ORIGINAL ARTICLE

Nr 2025;15 (3):258-270

Association Between Primary Dysmenorrhea and Accelerometer-Measured Physical Activity Metrics in Nulliparous Women of the United Arab Emirates: A Cross-sectional Study

Jenan Ali[1], Nicola Maffulli[2,3,4], Filippo Migliorini[5,6,7], Ashokan Arumugam[1,8,9,10]

[1] *Department of Physiotherapy, College of Health Sciences, University of Sharjah, Sharjah, United Arab Emirates*
[2] *Faculty of Medicine and Psychology, University "La Sapienza" of Rome, Italy*
[3] *School of Pharmacy and Bioengineering, Keele University Faculty of Medicine, Stoke on Trent, U.K.*
[4] *Queen Mary University of London, Barts and the London School of Medicine and Dentistry, Centre for Sports and Exercise Medicine, Mile End Hospital, London, U.K.*
[5] *Department of Trauma and Reconstructive Surgery, University Hospital of Halle, Martin-Luther University Halle-Wittenberg, Halle (Saale), Germany*
[6] *Department of Orthopaedic and Trauma Surgery, Academic Hospital of Bolzano (SABES-ASDAA), Bozen, Italy*
[7] *Department of Life Sciences, Health, and Health Professions, Link Campus University, Rome, Italy*
[8] *Neuromusculoskeletal Rehabilitation Research Group, RIMHS – Research Institute of Medical and Health Sciences, University of Sharjah, Sharjah, United Arab Emirates*
[9] *Sustainable Engineering Asset Management Research Group, RISE – Research Institute of Sciences and Engineering, University of Sharjah, Sharjah, United Arab Emirates*
[10] *Department of Physiotherapy, Manipal College of Health Professions, Manipal Academy of Higher Education, Manipal, Karnataka, India*

CORRESPONDING AUTHOR:
Filippo Migliorini
Department of Trauma and Reconstructive Surgery
University Hospital of Halle
Martin-Luther University Halle-Wittenberg
Ernst-Grube-Street 40, 06097 Halle (Saale), Germany
E-mail: filippo.migliorini@uk-halle.de

DOI:
10.32098/mltj.03.2025.03

LEVEL OF EVIDENCE: 3B

SUMMARY

Background. Dysmenorrhea and menstrual characteristics significantly impact physical activity patterns, yet few studies have objectively measured these associations using accelerometers. This study aimed to investigate the association between dysmenorrhea severity, menstrual characteristics, and accelerometer-measured physical activity levels in nulliparous women in the UAE.

Methods. An observational study was conducted among 46 women aged 18-45 years, with varying severity levels of primary dysmenorrhea (PD) classified by the Numeric Pain Rating Score (NPRS) and Working ability, Location, Intensity, Days of pain, Dysmenorrhea (WaLIDD) scores. Participants wore a Fibion triaxial accelerometer for three consecutive menstrual days to measure sitting time and light, moderate, and vigorous intensity physical activity times.

Results. Participants spent 11.0 ± 1.56 hours/day sitting, with 3.84 ± 1.73 hours in light-intensity activity, 33.6 ± 20.3 minutes in moderate-intensity activity, and 0.38 ± 0.62 minutes in vigorous-intensity activity during the menstrual days. Women with moderate-to-severe PD had lower light-intensity activity by 1.26 hours/day than those with mild PD ($p = 0.030$). Women with heavier menstrual flow had lower vigorous-intensity activity by 0.75min compared to those with scanty menstrual flow ($p < 0.050$). No significant associations were found between menstrual characteristics and sitting or moderate-intensity activity times.

Conclusions. Dysmenorrhea severity and menstrual flow were associated with physical activity times, particularly with reduced light and vigorous activity. Tailored interventions addressing these menstruation-related characteristics may improve physical activity levels and mitigate long-term health risks, enhancing the well-being of women with PD.

KEY WORDS

Accelerometer; dysmenorrhea; menstrual flow; physical activity; sedentary behavior.

INTRODUCTION

Physical inactivity is becoming a global burden as sedentary behaviors have increased over the last few years. The World Health Organization (WHO) 2020 physical activity guidelines highlighted the importance of moderate and vigorous activities and provided recommendations on the dose needed to achieve optimal health outcomes (1). However, these guidelines lack recommendations for the time spent doing light activity and being sedentary. Moreover, precise guidelines for managing sedentary behavior and improving the physical activity of individuals living with disabilities or chronic diseases are lacking as well (2).

Physical inactivity is a significant risk factor associated with an increase in non-communicable diseases (NCD) (3, 4), such as cardiovascular diseases (5, 6), diabetes, chronic respiratory conditions (7), *etc*. NCD is a leading cause of morbidity and mortality worldwide. It is considered the leading cause of 68% of deaths globally (8), with a noticeable increase in NCD risk factors like hypertension and obesity in adolescents (9, 10). Deaths due to physical inactivity might account for approximately 5.3 million per year (11).

Global decrease in physical activity levels persisted even with the implementation of campaigns to increase awareness about the importance of exercise. Approximately 27.5% of adults worldwide have an extremely low activity level (12). In the United Arab Emirates (UAE), the prevalence of regular physical activity among youth is dangerously low (13). A study was conducted on the young adult population in the UAE using the ActiGraph device, which reported that a quarter of the individuals are sedentary, around one-fifth are moderately active, and only about a quarter are engaged in intensive physical activities. The study also showed that young men (50%) and women (76.6%) had a high sedentary behaviour time for approximately 80% of waking hours. Moreover, female participants are more involved in light physical activities, while male participants are more engaged in moderate and vigorous physical activities (14).

Exploring the association between physical activity levels and menstrual pain (dysmenorrhea) in women is an area worthy of investigation. Dysmenorrhea is defined as pain associated with menstruation and can be categorized into primary dysmenorrhea (PD) or secondary dysmenorrhea. PD is one of the most common gynecological issues among young women (15). PD is a painful uterine contraction that usually starts a few days before menstruation and continues during the first 48-72 hours of menstruation without an obvious pelvic pathology. It usually starts 1-2 years after the onset of menarche and gradually decreases with ageing (16). PD prevalence ranges from 45% to 97% among women worldwide, irrespective of socioeconomic status, and is one of the main causes of absenteeism at school and work, with reports of negative impact on academic performance (17-20). Specifically, the prevalence of PD among adults studying in the Kingdom of Bahrain was 90.7%; these data were taken from a population of 42.5% Bahrainis, 27.9% Saudis, 22.1% Kuwaitis, and 7.5% Omanis (21). Among the young adult females in the Kingdom of Saudi Arabia with a history of PD, 70% had moderate-to-severe PD, while the remaining 30% had mild PD (22). Furthermore, the prevalence of PD in adolescent females in Dubai has been reported to be 94.7%, leading to absenteeism at school, cessation of regular training, and a decrease in physical activity levels (23).

The global burden of dysmenorrhea is high, as it has a profound negative impact on all aspects of life, including an effect on health (30%-50% reports of severe pain and up to one-third of adolescents reporting symptoms such as headaches, nausea, dizziness, and fatigue) (24). Social relationships (reporting poor relationships with friends and family as well as poor sports activities) (25, 26), and healthcare/economic aspects (increased healthcare costs by ≈ 2.2 to 2.9 times higher than usual costs) (27). If the symptoms go untreated, then it increases the risk of chronic pelvic pain and general chronic pain over time (28, 29). However, another study negates this claim and states that women with chronic dysmenorrhea are more likely to develop central sensitivity syndromes rather than chronic pain (30).

Studies have yielded contradictory results to date, with some indicating an increase in PD-related menstrual pain with increased activity in women, while others suggest the opposite. A study comparing the difference in menstrual pain and premenstrual symptoms in athletes *versus* the sedentary population showed that the athletes had higher menstrual pain (6.15 ± 2.85) than the sedentary population (5.54 ± 2.35) on the numeric pain rating scale (range: 0-10) (31). However, other studies showed improvement of menstrual pain after adding aerobic exercises (32, 33). Previous studies have shown that increased activity of the posterior and anterior sling of muscles due to repetitive concentric and eccentric contractions could improve core muscle control and decrease low back problems (34, 35).

Various other risk factors have been linked to the presence of PD, including a maternal history of dysmenorrhea (36-38), skipping breakfast (39), poor dietary behaviors (40), and a menarche age of less than 12 years. Dysmenorrhea may be accompanied by other physical symptoms such as headaches, dizziness, nausea, diarrhea, changes in appetite, bloating, swelling in the legs, breast tenderness, and lethargy (41, 42).

Menstrual distress causes negative responses that might impair social activity, activities of daily living, and even working and school attendance (43). Nevertheless, the distress varies between different women depending on their nutritional intake and lifestyle. Most women who had menstrual distress also reported being active smokers, having high sugar and caffeine intake, and drinking alcohol (44, 45). A Working ability, Location, Intensity, Days of pain, Dysmenorrhea (WaLIDD) score was created to self-report the degree of menstrual pain and interference with activities of daily living, as it measures the working ability, number of painful locations during menstruation, intensity of pain, and days of pain during menstruation. A high WaLIDD score indicates increased severity of dysmenorrhea (46).

Very few studies have been conducted on the specific characteristics of menstruation (*e.g.*, menstrual flow heaviness and length of menstruation) and their relationship with physical activity. De Carvalho et al. (2023) analyzed physical performance and self-perception of menstrual symptoms during early menstruation and after menstruation. They found that women with heavier menstrual flow had shorter activity performance, and an increased perception of menstrual symptoms was correlated with a decrease in total time to exhaustion during activities (47). Another study compared physical activity avoiders and non-avoiders during menstruation; the avoiders group showed an increase in menstrual flow heaviness, a longer menstrual period, and a higher level of fatigue than non-avoiders (48). These results are similar to the results of another study that concluded that lifestyle modifications with the addition of physical activity decreased PD pain and menstrual flow (49). Additionally, the muscular stiffness is lower in women, and the tolerance for muscular stretching is higher in women than in men; therefore, light physical activity like mobility exercises might help ease pain during menstruation due to a reduction in muscular stiffness (50, 51).

An association between the addition of physical activity and change in menstrual pain rating in women with PD has been reported previously (52-54). Recent studies showed a reduction in the severity of PD after the prescription of 8 weeks of aerobic exercises (32, 55, 56). Another study showed that regular strengthening, stretching, jogging, and muscle relaxation reduced PD symptoms (57). Exercise has been hypothesized to reduce pain intensity in those with PD by acting as a non-specific analgesic by increasing the blood flow to the pelvis, disrupting the accumulation of prostaglandins and delaying the onset of pain (58, 59). Exercise also reduces stress and improves mood by reducing sympathetic nervous system activation and increasing endorphin secretion, which in turn aids in reducing pain intensity in PD (60). Regular exercise before the onset of menarche and during menstruation has been claimed to be the strongest dysmenorrhea prevention measure (61), where brisk walking for 30 minutes, especially in the first 3 days of menstruation, has been reported to reduce the severity of PD (62). However, it is crucial to understand that the interaction between physical activity and anthropometric factors varies significantly during the pre-pubertal growth phase in females. This, in turn, affects the age of menarche and the onset of menstruation due to changes in body composition (63, 64).

Barriers to physical activity of women in the UAE ranged between cultural challenges such as difficulty in women joining the gym as there are few centers for women only, longer sitting hours in office jobs, presence of chronic illnesses, and other barriers like lack of time to incorporate physical activity in daily life, a belief that physical activity is not a social activity that can be done with friends or relatives, and boredom of exercise (65-67). The “walkability” of the city was also a major component influencing physical activity levels. This was determined by how the city is built and the perceived barriers that hinder the practice of physical activity, such as the physical attractions, street crossings, and sidewalk characteristics. Recent studies reported that Dubai, an Emirate in the United Arab Emirates, is not considered a highly “walkable” city due to the urban sprawl, lack of public transportation, roads being designed mainly for car usage, lack of shadows and sidewalks in many areas, and harsh weather (68, 69).

The effect of PD on physical activity has been studied using self-reported questionnaires in the UAE (14). One study reported the level of physical activity using hip-worn ActiGraph accelerometer data in adult women (70). The latter research only reported physical activity as a percentage on days with and without menstrual pain. It did not specify individual differences in time duration for sitting, light, moderate, and vigorous activities (70). The hip-worn accelerometer only measured motions occurring in the vertical plane (walking and running) as it is an omnidirectional accelerometer. The study showed that the women without PD experienced mild menstrual pain with no significant decrease in physical activity levels, whilst women with moderate-to-severe PD showed a 40% decrease in physical activity compared to the control group (70).

In addition, a study investigated the differences in physical activity data between accelerometers and self-reported questionnaires. Self-reported data met 90% of the required physical activity recommendations, whilst according to the accelerometer data, only 70% were met (71). This indicates that accelerometer-measured data can capture objective physical activity data while minimizing biases such as exaggeration or reduction of time spent in sedentary or physical activity from self-reported measures.

The present study aimed to investigate the association between dysmenorrhea status, menstrual period length, menstrual flow amount, and WaLIDD scores with accelerometer-measured sedentary (sitting) time and light, moderate, and vigorous intensity activity times in women with different severity levels of PD in the UAE. We hypothesized that the history and severity of dysmenorrhea and heavier menstrual flows are associated with increased sedentary time and reduced physical activity.

MATERIALS AND METHODS

Study design and setting

An observational study was conducted among nulliparous women in the emirates of Sharjah, Ajman, and Dubai in the United Arab Emirates. The study was reviewed and approved by the Research Ethics Committee, University of Sharjah (REC-22-10-10-S – approval date: October 10, 2022). Informed consent was obtained from all subjects involved in the study.

Participants

Nulliparous women aged 18-45 years with regular menstrual cycles, with no, mild, or moderate-to-severe PD, who could read and understand English and had a normal body mass index (18.5-25 kg/m^2) were included in the study. Those with menstrual pain of at least 4/10 on the Numeric Pain Rating Score (NPRS) for at least two consecutive periods were classified as having moderate-to-severe PD, while those with NPRS < 4/10 were classified as mild dysmenorrhea, and those with NPRS = 0 were classified as no dysmenorrhea (72-74).

Women were excluded from the study if they met the following criteria: a self-reported history of pregnancy, irregular menstrual periods, secondary dysmenorrhea (menstrual pain due to an underlying gynecological condition such as endometriosis or polycystic ovarian syndrome), menstrual cycles more than 35 days apart, hormonal therapy or an intrauterine birth control device, any recent history of pelvic, uterine, gynecological, or abdominal disease/surgery, and psychiatric disorders.

Sample size estimation

Considering an effect size of 0.35, an α value of 0.05, a power of 0.80, and five independent variables to be included in multiple linear regression analysis, 43 participants are deemed adequate. We used the G*Power 3.1.9.7 software to estimate sample size.

Procedure

Women were contacted through adverts posted on social media websites and word of mouth. A custom-designed questionnaire asked questions regarding the history of PD and the absence of any exclusion criteria to ensure women's eligibility before enrolling them in the study. All eligible participants received a detailed description of the study procedure and were asked to sign an informed consent form before data collection. Sociodemographic data were recorded using a set of questions in the screening questionnaire.

Each participant received a Fibion device (Fibion Inc., Jyväskylä, Finland) on day 1 and was requested to wear the device throughout the day except when participating in water-based activities. The volunteers were asked to wear the device for the first 3 days of the menstrual cycle and fill out an NPRS score, where zero means no pain and 10 represents the worst pain possible. The Fibion device (20 g, L = 30 mm, W = 32 mm, T = 10 mm) was attached using hypoallergenic Hypafix® tapes on the right anterior upper thigh between the hip and knee joints. Participants were reminded to wear the device daily through text messages to their mobile phones throughout the data collection period. This device has proven valid and reliable for monitoring and measuring sedentary time and physical activities of daily living (75-78).

Fibion data processing techniques reported by the previous studies were employed in the current research to analyze sitting and upright posture/activity time (76). Fibion data were transferred to the manufacturer's website (www.fibion.com/upload), and explicit reports on time spent sitting and different intensities of physical activity were obtained from the Fibion website. Intensities of physical activities were categorized as light-intensity (energy expenditure between 1.5 and 3 metabolic equivalents of task (MET)), moderate-intensity (between 3 and < 6 METs), and vigorous-intensity (≥ 6 METs). Sedentary activity refers to energy expenditure of ≤ 1.5 METs.

Only participants who wore a device for ≥ 10 hours per day for the first three menstrual days were included. The participants were instructed to wear the Fibion device during waking hours as long as possible and remove it at night before sleeping to prevent conflation of night-time data with sitting and physical activity time (79). The accelerometer might record the reclining posture and consider it sitting time. Also, the device can interpret turning movements in

bed with side-lying posture (with the hips in flexion) as a different activity other than sleeping. For these reasons, we have asked our participants to remove the accelerometer before going to sleep to exclude night-time data before analyzing daytime sedentary and upright behavior. Additionally, to account for any variation between participants in wear time of the Fibion device, time spent in each activity was normalized to 16 hours of waking time per day (75).
The intensity of menstrual symptoms was measured using the WaLIDD score questionnaire which assesses the working ability, anatomical location of pain, intensity of pain, and days of pain. The WaLIDD score has been reported to have good sensitivity and specificity of 63.7% and 56.9%, respectively, for detecting PD intensity rather than relying solely on NPRS (80).

Statistical analysis

Data normality was checked using the Shapiro-Wilk test. Data descriptive statistics were presented as mean and standard deviation (SD), or frequencies (with %). Multiple linear regression analyses were used to analyse the association between independent variables (PD intensity, length

Table I. Participant characteristics.

Variable	Value
Age (years)	22.60 ± 2.99
Weight (kg)	65.70 ± 8.59
Height (cm)	165 ± 6.98
BMI (kg/m²)	24.10 ± 2.19
Occupation	
Student	21 (45.7%)
Physiotherapist	9 (19.6%)
Personal trainer	7 (15.2%)
Research Assistant	5 (10.9%)
Clinical Dietitian	4 (8.7%)
Sedentary and physical activity times (per 16-h day)	
Sitting time (min)	660 ± 93.60
Light-intensity activity (min)	230.40 ± 103.80
Moderate-intensity activity (min)	33.60 ± 20.30
Vigorous-intensity activity (min)	0.38 ± 0.62

Table II. Menstruation-related information for all participants.

Variables related to menstruation		n (%)
Length of cycle (days)	≤ 21	2 (4.3%)
	22-28	40 (87%)
	≥ 29	4 (8.7%)
Length of menstruation (days)	< 5	2 (4.3%)
	5-7	40 (87%)
	≥ 8	4 (8.7%)
Amount of menstrual flow	Scanty	4 (8.7%)
	Normal	28 (60.9%)
	Heavy	14 (30.4%)
Menstrual pain in the last 3 menstruations	Yes	25 (54.3%)
	No	16 (34.8%)
	I don't know	5 (10.9%)
Frequency of presence of menstrual pain	Every menstruation	16 (34.8%)
	At intervals	15 (32.6%)
	Rarely	14 (30.4%)
	Never	1 (2.2%)
When is the menstrual pain experienced	Before menses start	10 (21.7%)
	During menstruation	22 (47.8%)
	Before and during menstruation	9 (19.6%)
	Not applicable	5 (10.9%)
Severity of dysmenorrhea	Mild primary dysmenorrhea (NPRS < 4/10)	23 (50%)
	Moderate-to-severe primary dysmenorrhea (NPRS ≥ 4/10)	23 (50%)

of menstrual period, amount of menstrual flow, WaLIDD score, presence of menstrual pain in the last three cycles) and dependent variables (sitting, light, moderate, and vigorous physical activity times per 16-h day). The level of significance was set at $p < 0.05$. The degree of multicollinearity of predictor variables was measured using the variance inflation factor (VIF), and all included independent variables in the model had a VIF < 3.0. Jamovi (Version 2.6) was used for all statistical analyses (81).

RESULTS

Sixty healthy young women were enrolled in the study; four dropped out due to personal reasons, while 10 were excluded due to technical issues with the accelerometer data. Forty-six healthy young women with a mean age of 22.6 ± 2.99 years and a mean BMI of 24.1 ± 2.19 kg/m^2 were included in the analysis. Students comprised 45.7% of the population, while the remaining 54.3% were working women. **Table I** summarizes the demographic and anthropometric characteristics of participants. The median age of menarche was 13 and 12 in women with moderate-to-severe PD and those with mild PD, respectively. All information related to menstruation is summarized in **table II**.

Physical activity information

During the first three days of the menstrual cycle, participants spent most of their time sitting (11.00 ± 1.56 h). As for the physical activity, participants spent most of their time doing light-intensity activities (3.84 ± 1.73 h), followed by moderate-intensity activities (33.60 ± 20.30 min), and then very low durations of vigorous-intensity activities (0.38 ± 0.62 min).

Sitting time

None of the variables of interest related to menstruation were significantly associated with the sitting time (**table III**).

Light-intensity activity time

PD status was negatively associated with light-intensity activity time (p = 0.03), with women in the moderate-to-severe PD group having light activity time shorter by 1.26 hours than the mild PD group (defined using

Table III. Variables associated with sitting time.

Variable	β Coefficient	95%CI	P-value	Adjusted R^2
Constant	9.5		< 0.001	0.095
PD status (moderate-to-severe *vs* mild)	0.94	(-0.034, 0.64)	0.077	
Length of menstrual period				
5-8 *vs* <5	0.65	(-1.22, 2.06)	0.609	
>8 *vs* <5	1.75	(-0.79, 3.04)	0.241	
Amount of menstrual flow				
Scanty *vs* heavy	0.39	(-1.03, 1.54)	0.694	
Moderate *vs* heavy	-0.26	(-1.07, 0.74)	0.715	
Presence of menstrual pain in last 3 menstruations.				
No *vs* Yes	-2.12	(-2.96, 0.23)	0.092	
IDK *vs* yes	-1.53	(-2.34, 0.38)	0.151	
WaLIDD score				
Mild PD *vs* severe PD	1.17	(-0.90, 2.41)	0.360	
Moderate *vs* severe PD	-0.10	(-0.99, 0.87)	0.891	

IDK: I don't know; PD: primay dysmenorrhea; WaLIDD: Working ability, Location, Intensity, Days of pain, Dysmenorrhea.

NPRS scores). The length of menstrual cycle, amount of menstrual flow, WaLIDD score, and presence of menstrual pain within the last three menstrual cycles were not significantly associated with light activity time (**table IV**).

Moderate-intensity activity time

None of the menstrual variables were significantly associated with moderate-intensity activity time (**table V**).

Vigorous-intensity activity time

The amount of menstrual flow was significantly associated with vigorous-intensity activity time. Vigorous-intensity activity time was longer by 0.75 minutes in participants with scanty menstrual flow than in participants with heavy menstrual flow (p = 0.031). Vigorous-intensity activity time was longer by 0.94 minutes in participants with moderate menstrual flow (p < 0.001) than those with heavy menstrual flow. Vigorous-intensity activity time was longer by 0.57 minutes in women with moderate PD than those with severe PD based on the WaLIDD scores (p = 0.025). On the other hand, the length of the menstrual cycle and the presence of menstrual pain within the last three menstrual cycles were not significantly associated with vigorous-intensity activity time (**table VI**).

DISCUSSION

A key finding of this study is the significant association between PD and light-intensity and vigorous-intensity activity durations. Our participants sat for an average of 11.0 ± 1.56 h per 16 hours daily. These levels are similar to the sedentary behavior of Emirati women employed in desk jobs (11.6 ± 1.1 h per 16-hour day) (66). It has also been shown that individuals who spent most of their working day sitting also spent longer outside work (82). These values indicate high sedentary activity times, as the sitting time was higher than the recommended seven hours of sedentary levels per day (83). Sitting hours equal to or exceeding 10 hours a day have been linked to a 34% increase in mortality rate (83). The increase in sitting time suggests that women with different levels of PD may be less likely to engage in activities like walking or light exercise, which in turn might contribute to an increase in various health issues like diabetes, hypertension, cardiovascular disorders, *etc*. (84-87).

Our female participants showed a mean light activity of 3.84 ± 1.73 h per 16-hr day. Light-intensity activity durations were further shortened by 1.26 hours in women with moderate-to-severe PD than in those with mild PD. These differences might be linked to avoiding exercises or adapting them to be lighter by 34.3% of participants in another

Table IV. Variables associated with light-intensity activity time.

Variable	β Coefficient	95%CI	P-value	Adjusted R^2
Constant	5.31		0.005	0.15
PD status (moderate-to-severe *vs* mild)	-1.26	(-0.69, -0.038)	0.030	
Length of menstrual period				
5-8 *vs* <5	-0.30	(-1.77, 1.42)	0.826	
>8 *vs* <5	-2.01	(-3.01, 0.69)	0.213	
Amount of menstrual flow				
Scanty *vs*s heavy	0.18	(-1.14, 1.35)	0.868	
Moderate *vs* heavy	0.25	(-0.74, 1.02)	0.746	
WaLIDD score				
Mild PD *vs* severe PD	0.26	(-1.46, 1.75)	0.853	
Moderate *vs* severe PD	0.42	(-0.66, 1.14)	0.591	
Presence of menstrual pain in last 3 menstruations.				
No *vs* Yes	0.90	(-1.03, 2.07)	0.500	
IDK *vs* yes	1.47	(-0.47, 2.17)	0.199	

IDK: I don't know; PD: primary dysmenorrhea; WaLIDD: Working ability, Location, Intensity, Days of pain, Dysmenorrhea.

Table V. Variables associated with moderate-intensity activity time.

Variable	β Coefficient	95%CI	P-value	Adjusted R^2
Constant	18.2		0.433	-0.046
PD status (moderate-to-severe *vs* mild)	6.59	(-0.20, 0.53)	0.367	
Length of menstrual period				
5-8 *vs* <5	11.28	(-1.21, 2.32)	0.528	
>8 *vs* <5	9.59	(-1.59, 2.53)	0.645	
Amount of menstrual flow				
Scanty *vs* heavy	-8.05	(-1.78, 0.99)	0.565	
Moderate *vs* heavy	-8.77	(-1.41, 0.54)	0.375	
WaLIDD score				
Mild PD *vs* severe PD	-16.2	(-2.57, 0.98)	0.369	
Moderate *vs* severe PD	6.12	(-0.70, 1.30)	0.546	
Prescence of menstrual pain in last 3 menstruations.				
No *vs* Yes	17.15	(-0.87, 2.56)	0.326	
IDK *vs* yes	-7.12	(-1.81, 1.11)	0.630	

IDK: I don't know; PD: primary dysmenorrhea; WaLIDD: Working ability, Location, Intensity, Days of pain, Dysmenorrhea.

Table VI. Variables associated with vigorous-intensity activity time.

Variable	β Coefficient	95%CI	P-value	Adjusted R^2
Constant	0.79		0.163	0.33
PD status (moderate-to-severe *vs* mild	-0.32	(-0.55, 0.027)	0.074	
Length of menstrual period				
5-8 *vs* <5	0.58	(-0.48, 2.34)	0.189	
>8 *vs* <5	-0.45	(-2.37, 0.91)	0.375	
Amount of menstrual flow				
Scanty *vs* heavy	0.75	(0.12, 0.87)	0.031	
Moderate *vs* heavy	0.94	(0.74, 1.69)	< 0.001	
WaLIDD score				
Mild PD *vs* severe PD	0.69	(-0.30, 2.58)	0.118	
Moderate *vs* severe PD	0.57	(0.12, 1.72)	0.025	
Prescence of menstrual pain in last 3 menstruations.				
No *vs* Yes	-0.35	(-1.94, 0.80)	0.406	
IDK *vs* yes	-0.49	(-1.96, 0.37)	0.175	

IDK: I don't know; PD: primary dysmenorrhea; WaLIDD: Working ability, Location, Intensity, Days of pain, Dysmenorrhea.

study due to increased menstrual pain, heavier menstrual flow, and/or increased fatigue (48). Light-intensity physical activity recommendations are currently not included in the WHO physical activity guidelines (1). However, the Canadian 24-hour movement guidelines recommend that "*adults should accumulate several hours of light physical activities, including standing daily*". These recommendations were based on the reports showing that doubling the time spent doing light physical activities reduced the mortality rate by 29% (88, 89). Furthermore, shifting focus from isolating movement behaviors to integrating all movement behaviors of any intensity throughout the day is recommended to allow additional movement options for adults (89, 90).

Moderate-intensity and vigorous-intensity activities timings of our participants were 33.6 ± 20.3 min and 0.376 ± 0.618 min per 16-hr day, respectively. These values fall very short of the WHO physical activity recommendations that recommend 150-300 minutes of moderate-intensity activities and at least 75-150 minutes of vigorous-intensity activities or an equivalent combination of both activities (1).

Vigorous-intensity activity duration is longer by 0.75 min in women with scanty menstrual flow than in those with heavy menstrual flow. In comparison, the duration of vigorous activity is longer, 0.94 min, in women with moderate menstrual flow than in those with heavy menstrual flow. Those women with scanty or moderate menstrual flow might be able to better participate in vigorous activities compared to their counterparts with heavy menstrual flow. The differences observed in vigorous activity between these subgroups were negligible (< 1 min). Most studies combine moderate and vigorous-intensity activities as one variable; it is plausible that the values reported in previous literature were higher since they included a combination of moderate and vigorous-intensity times (90).

Although the vigorous activity timings are very low for all participants, they were shorter in participants with increased PD intensity, where vigorous activity duration is longer by 0.57 min in women with moderate-intensity PD than severe PD (classified using the WaLIDD score). The results in the current study are nearly similar to from the findings of Chantler *et al*. (2009), where the study concluded that there was a 40% decrease in all physical activities in participants with moderate to severe PD during the days of menstrual pain *versus* the non-menstrual days, whilst there was no significant difference in those with no dysmenorrhea (70). A previous study highlighted that the intensity of PD was reduced with the addition of 10-week high-intensity interval training; this change was mainly attributed to hormonal modulation and a decrease in inflammatory proteins (89).

Limitations and recommendations

To the best of our knowledge, this is the first study in the UAE to investigate the association of PD characteristics, physical activity intensities, and related information with objective sedentary and physical activity times measured by a triaxial (Fibion) accelerometer. In addition, we used the WaLIDD score to assess specific menstrual pain information and its effect on physical activity, whilst other studies measured menstrual pain only through NPRS.

Limitations of the current study include the lack of inclusion of sleep quality and other factors, such as smoking and dietary factors (40), that may be associated with PD. The accelerometer is not waterproof; therefore, no water-based activity can be measured. However, we have not received any complaints about the involvement of participants in water-based sports, mainly since such sports are not very commonly practiced by women during their menstruation.

Future studies are warranted to explore the underlying mechanisms between physical activity and its effect on PD. Prospective longitudinal cohort studies are required to provide detailed insights into the cyclic nature and changes in menstrual cycle patterns/characteristics and their association with sedentary behavior and physical activity of women with and without PD. Finding the factors associated with physical activity times in women with PD would aid in developing more effective interventions to manage sedentary behavior and improve activity levels of women with PD.

CONCLUSIONS

We found that women with moderate-to-severe PD had lower light-intensity activity time than women with mild PD. The severity of menstrual flow influences the duration of vigorous-intensity activities, and women with heavier menstrual flow had lower vigorous-intensity activity time than women with scanty menstrual flow. If these associations are confirmed in prospective longitudinal cohort studies, then tailored interventions to mitigate sedentary behavior and physical inactivity in women with dysmenorrhea could be delivered.

FUNDINGS

The Fibion accelerometers used in the study were funded by the Office of the Vice Chancellor for Research and Graduate Studies, University of Sharjah, United Arab Emirates.

DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

JA: conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing - original draft preparation, writing - review & editing, visualization, project administration. NM, FM: supervision, writing - original draft preparation, writing - review & editing. AA: conceptualization, methodology, software, validation, formal analysis, resources, data curation, writing – review & editing, visualization, supervision, project administration.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

REFERENCES

1. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020;54:1451-62. doi: 10.1136/BJSPORTS-2020-102955.
2. DiPietro L, Al-Ansari SS, Biddle SJH, et al. Advancing the global physical activity agenda: recommendations for future research by the 2020 WHO physical activity and sedentary behavior guidelines development group. International Journal of Behavioral Nutrition and Physical Activity. 2020;17:1-11. doi: 10.1186/S12966-020-01042-2/TABLES/2.
3. Budreviciute A, Damiati S, Sabir DK, et al. Management and Prevention Strategies for Non-communicable Diseases (NCDs) and Their Risk Factors. Front Public Health. 2020;8:574111. doi: 10.3389/FPUBH.2020.574111/BIBTEX.
4. Di Cesare M. Global trends of chronic non-communicable diseases risk factors. Eur J Public Health. 2019;29. doi: 10.1093/EURPUB/CKZ185.196.
5. World Health Organization. Noncommunicable diseases. Available at: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases. Last access date: 12/6/2024.
6. Blundell HJ, Hine P. Non-communicable diseases: ditch the label and recapture public awareness. Int Health. 2019;11:5-6. doi: 10.1093/INTHEALTH/IHY063.
7. Navarro-Torné A, Vidal M, Trzaska DK, et al. Chronic respiratory diseases and lung cancer research: a perspective from the European Union. Eur Respir. 2015;46:1270-80. doi: 10.1183/13993003.00395-2015.
8. Nethan S, Sinha D, Mehrotra R. Non Communicable Disease Risk Factors and their Trends in India. Asian Pac J Cancer Prev. 2017;18:2005. doi: 10.22034/APJCP.2017.18.7.2005.
9. Johnson W, Li L, Kuh D, Hardy R. How Has the Age-Related Process of Overweight or Obesity Development Changed over Time? Co-ordinated Analyses of Individual Participant Data from Five United Kingdom Birth Cohorts. PLoS Med. 2015;12. doi: 10.1371/JOURNAL.PMED.1001828.
10. Song P, Zhang Y, Yu J, et al. Global Prevalence of Hypertension in Children: A Systematic Review and Meta-analysis. JAMA Pediatr. 2019;173:1154-63. doi: 10.1001/JAMAPEDIATRICS.2019.3310.
11. Lee IM, Shiroma EJ, Lobelo F, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet. 2012;380:219-29. doi: 10.1016/S0140-6736(12)61031-9.
12. Ding D. Surveillance of global physical activity: progress, evidence, and future directions. Lancet Glob Health. 2018;6:e1046-7. doi: 10.1016/S2214-109X(18)30381-4.
13. Yammine K. The prevalence of physical activity among the young population of UAE: a meta-analysis. Perspect Public Health. 2017;137:275-80. doi: 10.1177/1757913916675388.
14. Dalibalta S, Majdalawieh A, Yousef S, et al. Objectively quantified physical activity and sedentary behaviour in a young UAE population. BMJ Open Sport Exerc Med. 2021;7. doi: 10.1136/BMJSEM-2020-000957.
15. Zahradnik HP, Hanjalic-Beck A, Groth K. Nonsteroidal anti-inflammatory drugs and hormonal contraceptives for pain relief from dysmenorrhea: a review. Contraception. 2010;81:185-96. doi: 10.1016/J.CONTRACEPTION.2009.09.014.
16. Bavil DA, Dolatian M, Mahmoodi Z, Baghban AA. Comparison of lifestyles of young women with and without primary dysmenorrhea. Electron Physician. 2016;8:2107. doi: 10.19082/2107.
17. Armour M, Parry K, Manohar N, et al. The Prevalence and Academic Impact of Dysmenorrhea in 21,573 Young Women: A Systematic Review and Meta-Analysis. J Womens Health. 2019;28:1161-71. doi: 10.1089/JWH.2018.7615/ASSET/IMAGES/LARGE/FIGURE3.JPEG.
18. Kim K Il, Nam HJ, Kim M, Lee J, Kim K. Effects of herbal medicine for dysmenorrhea treatment on accompanied acne vulgaris: a study protocol for a randomized controlled trial. BMC Complement Altern Med. 2017;17. doi: 10.1186/S12906-017-1813-1.
19. Lee H, Choi TY, Myung CS, Lee MS. Herbal medicine Shaofu Zhuyu decoction for primary dysmenorrhea: a systematic review protocol. Syst Rev. 2016;5. doi: 10.1186/S13643-016-0185-9.
20. Kamel DM, Tantawy SA, Abdelsamea GA. Experience of dysmenorrhea among a group of physical therapy students from Cairo University: an exploratory study. J Pain Res. 2017;10:1079-85. doi: 10.2147/JPR.S132544.
21. Y Khamdan H. The Impact of Menstrual Period on Physical Condition, Academic Performance and Habits of Medical Students. J Womens Health Care. 2014;03. doi: 10.4172/2167-0420.1000185.

22. Shaji H. Severity of Primary Dysmenorrhea and Menstrual Distress among University Students in Kingdom of Saudi Arabia. IJHSR. 2014;4(11):209-15.
23. Al Mulla A, Lotfi G, Hassan Khamis A, Al Mulla A. Prevalence of Dysmenorrhea among Female Adolescents in Dubai: A Cross-Sectional Study. Open J Obstet Gynecol. 2022;12:686-705. doi: 10.4236/ojog.2022.128061.
24. Armour M, Parry K, Al-Dabbas MA, et al. Self-care strategies and sources of knowledge on menstruation in 12,526 young women with dysmenorrhea: A systematic review and meta-analysis. PLoS One. 2019;14:e0220103. doi: 10.1371/JOURNAL.PONE.0220103.
25. Yesuf TA, Eshete NA, Sisay EA. Dysmenorrhea among University Health Science Students, Northern Ethiopia: Impact and Associated Factors. Int J Reprod Med. 2018;2018:1-5. doi: 10.1155/2018/9730328.
26. Huseth-Zosel AL, Secor-Turner M. The Impact of Menstrual Flow Intensity on Daily Activities for College Students in the United States. Women's Reproductive Health. 2024;11:182-93. doi: 10.1080/23293691.2023.2209086.
27. Akiyama S, Tanaka E, Cristeau O, Onishi Y, Osuga Y. Evaluation of the treatment patterns and economic burden of dysmenorrhea in Japanese women, using a claims database. Clinicoecon Outcomes Res. 2017;9:295. doi: 10.2147/CEOR.S127760.
28. Macgregor B, Allaire C, Bedaiwy MA, Yong PJ, Bougie O. Disease Burden of Dysmenorrhea: Impact on Life Course Potential. Int J Womens Health. 2023;15:499-509. doi: 10.2147/IJWH.S380006.
29. Li R, Kreher DA, Jusko TA, Chapman BP, Bonham AD, Seplaki CL. Prospective Association between Dysmenorrhea and Chronic Pain Development in Community-Dwelling Women. J Pain. 2021;22:1084-96. doi: 10.1016/J.JPAIN.2021.03.139.
30. Gagnon MM, Elgendy R. Comorbid pain experiences in young women with dysmenorrhea. Women Health. 2020;60:946-57. doi: 10.1080/03630242.2020.1781741.
31. Kartal B, Kıssal A, Kaya M. Comparison of Athletes and Sedentary Students in Terms of Premenstrual Syndrome and Dysmenorrhea. Ordu Üniversitesi Hemşirelik Çalışmaları Dergisi. 2020;3:125-35. doi: 10.38108/OUHCD.732559.
32. Mahvash N, Eidy A, Mehdi K, Zahra MT, Mani M, Shahla H. The Effect of Physical Activity on Primary Dysmenorrhea of Female University Students. World Appl Sci J. 2012;17:1246-52.
33. Dehnavi ZM, Jafarnejad F, Kamali Z. The Effect of aerobic exercise on primary dysmenorrhea: A clinical trial study. J Educ Health Promot. 2018;7:3. doi: 10.4103/JEHP.JEHP_79_17.
34. Drummond C, Lebedeva V, Kirker K, Masaracchio M. Sling Exercise in the Management of Chronic Low Back Pain: A Systematic Review and Meta-Analysis. J Strength Cond Res. 2024;38(10):1822-33. doi: 10.1519/JSC.0000000000004135.
35. Sakne KE, Liepa A, Pontaga I. Peculiarities of Adolescent, Qualified Female Volleyball Players' Shoulder Girdle. Muscles Ligaments Tendons J. 2024;14(1):168-79. doi: 10.32098/mltj.01.2024.14.
36. Muluneh AA, Nigussie T seyuom, Gebreslasie KZ, Anteneh KT, Kassa ZY. Prevalence and associated factors of dysmenorrhea among secondary and preparatory school students in Debremarkos town, North-West Ethiopia. BMC Womens Health. 2018;18:1-8. doi: 10.1186/S12905-018-0552-X/TABLES/5.
37. Tavallaee M, Joffres MR, Corber SJ, Bayanzadeh M, Rad MM. The prevalence of menstrual pain and associated risk factors among Iranian women. J Obstet Gynaecol Res. 2011;37:442-51. doi: 10.1111/J.1447-0756.2010.01362.X.
38. Ozerdogan N, Sayiner D, Ayranci U, Unsal A, Giray S. Prevalence and predictors of dysmenorrhea among students at a university in Turkey. Int J Gynecol Obstet. 2009;107:39-43. doi: 10.1016/J.IJGO.2009.05.010.
39. Hu Z, Tang L, Chen L, Kaminga AC, Xu H. Prevalence and Risk Factors Associated with Primary Dysmenorrhea among Chinese Female University Students: A Cross-sectional Study. J Pediatr Adolesc Gynecol. 2020;33:15-22. doi: 10.1016/J.JPAG.2019.09.004.
40. Hashim MS, Obaideen AA, Jahrami HA, et al. Premenstrual Syndrome Is Associated with Dietary and Lifestyle Behaviors among University Students: A Cross-Sectional Study from Sharjah, UAE. Nutrients. 2019;11(8):1939. doi: 10.3390/nu11081939.
41. Sharghi M, Mansurkhani SM, Ashtary-Larky D, et al. An update and systematic review on the treatment of primary dysmenorrhea. JBRA Assist Reprod. 2019;23:51. doi: 10.5935/1518-0557.20180083.
42. Yacubovich Y, Cohen N, Tene L, Kalichman L. The prevalence of primary dysmenorrhea among students and its association with musculoskeletal and myofascial pain. J Bodyw Mov Ther. 2019;23:785-91. doi: 10.1016/J.JBMT.2019.05.006.
43. Maqbool R, Maqbool M, Zehravi M, Ara I. Menstrual distress in females of reproductive age: a literature review. Int J Adolesc Med Health. 2021;34:11-7. doi: 10.1515/IJAMH-2021-0081.
44. Burnett MA, Antao V, Black A, et al. Prevalence of primary dysmenorrhea in Canada. J Obstet Gynaecol Can. 2005;27:765-70. doi: 10.1016/S1701-2163(16)30728-9.
45. Al-Husban N, Odeh O, Dabit T, Masadeh A. The Influence of Lifestyle Variables on Primary Dysmenorrhea: A Cross-Sectional Study. Int J Womens Health. 2022;14:545-53. doi: 10.2147/IJWH.S338651.
46. Abubakar U, Zulkarnain AI, Samri F, et al. Use of complementary and alternative therapies for the treatment of dysmenorrhea among undergraduate pharmacy students in Malaysia: a cross sectional study. BMC Complement Med Ther. 2020;20(1):285. doi: 10.1186/s12906-020-03082-4.
47. de Carvalho G, Papoti M, Rodrigues MCD, Foresti YF, de Oliveira Guirro EC, de Jesus Guirro RR. Interaction predictors of self-perception menstrual symptoms and influence of the menstrual cycle on physical performance of physically active women. Eur J Appl Physiol. 2023;123:601-7. doi: 10.1007/S00421-022-05086-Z/METRICS.
48. Kolić P V, Sims DT, Hicks K, Thomas L, Morse CI. Physical Activity and the Menstrual Cycle: A Mixed-Methods Study of Women's Experiences. Women Sport Phys Act J. 2021;29:47-58. doi: 10.1123/WSPAJ.2020-0050.
49. Fallah F, Mirfeizi M. How is the quality and quantity of primary dysmenorrhea affected by physical exercises? A study among Iranian students. Int J Women Health Rep Sci. 2018;6:60-6. doi: 10.15296/IJWHR.2018.11.
50. Maior AS, Braz M, Maior AS. Functional Performance of Ankles Between Male and Female Practitioners of Resistance

Exercise. Muscles Ligaments Tendon J. 2021;11(4):704-11. doi: 10.32098/mltj.04.2021.13.
51. Ham S, Kim S, Choi H, Lee Y, Lee H. Greater Muscle Stiffness during Contraction at Menstruation as Measured by Shear-Wave Elastography. Tohoku J Exp Med. 2020;250(4):207-13.
52. Gilliam ML. Exercise for dysmenorrhoea. Obstet Gynecol. 2010;116:186-7. doi: 10.1097/AOG.0b013e3181e5ef4d.
53. Fuentes-Aparicio L, Cuenca-Martínez F, Muñoz-Gómez E, Mollà-Casanova S, Aguilar-Rodríguez M, Sempere-Rubio N. Effects of therapeutic exercise in primary dysmenorrhea: an umbrella and mapping review. Pain Med. 2023;24:1386-95. doi: 10.1093/PM/PNAD104.
54. Matthewman G, Lee A, Kaur JG, Daley AJ. Physical activity for primary dysmenorrhea: a systematic review and meta-analysis of randomized controlled trials. Am J Obstet Gynecol. 2018;219:255.e1-255.e20. doi: 10.1016/J.AJOG.2018.04.001.
55. Tharani G, Dharshini E, Rajalaxmi V, Kamatchi K, Vaishnavi G. To compare the effects of stretching exercise versus aerobic dance in primary dysmenorrhea among collegiates. Drug Intervent Today. 2018;10:2844-8.
56. Ortiz MI, Cortés-Márquez SK, Romero-Quezada LC, Murguía-Cánovas G, Jaramillo-Díaz AP. Effect of a physiotherapy program in women with primary dysmenorrhea. Eur J Obstet Gynecol Reprod Biol. 2015;194:24-9. doi: 10.1016/J.EJOGRB.2015.08.008.
57. Jaleel G, Shaphe MA, Khan AR, et al. Effect of Exercises on Central and Endocrine System for Pain Modulation in Primary Dysmenorrhea. J Lifestyle Med. 2022;12:15. doi: 10.15280/JLM.2022.12.1.15.
58. Basso JC, Suzuki WA. The Effects of Acute Exercise on Mood, Cognition, Neurophysiology, and Neurochemical Pathways: A Review. Brain Plasticity. 2017;2:127. doi: 10.3233/BPL-160040.
59. Abadi Bavil D, Dolatian M, Mahmoodi Z, Akbarzadeh Baghban A. A comparison of physical activity and nutrition in young women with and without primary dysmenorrhea. F1000Res. 2018;7:59. doi: 10.12688/F1000RESEARCH.12462.1.
60. Abbaspour Z, Rostami M, Najjar S. The Effect of Exercise on Primary Dysmenorrhea. J Res Health Sci. 2023;6:26-31.
61. Padulo J, Jawabreh L, Tounsi M et al. Reference Values of Physical Performances in Young Female Basketball Players in Palestine: Effect of Maturity Status. Muscles Ligaments Tendons J. 2024;14(3):458-69. doi: 10.32098/mltj.03.2024.09.
62. Mohamad K, Jamshidi L, Nouri Jelyani K. Is Age of Menarche Related with Body Mass Index? Iran J Public Health. 2013;42(9):1043.
63. Benjamin K, Donnelly TT. Barriers and facilitators influencing the physical activity of Arabic adults: A literature review. Avicenna. 2013;8. doi: 10.5339/avi.2013.8.
64. Alsamman RA, Shousha TM, Faris MAIE, Abdelrahim DN, Arumugam A. Association of sociodemographic, anthropometric, and sleep quality factors with accelerometer-measured sitting and physical activity times among Emirati working women during the COVID-19 pandemic: A cross-sectional study. Women Health. 2024;20:17455057231225540. doi: 10.1177/17455057231225539.
65. Ali H, Bernsen R, Baynouna L. Barriers to weight management among Emirati women: a qualitative investigation of health professionals' perspectives. Int Q Community Health Educ. 2008;29:143-59. doi: 10.2190/IQ.29.2.D.
66. Maghelal P, Alawadi K, Arlikatti S, Wahdain A. Influence of the Built Environment on Physical Activity Choices among Emirati Male and Female Adolescents: An Examination of Parents' and Students' Perceptions. Sustainability (Switzerland). 2022;14. doi: 10.3390/su14010444.
67. Marzbani M, Awad J, Rezaei M. The Sense of Place: Components and Walkability: Old and New Developments in Dubai, UAE. J Pub Space. 2020;5:21-36. doi: 10.32891/JPS.V5I1.1249.
68. Chantler I, Mitchell D, Fuller A. Actigraphy quantifies reduced voluntary physical activity in women with primary dysmenorrhea. J Pain. 2009;10:38-46. doi: 10.1016/J.JPAIN.2008.07.002.
69. Garriguet D, Tremblay S, Colley RC. Comparison of Physical Activity Adult Questionnaire results with accelerometer data. Health Rep. 2015;26(7):11-7.
70. Türk O, Dergisi SB, Keklik SS, Barği G. Investigation of the Relationship between Physical Activity Levels and Menstrual Symptoms in Healthy Women. Online Turk J Health Sci. 2023;8:192-9. doi: 10.26453/OTJHS.1193870.
71. Barcikowska Z, Wójcik-Bilkiewicz K, Sobierajska-Rek A, Grzybowska ME, Wąż P, Zorena K. Dysmenorrhea and Associated Factors among Polish Women: A Cross-Sectional Study. Pain Res Manag. 2020;2020. doi: 10.1155/2020/6161536.
72. Al-Matouq S, Al-Mutairi H, Al-Mutairi O, et al. Dysmenorrhea among high-school students and its associated factors in Kuwait. BMC Pediatr. 2019;19. doi: 10.1186/S12887-019-1442-6.
73. Arumugam A, Mohammad Zadeh SA, Zabin ZA, et al. Sedentary and physical activity time differs between self-reported ATLS-2 physical activity questionnaire and accelerometer measurements in adolescents and young adults in the United Arab Emirates. BMC Public Health. 2023;23(1):1045. doi: 10.1186/S12889-023-15881-8.
74. Alkalih HY, Pesola AJ, Arumugam A. A new accelerometer (Fibion) device provides valid sedentary and upright time measurements compared to the ActivPAL4 in healthy individuals. Heliyon. 2022;8. doi: 10.1016/J.HELIYON.2022.E11103.
75. Yang Y, Schumann M, Le S, Cheng S. Reliability and validity of a new accelerometer-based device for detecting physical activities and energy expenditure. PeerJ. 2018;6. doi: 10.7717/PEERJ.5775.
76. Montoye AHK, Coolman O, Keyes A, et al. Evaluation of Two Thigh-Worn Accelerometer Brands in Laboratory and Free-Living Settings. J Meas Phys Behav. 2022;5:233-41. doi: 10.1123/JMPB.2022-0012.
77. Alsamman RA, Pesola AJ, Shousha TM, Hagrass MS, Arumugam A. Effect of night-time data on sedentary and upright time and energy expenditure measured with the Fibion accelerometer in Emirati women. Diabetes Metab Syndr. 2022;16. doi: 10.1016/J.DSX.2022.102415.
78. Rashidi Fakari F, Simbar M, Tahmasebi G, et al. Efficacy of working ability, location, intensity, days of pain, dysmenorrhea (Walidd) and verbal rating scale (pain and drug) in diagnosing and predicting severity of dysmenorrhea among adolescents: A comparative study. J Obstet Gynecol Cancer Res. 2021;6:81-6. doi: 10.30699/JOGCR.6.2.81.
79. Jamovi project. Available at: https://www.jamovi.org/about.html. Last access date: 11/16/2024.

80. Clemes SA, Patel R, Mahon C, Griffiths PL. Sitting time and step counts in office workers. Occup Med (Lond). 2014;64:188-92. doi: 10.1093/OCCMED/KQT164.
81. Chau JY, Grunseit AC, Chey T, et al. Daily sitting time and all-cause mortality: a meta-analysis. PLoS One. 2013;8. doi: 10.1371/JOURNAL.PONE.0080000.
82. Dunstan DW, Howard B, Healy GN, Owen N. Too much sitting--a health hazard. Diabetes Res Clin Pract. 2012;97:368-76. doi: 10.1016/J.DIABRES.2012.05.020.
83. Batacan RB, Duncan MJ, Dalbo VJ, Tucker PS, Fenning AS. Effects of Light Intensity Activity on CVD Risk Factors: A Systematic Review of Intervention Studies. Biomed Res Int. 2015;20:15-8. doi: 10.1155/2015/596367.
84. Healy GN, Dunstan DW, Salmon J, et al. Objectively measured light-intensity physical activity is independently associated with 2-h plasma glucose. Diabetes Care. 2007;30:1384-9. doi: 10.2337/DC07-0114.
85. Howard B, Winkler EAH, Sethi P, et al. Associations of Low- and High-Intensity Light Activity with Cardiometabolic Biomarkers. Med Sci Sports Exerc. 2015;47:2093-101. doi: 10.1249/MSS.0000000000000631.
86. Ross R, Chaput JP, Giangregorio LM, et al. Canadian 24-Hour Movement Guidelines for Adults aged 18-64 years and Adults aged 65 years or older: an integration of physical activity, sedentary behaviour, and sleep. Appl Physiol Nutr Metab. 2020;45:S57-S102. doi: 10.1139/APNM-2020-0467.
87. Amagasa S, Machida M, Fukushima N, et al. Is objectively measured light-intensity physical activity associated with health outcomes after adjustment for moderate-to-vigorous physical activity in adults? A systematic review. Int J Behav Nut Phys Act. 2018;15:1-13. doi: 10.1186/S12966-018-0695-Z/TABLES/2.
88. Ross R, Janssen I, Tremblay MS. Public health importance of light intensity physical activity. J Sport Health Sci. 2024;13:674. doi: 10.1016/J.JSHS.2024.01.010.
89. Füzéki E, Engeroff T, Banzer W. Health Benefits of Light-Intensity Physical Activity: A Systematic Review of Accelerometer Data of the National Health and Nutrition Examination Survey (NHANES). Sports Med. 2017;47:1769-93. doi: 10.1007/S40279-017-0724-0/METRICS.
90. Huang WC, Chiu PC, Ho CH. The Sprint-Interval Exercise Using a Spinning Bike Improves Physical Fitness and Ameliorates Primary Dysmenorrhea Symptoms Through Hormone and Inflammation Modulations: A Randomized Controlled Trial. J Sports Sci Med. 2022;21:595. doi: 10.52082/JSSM.2022.595.