2 (6.2)	4 (13.3)	F^{ET} =2.489	18 (56.2)	8 (26.7)	F^{ET} =15.655
Sometimes	4 (12.5)	7 (23.3)	p=0.514	11 (34.4)	5 (16.7)	p=0.001*
Often	12 (37.5)	9 (30.0)		2 (6.2)	10 (33.3)	
All the time	14 (43.8)	10 (33.3)		1 (3.1)	7 (23.3)	
Change your underclothes when they get wet?						
Never	3 (9.4)	2 (6.7)	F^{ET} =1.238	18 (56.2)	8 (26.7)	F^{ET} =10.5
Sometimes	10 (31.2)	7 (23.3)	p=0.777	9 (28.1)	7 (23.3)	p=0.011*
Often	9 (28.1)	12 (40.0)		5 (15.6)	10 (33.3)	
All the time	10 (31.2)	9 (30.0)		0 (0.0)	5 (16.7)	
Worry in case you smell						
Never	4 (12.5)	7 (20.7)	$\chi2$=2.461	20 (62.5)	10 (33.3)	F^{ET} =8.393
Sometimes	14 (43.7)	15 (51.7)	p=0.527	6 (18.7)	15 (50.0)	p=0.024*
Often	11 (34.4)	6 (20.7)		6 (18.7)	4 (13.3)	
All the time	3 (9.4)	2 (6.9)		0 (0.0)	1 (3.3)	
Get embarrassed because of your bladder problem						
Never	6 (18.8)	7 (23.3)	$\chi2$=0.21	24 (75.0)	14 (46.7)	F^{ET} =6.402
Sometimes	12 (37.5)	11 (36.7)	p=1	6 (18.8)	9 (30.0)	p=0.082
Often	7 (21.8)	6 (20.0)		2 (6.2)	4 (13.3)	
All the time	7 (21.8)	6 (20.0)		0 (0.0)	3 (10.0)	

$\chi2$ Chi-square Test, F^{ET} Fisher's Exact Test, Significant at p≤0.05

Chapter Five

Discussion

5.1. Severity, Frequency, and Volume of Urinary Incontinence

5.2. Effect of Quality of Life on Urinary Incontinence

Chapter five

Discussion

Urinary incontinence, a widely prevalent yet often stigma-associated condition, significantly impacts QoL by causing embarrassment, psychological distress and social isolation. Addressing this issue through increased awareness and improved treatment accessibility is crucial for enhancing patient well-being (Murukesu et al., 2019). This study aimed to evaluate the effectiveness of Home-Based Pelvic Floor Muscle Rehabilitation (HB-PFMR) compared to routine Kegel exercises, analyzing their impact on the severity, frequency, and volume of urinary leakage in women with incontinence in Bahrain.

The findings revealed that more than half of the participants experienced SUI, which is the most common form of UI. SUI is more prevalent than other types of incontinence due to mechanical and anatomical factors. In females, the PFM and connective tissues provide critical support to the urethra and bladder neck. Events such as pregnancy, childbirth, and menopause weaken these structures, leading to urethral hypermobility and compromised sphincter function. This weakening diminishes the urethra's ability to maintain closure during activities that increase intra-abdominal pressure, such as coughing or lifting, resulting in the characteristic urine leakage of SUI. In contrast, other forms of UI, like urge incontinence, are often linked to detrusor muscle overactivity rather than structural deficiencies. The anatomical susceptibility of the pelvic floor to these weakening factors explains the higher prevalence of SUI among the participants(Falah-Hassani et al., 2021).

These findings underscore the urgent need for structured exercise training programs to strengthen pelvic floor muscles and address SUI

effectively. This aligns with the recommendation by Al-Najjar et al. (2014), who emphasized the need for further studies to determine the prevalence and types of UI in the population and optimize management strategies. Such efforts are critical to mitigating the burden of UI and improving the QoL of affected individuals in the Kingdom of Bahrain.

5.1 Severity, Frequency, and Volume of Urinary Incontinence

The results of the present study highlighted that the intervention group experienced reductions in the severity scores comparable to the control group. This reduction addresses the physical symptoms of UI and contributes to broader health improvements (Loohuis et al., 2021). These findings are consistent with existing literature highlighting the efficacy of structured PFMT (Chaffee & Harpster, 2019; Fisher et al., 2024; Hagen et al., 2020). For instance, the significant decline in UI severity documented in this study is supported by Dumoulin et al. (2018), who observed similar improvements through structured PFMT programs. These programs typically involve exercises that strengthen the PFM, thereby enhancing their ability to maintain continence. However, the study by Mahmood et al. (2023) provides a contrasting perspective, suggesting that minimal changes in some cases may be attributed to variables such as patient adherence, duration of the intervention, and exercise intensity.

Likewise, the results of the present study indicate a significant decline in both frequency and volume of urinary leakage among women in the study group compared to the control one, suggesting effective management of UI symptoms. These findings are consistent with a study conducted by Botelho et al. (2015), which highlighted reductions in leakage frequency and volume in individuals engaged in similar PFMT programs. These data

underscore the effectiveness of the HB-PFMR program in reducing both the frequency and volume of leakage, aspects that significantly contribute to enhancing the QoL.

The result of ICIQ-UI SF highlighted that the intervention group had reductions in the frequency of episodes from daily occurrences to less frequent episodes, reflecting improvements in the volume from larger amounts to minimal leakage. Such reduction in the frequency and volume of UI is attributed to different factors, including, but not limited to, an increase in pelvic floor muscle tone, strength, flexibility, endurance, and neuromuscular adaptation. Unlike routine Kegel exercises, the HB-PFMR program included various exercises such as Maximum PFM contractions, Flicks, Knack, Podium, and Rapid Repeated PFM Contractions. Further, the HB-PFMR includes techniques and strategies, such as PFM contractions, while doing five functional movements and breathing exercises. At the physiological level, home-based exercises increase muscle fiber size and enhance coordination between muscle groups, which is crucial for maintaining the structural integrity of the pelvic organs and ensuring functional stability (Shah et al., 2019). Additionally, regular exercise promotes improved circulation, which facilitates tissue healing and regeneration, as well as supporting the rehabilitation process (Chaiyawat et al., 2021). In this context, Hagen et al. (2020) reported that enhanced muscle strength from targeted resistance training is vital for reinforcing pelvic floor support, which is essential for UI management. A systematic review conducted by Bø et al. (2009) about the benefit of training both TrA and PFM in treating UI in females revealed improvements in PFM strength and urinary control following specialized exercise programs. Moreover, Dumoulin et al. (2018) observed a significant reduction in the incidence of UI among participants who engaged in regular PFMT. It also confirms the findings of Wang et al.

(2020), who conducted a randomized controlled trial with over 100 women suffering from SUI. Their results indicated that participants who followed a structured PFMT regimen experienced a 70% decrease in UI episodes compared to those who were only provided with general lifestyle counseling over six months. This research confirms the effectiveness of targeted PFMT in significantly improving symptoms of UI, particularly when consistently implemented as part of a structured rehabilitation program.

The current study shows more than half of the women in the intervention group reported a cessation of urinary leakage, a significantly higher proportion than in the control group. This notable improvement underlines the critical role of personalized and specific therapeutic exercises tailored to individual needs in enhancing UI interventions' efficacy. This is also supported by the findings from Yang et al. (2021), which demonstrated marked improvements in urinary leakage and pelvic muscle strength in women following a comprehensive rehabilitation program that included PFMT. Similarly, García-Sánchez et al. (2019) found that regardless of the specific protocol, PFMT decreased urine loss in women suffering from UI. However, Imamura et al. (2019) reported minimal changes in the frequency and volume of UI. They justified the lesser effectiveness of their intervention by the individual differences regarding the initial severity of incontinence, lifestyle considerations, and adherence to the prescribed protocol.

The significant reduction in the UI among the study group can be attributed to various demographic and clinical characteristics of the study participants, such as age, occupational stress, physical activity, and obstetric history. Similarly, Parra et al. (2023) reported these differences often stem from variations in intervention design, exercise intensity and duration, and participant demographics, such as age and health status.

Dumoulin et al. (2018) also emphasized that older individuals or those with more severe symptoms might show less improvement, possibly due to lower physical resilience or more entrenched symptoms. In this regard, the current study highlights the importance of the age range of 35 to 55 for pelvic floor interventions, where the mean ages of participants—43.74 in the intervention group and 40.36 in the control group, correlate with increased susceptibility to PFD. This demographic is critical as physiological changes and life events like childbirth peak, impacting pelvic health(Yoon et al., 2003). Cho & Kim (2021) further indicate that PFMTs are particularly beneficial during this period, supporting symptom management and potentially preventing further pelvic dysfunction. By focusing on this age group, this study's findings align with existing literature (Cho & Kim, 2021; Grodstein et al., 2003; Henderson & Taylor, 1987), suggesting that targeted interventions can effectively enhance pelvic health outcomes. This study's findings also reveal a significant percentage of women with higher education and engaging in high-intensity occupations, suggesting that lifestyle and occupational stress may influence or exacerbate the incidence of PFD. Hagovská (2022) explores how high-intensity physical activities in various sports are significant risk factors for SUI and other PFD, further supporting the relationship between high-intensity activities and pelvic health.

From another perspective, the clinical data of the study participants contributed to the decline in UI symptoms. For instance, the obstetric history data from this study's participants underscores a significant prevalence of vaginal deliveries, which literature identifies as a considerable risk factor for the development of UI due to mechanical strain and potential nerve damage during childbirth (Gyhagen et al., 2015). Consistent with broader research, this study's findings demonstrate that a greater proportion of women in both the intervention and control groups

experienced vaginal deliveries compared to cesarean sections. Notably, longitudinal studies such as those reported by Barca et al., 2021; Juliato, 2020 suggest that vaginal delivery, especially without instrumental assistance, significantly increases the likelihood of PFD compared to cesarean deliveries. This aligns with the current understanding that the method of delivery plays a pivotal role in the long-term health of pelvic floor muscles, emphasizing the need for targeted preventative measures following vaginal births to mitigate the risk of PFD (Johnston, 2019). These findings underline the need to develop individual treatment plans and probably carry out more intensive or prolonged interventions in some groups of patients.

The HB-PFMR induces an enhancement in neuromuscular coordination, and the effective recruitment of muscle fibers is crucial for preventing UI during physical activities (Stania et al. 2015). Greer et al. (2015) confirmed the vital role of neuromuscular training in improving the structural integrity and functional capacity of the PFM, supporting their use in continence management strategies. Castro-Pardiñas et al. (2017) highlighted the importance of exercise specificity in enhancing neuromuscular coordination within the PFM. This advanced coordination is vital for maintaining continence during sudden intra-abdominal pressure increases, such as coughing, sneezing, or lifting heavy objects. Their findings suggest that designed exercises tailored to the specific needs of individuals with UI significantly improve therapeutic outcomes. These exercises strengthen muscle control and responsiveness, effectively supporting the pelvic floor during high-pressure activities. However, Castro-Pardiñas et al. (2017) also found that individuals with robust PFM functionality demonstrate significantly better neuromuscular activation and endurance than those with PFD.

The result of the present study also reflects the positive impact of breathing exercises on PFM strength. Breathing exercises, particularly those synchronizing diaphragmatic motion with pelvic floor contractions, significantly improve PFM functionality by optimizing intra-abdominal pressure and enhancing the respiratory cycle's mechanical efficiency. H. Park & Han (2015) demonstrated that specific breathing patterns involving the simultaneous diaphragm contraction and PFM during expiration can significantly alter diaphragmatic motion, influencing pulmonary function and enhancing PFM strength. This interaction underscores the physiological synergy between the pelvic floor and respiratory muscles, facilitating more effective muscle activation during both respiratory and pelvic floor activities. Moreover, Talasz et al. (2022) proposed that different breathing patterns during physical efforts have distinct effects on the PF, providing evidence that PFM function is closely correlated with expiratory flows, particularly during forced expiratory maneuvers. So, they recommended that breathing exercises be a staple in training regimens to enhance PFM strength and functionality. This relationship suggests that exercises aiming to strengthen the pelvic floor could benefit from routines enhancing expiratory muscle function, thereby providing a dual approach to managing conditions associated with PFD. This study's findings suggest that implementing targeted breathing exercises that engage the PFM can significantly improve PFM strength and thereby reduce symptoms of UI.

The integration of breathing exercises into PFMT is essential for maximizing therapeutic outcomes. Such exercises improve the mechanical efficacy of the PF and contribute to overall respiratory health, showcasing the interdependent nature of body systems and the importance of a holistic approach to physical rehabilitation.

5.2 Effect of Quality of Life and Emotional Well-Being on Urinary Incontinence

In the comprehensive treatment of UI, considering QoL is paramount, as it directly affects an individual's psychological well-being and social interactions, thus playing a critical role in shaping both the short-term relief and long-term management strategies. The severity of UI can significantly influence mental health and social engagement, as shown in the results of this study, which highlighted improvements in QoL scores among the intervention group compared to the control group (Poomalar & M, 2015). Women in the intervention group reported reduced embarrassment and increased ability to engage in social and physical activities, addressing critical aspects of daily life. These findings align with Oliveira et al. (2020), who emphasized that addressing UI can enhance QoL by allowing women to participate freely in their daily activities without the fear of leakage or social stigma.

This study also revealed a significant emotional impact of UI, with 75% of participants initially reporting negative feelings about themselves. Such psychological distress, often characterized by embarrassment, shame, and diminished self-esteem, is well-documented in the literature (Corrado et al., 2020; Chaiyawat et al., 2021). Post-intervention, 75% of participants in the study group no longer reported feeling bad about themselves, reflecting substantial improvements in emotional well-being. This improvement is attributed to the sense of control and empowerment gained through self-managed rehabilitation and the noticeable reduction in urinary leakage symptoms. By alleviating physical symptoms, the HB-PFMR program helped reduce the stigma and psychological burden often associated with UI.

Psychological and emotional well-being are integral to the overall QoL for women with UI. Previous studies, including those by Navarro-Brazález et al. (2021) and Dumoulin et al. (2020), have demonstrated that interventions addressing both physical and psychological components of UI management yield better patient-reported QoL outcomes. Dumoulin et al. (2020) further highlighted the importance of integrating psychological or counseling support with physical training, reinforcing the multifaceted nature of UI. Similarly, Weber-Rajek et al. (2020) confirmed that PFMT significantly enhances both QoL and mental health, underscoring its comprehensive benefits in addressing the psychological and emotional challenges of UI.

The findings of this study support integrating mental health support into rehabilitation programs to ensure holistic improvement in physical, emotional, and social well-being. Combining HB-PFMR with psychological interventions may further enhance outcomes. Additionally, the study emphasizes the behavioral and physiological factors contributing to QoL improvements. The flexibility to perform exercises at home addresses barriers like logistical challenges and time constraints, boosting adherence and consistency (Cho & Kim, 2021). Connected health interventions, as reported by Argent et al. (2018), also play a crucial role in improving adherence by offering accessible, patient-centered solutions. Moreover, Nicolson et al. (2018) observed that incorporating exercises into daily routines enhances practical benefits, fostering sustained rehabilitation outcomes.

The synergy between physiological, behavioral, and psychological mechanisms within HB-PFMR creates a robust framework for significantly enhancing recovery outcomes for UI. Physiological improvements, as

demonstrated by Ibrahim et al. (2019), involve strengthening the PF muscles and reducing UI severity through targeted exercises. Behavioral changes, such as consistent home-based exercise practice (Cho & Kim, 2021), and psychological empowerment through self-directed rehabilitation collectively promote better engagement and adherence. By addressing the physical, emotional, and social aspects of UI, HB-PFMR underscores the importance of patient-centered care in contemporary health practices, advocating for a holistic and sustainable recovery approach (Navarro Brazález et al., 2018).

Chapter six

Conclusion and recommendations

6.1. Conclusion

6.2. Limitations

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6.4. Recommendations and Research Implications

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6.6. Summary

Chapter Six

Conclusion and Recommendations

6.1 Conclusion

Based on the study results, it is concluded that implementing Home-Based Pelvic Floor Muscle Rehabilitation (HB-PFMR) is effective in reducing the severity, frequency, and volume of urinary leakage among women with urinary incontinence (UI). This study's findings underscore the practicality and effectiveness of HB-PFMR in enhancing patients' quality of life (QoL) and providing a non-invasive, cost-effective treatment alternative. Therefore, HB-PFMR is recommended as an evidence-based intervention for improving self-management practices and overall health outcomes for women with UI.

6.2 Limitation

This study has several limitations. The relatively small sample size may limit the generalizability of the findings, necessitating more extensive studies to confirm these results across diverse populations. The short study duration might not capture the long-term effects of HB-PFMR on UI, reporting the need for longitudinal studies. The reliance on self-reported data of urinary leakage introduces less accurate measurement, as participants may overestimate or underestimate their symptoms. Conducting the study in a single healthcare setting limits the access to various participants, suggesting the need for multicenter trials.

Although the study compared HB-PFMR to routine Kegel exercises, including a no-treatment or placebo control group could provide a clearer understanding of the intervention's effectiveness due to the limited sample

size of those who meet the inclusion criteria. The researcher in the current study faced the challenge of monitoring the participants' adherence to the HB-PFMR exercises, and more objective measures like wearable devices could more accurately measure their compliance. Variability in exercise performance among participants might create a difference in the effectiveness of HB-PFMR.

6.3 Future Research

Future research should address the following areas to build on the current study's findings:

- Long-term studies should be conducted to evaluate the sustained effects of HB-PFMR on urinary leakage and QoL over a longer duration.
- Compare the effectiveness of HB-PFMR with other non-invasive treatments and physiotherapy techniques to determine the most effective interventions for UI. Which can help identify the best practices and potentially combine different methods for improved outcomes.
- Develop and implement further educational programs tailored to improve patients' self-care and self-efficacy skills, addressing the specific needs of women with UI. Incorporate nutrition programs focusing on dietary choices that support pelvic floor health and integrate therapeutic devices like biofeedback machines and electrical stimulation units to enhance muscle control and strength.
- Explore the use of technology, such as mobile apps and wearable devices, to assist in delivering and monitoring HB-PFMR exercises. Which can increase adherence, provide real-time feedback, and potentially improve the overall effectiveness of the intervention. Use

evidence-based biofeedback measurements to ensure exercises are performed correctly, further enhancing the effectiveness of these programs.

6.4 Recommendations

Based on the findings of the current study, the following recommendations are suggested:

- Healthcare providers should incorporate HB-PFMR into routine treatment protocols for UI. Healthcare providers should receive training in instructing patients in these exercises. Training sessions should be provided to ensure that patients perform these exercises correctly at home.
- Develop and implement comprehensive educational programs to raise awareness about the benefits and proper techniques of HB-PFMR. Educational materials, workshops, and digital resources can help disseminate this information effectively.
- Develop health policies that support the inclusion of HB-PFMR in community health services. Such policies should make this intervention more accessible to a broader population.
- Establish follow-up programs to monitor patients' adherence to HB-PFMR. Regular follow-ups can ensure sustained improvements, provide ongoing support, and address any issues that patients may encounter to ensure long-term benefits.
- Collaboration between physiotherapists, gynecologists, urologists, and primary care providers is essential for the comprehensive management of UI. A multidisciplinary approach ensures that patients receive holistic care, addressing both physical and psychological aspects of the condition.

- Healthcare providers should promote participation in support groups. These groups should follow best practices for forum design to maximize user engagement, provide accurate medical information, and share various self-management strategies for UI.

6.5 Practice Implications

Furthermore, the detailed analysis presented in the KHQ findings of this study reveals that the decrease in severity is not only statistically significant but also has practical implications.

6.5.1 Implication of HB-PFMR for Physiotherapist

The principle of exercise specificity is central to the HB-PFMR program, highlighting the necessity for tailored exercises to precisely strengthen PFM, which are vital for supporting pelvic organs and managing urinary continence. This specificity principle ensures that the rehabilitation exercises directly address the muscles that control bladder function. The research underscores that tailored rehabilitation exercises can lead to specific muscular adaptations, thereby improving pelvic floor strength and functional stability (Chaiyawat et al., 2021).

6.5.2 Economic Implications of HB-PFMR:

Integrating HB-PFMR into patient care advances clinical outcomes and introduces considerable economic efficiencies. These programs drastically reduce the direct costs of continuous medical appointments and costly surgical interventions. Boden & Elkins (2023) present a compelling case for the economic effectiveness of physiotherapy interventions targeting PFD, demonstrating substantial cost reductions compared to

traditional group therapies over a six-month interval. Additionally, these home-based modalities cut down on travel expenses and diminish losses in productivity by merging therapy with patients' everyday life activities, thus eliminating the typical downtime associated with conventional treatment approaches. Chaiyawat et al. (2021) support this perspective by showing that home-based functional exercises significantly mitigate UI's financial and psychosocial burdens, improving QoL for the affected individuals. Economic analysis has demonstrated that these interventions substantially decrease costs related to immediate and prolonged healthcare needs. Enhanced policy backing for home-based care can extend these advantages, positioning it as an economically viable option that boosts patient access and compliance while simultaneously cutting overall healthcare costs. Therefore, incorporating home-based rehabilitation into established care protocols is a strategic approach to enhance the efficacy and economy of healthcare delivery.

6.5.3 Strategic Implications of HB-PFMR in Bahrain:

In Bahrain, the strategic implementation of HB-PFMR holds substantial promise for enhancing the efficiency and reach of healthcare services. The Kingdom's small geographic size and advanced infrastructure provide an ideal setting for deploying home-based care efficiently, significantly reducing logistical challenges associated with patient travel to healthcare facilities.

Moreover, the cultural emphasis on family and home life in Bahrain supports the integration of home-based healthcare, making it a preferred and effective method for delivering care, especially for conditions requiring long-term management such as UI and PFDs. These programs optimize healthcare resource utilization by minimizing hospital visits and

associated costs, and they also align with Bahrain's healthcare policy objectives, which focus on preventive care and chronic disease management.

The report by Tayah & Assaf (2018) discusses the broader socioeconomic aspects of home-based services in the GCC, providing insights into economic and logistical efficiencies that could be extrapolated to healthcare and rehabilitation in Bahrain. Embracing home-based rehabilitation could lead to substantial healthcare savings, improved patient outcomes, and increased patient satisfaction by facilitating accessible, continuous, and culturally respectful care.

The outcomes of this investigation demonstrate a marked improvement in patients treated with HB-PFMR, thereby supporting its potential as an intense intervention for UI management in Bahrain. The congruent results reinforce this study's conclusions and enhance the broader evidence base advocating for specialized PFM interventions.

6.6 Summary

Urinary incontinence (UI) significantly impairs the daily lives of many women, challenging their ability to perform everyday activities with confidence and independence. This medical condition, marked by involuntary urine leakage, varies significantly among individuals and is influenced by factors such as pelvic floor muscle integrity, neurological functions, and personal life experiences. Managing UI effectively goes beyond conventional interventions and necessitates a comprehensive, patient-centered approach that considers the unique needs of each individual. Home-Based Pelvic Floor Muscle Rehabilitation (HB-PFMR) represents an innovative intervention tailored to strengthen pelvic muscles

and improve urinary control through personalized exercise regimens. This approach involves women actively in their therapeutic process and enhances their ability to manage symptoms efficiently and independently. By fostering greater control over their condition, HB-PFMR reduces reliance on continuous medical interventions and incontinence aids, thus promoting not only physical health but also psychological well-being; implementing HB-PFMR empowers women by restoring their autonomy and self-confidence, enabling a significant enhancement in their overall quality of life (QoL). Such personalized and empowering rehabilitation strategies are crucial in transforming the management paradigm for urinary incontinence, helping women to lead more active and fulfilling lives. This comprehensive approach ensures that women are equipped with the skills and knowledge necessary to manage their health condition effectively, promoting long-term improvements in both physical and mental health.

The study aims to assess the effectiveness of Home-Based Pelvic Floor Muscle Rehabilitation on the severity, frequency, volume of urinary leakage and QoL among women with UI.

The study was conducted at Ibn Al-Nafees Hospital in Manama, Bahrain, a modern medical institution known for its comprehensive services across various specialties, including a well-equipped physiotherapy department. This department offers specialized rehabilitation services, such as pelvic floor muscle training for women with urinary UI, referred by numerous healthcare providers. A convenience sampling involved 62 voluntarily participating women with UI, randomly assigned to two groups: 32 in the intervention group receiving Home-Based Pelvic Floor Muscle Rehabilitation (HB-PFMR) and 30 in the control group receiving routine Kegel exercises.

Four tools were employed to collect data, each specifically chosen for its ability to assess different aspects of UI, namely: (1) The 3-Incontinence Questionnaire (3IQ), developed by Brown et al. in 2006, it is a self-administered questionnaire used primarily in primary care settings to classify the type of incontinence, noted for its ease of administration and accuracy in identifying incontinence types. (2) The Incontinence Severity Index (ISI), created by Sandvik et al. in 1993, measures the severity of UI by assessing the frequency and amount of urinary leakage, providing a quantitative assessment of its impact on daily activities. (3) The International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF), initiated in 1998 under the sponsorship of the World Health Organization, evaluates the frequency, severity, and impact of UI on QoL. Lastly, (4) the King's Health Questionnaire (KHQ), developed in 1997 at King's College Hospital in London, it is designed to evaluate how UI affects an individual's QoL across nine domains.

Baseline demographic and obstetric data were collected for both groups, including age, educational level, employment status, intensity, number of pregnancies, and types of delivery. They also assessed for type of incontinence using the 3-Incontinence Questionnaire (3IQ), The severity of UI including the frequency and amount of urinary leakage using Incontinence Severity Index (ISI), the frequency, severity, and impact of UI on QoL using the International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF), and the effect of UI on the QoL using King's Health Questionnaire (KHQ)

The experimental group underwent HB-PFMR, consisting of five different Kegel exercises and five functional approach exercises performed daily. In contrast, the control group performed routine Kegel exercises twice daily, with 25 repetitions per session.

Both groups participated twice a week, with live training sessions lasting over one month, totaling eight sessions per participant. Women were monitored through log sheets and daily communication via social networking sites (What's App). After one month, both groups were reassessed using the ISI, ICIQ-UI SF, and KHQ to evaluate changes in UI severity, frequency, volume, and QoL. The final comparison aimed to determine the effectiveness of HB-PFMR in improving UI symptoms and QoL.

6.6.1 The main results of the present study revealed the following:

- The average age was 43.74±6.18 years in the study group and 40.36±4.08 years in the control group. A slightly higher percentage of women aged 35-40 was observed in the control group compared to the study group (53.3% and 46.9%).
- The majority in both groups held bachelor's degrees (62.5% in the study group and 70% in the control group).
- Both groups had higher-intensity occupations (40.6% study group and 46.6% control)
- Normal deliveries were more prevalent than C-sections in both groups but slightly higher in the control group (87.7% and 81.4%).
- Both the study and control groups reported a 100% incidence of urine leakage in the last three months prior to the intervention, as measured by the 3-Incontinence Questionnaire (3IQ), indicating that all participants experienced some form of UI. Notably, the majority of women in both groups reported leakage primarily during physical activities such as coughing, sneezing, lifting, or exercise, highlighting the prevalence of SUI among the women.

- For the ISI questionnaire, in the pre-intervention phase, both the study and control groups reported no instances of "Never" leaking urine, with high frequencies of leakage. Post-intervention, significant improvements were observed in the study group, where 53.1% reported no leakage, compared to only 13.3% in the control group ($p=0.008$). Daily leakage in the study group also dramatically reduced to 3.1%, demonstrating marked improvements in managing UI.

- For the ISI questionnaire, the pre-intervention, both the study and control groups reported similar rates of "Drops" and "Small splashes" as the most common forms of urine loss. Post-intervention, there was a significant improvement in the study group, with 53.1% reporting no urine loss compared to 13.3% in the control group ($p<0.001$). Additionally, there was a notable decrease in "Drops" and "Small splashes" in the intervention group, indicating effective urine loss management.

- It is noticed that initially, no participants in either group reported any incontinence as per ISI. Post-intervention, the study group showed substantial improvement, with 53.1% reporting no incontinence, a significant change from 0% ($p<0.001$). Additionally, severe incontinence dropped to 3.1% ($p=0.003$). In contrast, only 13.3% in the control group reported no incontinence post-intervention, with minimal changes in moderate to very severe levels.

- It was found in the ICIQ-UI-SF questionnaire both groups initially reported high frequencies of urinary leakage, with daily occurrences noted by 34.4% in the study group and 40.0% in the control group. Post-intervention, significant improvements were observed in the

study group, where 53.1% reported no leakage ($p<0.009$), and daily leakage was reduced to 3.1%. Conversely, only 13.3% of the control group reported no leakage. The amount of urine loss also improved substantially in the study group, with 53.1% experiencing no leakage post-intervention ($p<0.001$).

- It was revealed prior to the intervention the study group experienced considerable disruption in daily life due to UI, reflected by a mean interference score of 5.75±1.96. Post-intervention, this score improved significantly to 1.18±0.67 ($p<0.001$), indicating a substantial reduction in the impact of UI on daily activities. The control group, on the other hand, reported fewer substantial changes.
- It was observed in the pre-intervention phase that the incidence of urine leakage related to specific activities showed that 90.63% of the study group and 73.33% of the control group experienced leaks during physical activity. Notably, 59.38% of the study group and 60.00% of the control group reported leakage when coughing or sneezing. Post-intervention, significant improvements were observed in the study group, with a reduction to 31.25% in leaks during coughing or sneezing ($p=0.009$) and to 18.75% during physical activity.
- Regarding ICIQ-UI-SF, both the study and control groups showed no cases of "None" level incontinence, with the study group primarily experiencing moderate incontinence (59.4%). Post-intervention, the study group significantly improved, with 53.1% reporting no incontinence ($p<0.003$), while the control group had only 13.3% reaching this level.

- Post-intervention, the study group reported significant health improvements, with 59.3% rating their health as "Very Good," compared to only 26.7% in the control group (p=0.012).

- Regarding bladder problems, 56.2% of the study group reported no issues post-intervention, a substantial increase from 0%, demonstrating marked improvement over the control's 13.3% (p=0.003).

- It is noticed in the post-intervention, the study group showed a significant reduction in bladder problems affecting household tasks (p=0.013) and daily activities outside the home (p=0.008), with 53.1% reporting no impact at all compared to only 20.0% in the control group.

- Regarding Physical limitations, post-intervention, the study group showed significant improvements, with 53.1% reporting no interference from bladder problems in physical activities such as walking, running, or gym exercises, in contrast to only 13.3% in the control group (p=0.003).

- Changes in the ability to travel due to bladder problems were not statistically significant post-intervention, with 62.5% in the study group and 46.7% in the control group reporting no issues (p=0.186).

- Regarding social limitation post-intervention, 62.5% of the study group reported no limitation on social life due to bladder issues, compared to only 40.0% in the control group. However, this difference was not statistically significant (p=0.211). The study group also improved their ability to visit friends without limitations

from bladder problems, with 68.7% reporting no interference post-intervention, compared to 36.7% in the control group (p=0.026).

- The study group reported significant improvements in their personal relationships post-intervention, with 59.4% experiencing minimal impact on their relationship with partners and 65.6% reporting no effect on their sex life. Notably, 71.8% indicated no disruption to family life, significantly improving from pre-intervention levels (p=0.011). In contrast, the control group reported lesser pronounced changes, with only modest improvements in how bladder problems affected relationships and family life.

- Post-intervention, the study group demonstrated significant emotional improvements 62.5% reported feeling no anxiety or nervousness, a marked increase from pre-intervention levels, with significant reductions in feeling anxious (p=0.018) and bad about themselves (p=0.017).

- It was revealed that post-intervention, there was a significant improvement in the study group's sleep due to urinary problems, with 75.0% reporting no sleep disturbances, up from 46.9% pre-intervention. In contrast, the control group showed a minor improvement, with 63.3% reporting no impact post-intervention compared to 56.7% pre-intervention.

- Notably, there was a substantial increase in the study group women feeling less worn out or tired, with 81.2% reporting they never felt worn out post-intervention, a significant improvement from 43.7% pre-intervention (p=0.002). The control group also improved but less markedly, from 40.0% to 43.3%.

- It was observed that post-intervention, the study group showed a significant reduction in constant pad usage, decreasing from 78.1% to 25.0%. In contrast, the control group's reduction was less pronounced, from 66.7% to 46.6%.

- It was found in the study group the percentage of women who always needed to be careful about fluid intake dramatically decreased from 43.8% pre-intervention to just 3.1% post-intervention, marking a significant change ($p<0.001$). The control group reported a smaller decrease from 33.3% to 23.3%

- It was noticed in the study group the percentage of women who often needed to change underclothes due to wetness decreased significantly from 31.2% pre-intervention to 0% post-intervention. Meanwhile, in the control group, the frequency of changing underclothes when they got wet remained relatively unchanged, from 30.0% pre-intervention to 16.7% post-intervention.

- It was observed in the post-intervention, the study group showed a substantial decrease in participants often worried about smell, dropping from 34.4% to 18.7% ($p=0.024$). In contrast, the control group experienced a decrease from 20.7% to 13.3%.

- It was revealed that the study group reported a significant reduction in constant feelings of embarrassment due to bladder problems, decreasing from 21.8% to 0%. The control group, however, reported a decrease from 20.0% pre-intervention to 10.0% post-intervention.

- The HB-PFMR program emphasizes the principle of exercise specificity, which is crucial for designing targeted exercises that strengthen the pelvic floor muscles (PFM), which is essential for

supporting pelvic organs and managing UI. This approach ensures that the rehabilitation exercises enhance the muscles responsible for bladder control, improving pelvic floor strength and functional stability (Chaiyawat et al., 2021).

- Bahrain's compact geography and advanced infrastructure facilitate the efficient implementation of HB-PFMR. This approach minimizes logistical challenges and travels to healthcare facilities, aligning with national healthcare policies focused on preventive care and chronic disease management.

- The cultural values that emphasize family and home life in Bahrain make home-based healthcare a preferred method for managing conditions like UI. These programs optimize healthcare resources, reduce hospital visits and costs, and improve patient outcomes, offering substantial socioeconomic benefits, as discussed in the report by Tayah & Assaf (2018).

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Appendix (4): King's Health Questionnaire (KHQ)

Parts	Domain (9 in number)	Sub items (21 in number)	Responses	Score
Part I	1. General health perception	1. Self-perceived health	5 (Very good, Good Fair, Poor, Very poor)	0 to 100
	2. Incontinence impact	2. Life burden due to disease	4 (Not at all, A little, Moderately, A lot)	0 to 100
Part II	3. Role limitations	3. House hold tasks	4 (Not at all, A little, Moderately, A lot)	0 to 100
		4. Limitation of daily activities	4 (Not at all, A little, Moderately, A lot)	0 to 100
	4. Physical limitations	5. Limitation of physical activities	4 (Not at all, A little, Moderately, A lot)	0 to 100
		6. Limitation of daily activities	4 (Not at all, A little, Moderately, A lot)	0 to 100
	5. Social limitations	7. Limitation of social life	4 (Not at all, A little, Moderately, A lot)	0 to 100
		8. Inability to visit friends, relatives	4 (Not at all, A little, Moderately, A lot)	0 to 100
	6. Personal relationships	9. Partner relationship	4 (Not at all, A little, Moderately, A lot)	0 to 100
		10. Sex life	4 (Not at all, A little, Moderately, A lot)	0 to 100
		11. Family life	4 (Not at all, A little, Moderately, A lot)	0 to 100
	7. Emotions	12. Depression	4 (Not at all, A little, Moderately, Very much)	0 to 100
		13. Anxiety, nervousness	4 (Not at all, A little, Moderately, Very much)	0 to 100
		14. Feeling bad	4 (Not at all, A little, Moderately, Very much)	0 to 100
	8. Sleep/energy	15. Sleep deprivation	4 (Not at all, A little, Moderately, All the time)	0 to 100
		16. Tiredness	4 (Not at all, A little, Moderately, All the time)	0 to 100
	9. Severity measures	17. Pad usage	4 (Not at all, A little, Moderately, All the time)	0 to 100
		18. Fluid restriction	4 (Not at all, A little, Moderately, All the time)	0 to 100
		19. Change of underclothes	4 (Not at all, A little, Moderately, All the time)	0 to 100
		20. Urinary odour	4 (Not at all, A little, Moderately, All the time)	0 to 100
Part III	Symptom severity scale	21. Ten bladder related symptoms such as frequency, nocturia, urgency, urge & stress incontinence, bedwetting, intercourse incontinence, urinary infection, dysuria and dribbling.	For each sub question: 4 (Nil, Mild, Moderate, Severe)	0 to 30

Appendix (5): Ethical consideration for study setting

مستشفى ابن النفيس ش.م.ب (مقفلة)
IBN AL-NAFEES HOSPITAL CO. B.S.C(C)

5 يناير 2023

حضرة الفاضل الدكتور محمد عبدالله محمد عبدالله
منسق مقرر أطروحة الماجستير (PHTY699)
جامعة البحرين – مملكة البحرين

الموضوع: الموافقة على عقد بحث لأطروحة ماجستير العلاج الطبيعي للطالبة فرشته علي عباس فيروز تراب (الرقم الأكاديمي 20114378)

السلام عليكم ورحمه الله وبركاته،

بالإشارة إلى خطابكم المؤرخ بتاريخ 27 ديسمبر 2022 بشأن الموافقة على إجراء بحث على عينة من مرضى مستشفى ابن النفيس للطالبة فرشته علي تراب. نود الإفادة بعدم ممانعتنا ذلك شريطة الإلتزام بسرية المعلومات الخاصة للمستشفى.

هذا مالزم وتفضلوا بقبول وافر التحيات،،

علي فردان جواد
الرئيس التنفيذي للعمليات

TEL: 17828282 - 17828230 FAX: 17828232 EMAIL: info@ibnalnafees.com WEBSITE: www.ibnalnafees.com ADDRESS: 63, Road 3302, Manama 333 P.O. BOX: 54533 Manama - Kingdom of Bahrain

Appendix (6): Informed consent form

Informed consent form

I hereby give my consent to participate in the study titled: Effect of Home-Based Pelvic Floor Muscle Rehabilitation on Severity, Frequency, and Volume of Urinary Leakage among Women with Incontinence

Researcher name: Farishta Ali Turab Course title: Applied Research Project

Student No: 20114378 Supervisor name: Dr. Mohamed Abdulla/ Dr. Zohour Rashwan

I, the undersigned, confirm that : (please tick as appropriate)

Statement	Yes	No
1. I have read and understood the information regarding the study procedures, and requirements as provided in the information sheet		
2. I voluntarily agree to participate in this study		
3. I understand that I have the right to withdraw at any time without being asked for clarifications		
4. The procedures regarding confidentiality have been clearly explained to me (use of names, pictures, anonymization of data, etc)		
5. The use of the data in research, publications, sharing, and archiving has been explained to me		
6. I understand that other researchers will be able to access the data only if they agree to preserve the confidentiality of the data and if they agree to the term's I have specified in this form		
7. I have been given the opportunity to ask questions about the study and my participation. I have the right to ask further questions in the future		
8. All the information that I give to the researcher are true and accurate to the best of my knowledge and I understand that I must notify if there are any changes to the information		
9. I along with the Researcher agree to sign and date this informed consent form		

Participant Name	Signature	Date
Investigator Name	Signature	Date

Appendix (7): Consent form for photography and use of images in academic and educational materials

Consent form for photography and use of images in academic and educational materials

I. Purpose
This consent form seeks your permission to take photographs of you while performing functional exercises. The images will be used exclusively for academic and educational purposes, including inclusion in a thesis paper and a PowerPoint presentation as part of an academic requirement. The photographs will be taken with your face covered to ensure your privacy and anonymity.

II. Use of Images
The images taken may be utilized in the following ways:

- Inclusion in the written thesis paper as part of research documentation.
- Display in a PowerPoint presentation during thesis defense or other academic presentations.
- If needed, the images may be used for other academic or educational purposes, strictly within the scope of research, teaching, and professional presentations.

III. Confidentiality and Privacy

- All images will be captured with your face covered to protect your identity.
- Your personal details will remain strictly confidential, and no identifying information will be disclosed.
- The images will be used respectfully, ensuring your dignity is maintained throughout.

IV. Voluntary Participation
Your participation in this photography is entirely voluntary.

V. Consent
By signing this form, you provide permission for the following:

- To be photographed while performing functional exercises with your face covered.
- To allow the use of these images in a thesis paper, related educational presentations, and, if needed, other academic or educational uses as described above.

I have read, understood, and agree to the terms above, and I provide my consent accordingly.

Signature:

Date: March, 2023

الملخص:

المقدمة: يُعد السلس البولي (UI) حالة شائعة تؤثر على جودة حياة النساء على مستوى العالم. وقد أظهرت العلاج الطبيعي، ولا سيما إعادة تأهيل عضلات قاع الحوض المعتمد على المنزل (HB-PFMR)، فعالية في إدارة أعراض السلس البولي.

الهدف: تهدف هذه الدراسة إلى تقييم فعالية برنامج إعادة تأهيل عضلات قاع الحوض المعتمد على المنزل (HB-PFMR) في تقليل شدة وتكرار وحجم تسرب البول لدى النساء المصابات بالسلس البولي في مملكة البحرين. كما تهدف إلى دراسة تأثير هذا البرنامج على جودة الحياة لدى النساء المصابات بالسلس البولي.

الطريقة: دراسة شبه تجريبية ذات تصميم قبل وبعد التجربة. شملت الدراسة عينة متيسرة مكونة من 62 امرأة مصابة بالسلس البولي ممن استوفين معايير الدراسة، وتم توزيعهن عشوائيًا إلى مجموعتين: مجموعة الدراسة التي تلقت (ن =32) HB-PFMR ومجموعة التحكم التي تلقت تمارين كيجل الروتينية (ن =30) . خضعت مجموعة الدراسة لبرنامج HB-PFMR الذي تضمن خمسة تمارين كيجل مختلفة وخمسة تمارين وظيفية تؤدى يوميًا. في المقابل، قامت مجموعة التحكم بأداء تمارين كيجل الروتينية مرتين يوميًا بواقع 25 تكرارًا في كل جلسة. شاركت كلتا المجموعتين مرتين أسبوعيًا في جلسات تدريب حية لمدة تزيد عن شهر. تم متابعة النساء عبر جداول يومية وتواصل يومي. تمت إعادة تقييم المجموعتين فيما يتعلق بشدة وتكرار وحجم تسرب البول وجودة الحياة قبل وبعد العلاج.

النتائج: بشكل عام، أظهرت مجموعة الدراسة تحسنًا كبيرًا في إدارة السلس البولي. لوحظ انخفاض كبير في شدة تسرب البول، حيث انخفضت النسبة من 34.4% في البداية إلى 3.1% بعد الدراسة. بالإضافة إلى ذلك، تحسنت نسبة تكرار السلس البولي بشكل ملحوظ، حيث ارتفعت نسبة النساء اللواتي لم يعانين من السلس البولي من 0% في البداية إلى 53.1% بعد التدخل، مقارنة بعدم وجود تغيير في مجموعة التحكم. كما شهدت مجموعة الدراسة انخفاضًا في حجم التسرب من 18.8% قبل التدخل إلى 0% بعد التدخل. علاوة على ذلك، أفادت 56.2% من النساء في مجموعة الدراسة بعدم وجود مشاكل في المثانة بعد التدخل مقارنة بـ 13.3% فقط في مجموعة التحكم.(p=0.003)

الاستنتاج: يُستنتج أن HB-PFMR هو تدخل غير دوائي فعال في تقليل شدة وتكرار وحجم تسرب البول لدى النساء المصابات بالسلس البولي وتحسين جودة حياتهن بشكل عام. تسلط هذه الدراسة الضوء على الحاجة إلى دمج التدخلات العلاجية التأهيلية مثل HB-PFMR في الرعاية الاعتيادية كممارسة قائمة على الأدلة للنساء المصابات بالسلس البولي، مما قد يشكل استراتيجيات الرعاية الصحية المستقبلية في مملكة البحرين وخارجها.

جامعة البحرين

كلية العلوم الصحية والرياضية

تأثير البرنامج المنزلي لإعادة تأهيل عضلات قاع الحوض، على شدة وتكرار وحجم التسرب البولي بين النساء المصابات بسلس البول

أطروحة مقدمة كجزء من متطلبات الحصول على درجة الماجستير في العلاج الطبيعي

إعداد

فرشته علي تراب

20114378

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الدكتورة زهور رشوان

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جامعة البحرين

مملكة البحرين

نوفمبر 2024