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The Physical Activity Patterns and Exercise Routines during the Heatwave Season Among Young Adults

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Abstract:

Objective: Regular participation in physical activity (PA) during the heatwave season is extremely challenging due to its potential to cause heat-related illness. While previous research has examined exercise practices during cold weather, exercise behaviours during the heatwave season, particularly in Southeast Asian countries, have not been sufficiently explored. Hence, this study aimed to determine the patterns of PA and exercise routines among young adults during the heatwave season.

Material and Methods: An online cross-sectional survey was conducted among 220 young adults, with a mean age of 21.09 (standard deviation [S.D.] 1.68) years. Validated questionnaires assessing PA and exercise routines were utilised. The data were analysed using established statistical software.

Results: The amount of energy expended in low-intensity activity during the heatwave season was notably high (1,173.65±1,303.19 metabolic equivalent of task [MET]-minutes/week), in contrast to moderate- and high-intensity activities (517.82±1,128.36 MET-minutes/week and 447.91±763.27 MET-minutes/week, respectively). Correspondingly, more time was spent on light-intensity activity (62.93 minutes per day ±60.14) than on moderate- and high-intensity activities (39.91 minutes ±48.24 and 26.36 minutes ±45.07, respectively). The data also showed that a large proportion

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of participants reported a low exercise frequency (62%). Regarding gender differences, male participants had higher levels of PA and were more likely to engage in vigorous exercise during the heatwave season (p-value<0.01).

Conclusion: The PA and exercise routines were found to be substandard during the heatwave season. Health professionals should develop evidence-based exercise guidelines tailored to heatwave conditions and the specific needs of the population.

Keywords: exercise, gender difference, heatwave season, physical activity

Introduction

The heatwave season is defined as an unusual and intense period of hot weather lasting several days[1]. This season has become a threat to the global population, particularly for those living in sunny and warm regions, such as Southeast Asia[2]. According to the report, the trend of heatwave seasons in Southeast Asia is becoming more intense and prolonged as the annual average temperature is increasing consistently by up to 0.3 °C per decade since 1970[3].

In terms of atmospheric patterns, the countries in Southeast Asia share similar climatic conditions, characterised by a tropical climate. The weather in most of these countries falls into wet, dry, and hot seasons. The average daily temperature across the countries ranges from 26°C to 29°C and may rise to between 30 °C and 33°C on a sunny day[4]. However, temperatures during the hot season are much higher, approaching up to 40 °C and above, particularly in some countries such as Thailand[5]. During extreme heatwave seasons, many activities are temporarily restricted, interrupted, and suspended.

Performing exercises during hot weather poses several challenges[6-7]. Biologically, the human body can adapt and regulate its core body temperature, but it should not exceed 35 °C. Performing exercises in such an ambient temperature may cause physical discomfort as the body struggles to maintain the core body temperature. Several studies have shown that exercising in high temperatures may lead to enormous detrimental effects on the body system, such as hyperthermia, hypohydration, sodium disturbances, heart exhaustion, and cardiovascular strain[9-10].

Regardless of weather conditions, being active is vital for health maintenance and disease prevention. According to the American Heart Association (2017), adults should engage in at least 150 minutes of moderate-intensity aerobic activity per week[11]. Performing exercises for 30 minutes a day for five days a week can minimise the risk of non-communicable diseases and reduce the global mortality rates[12]. While several studies have explored the physiological impacts of exercising in hot ambient conditions, information on the patterns of physical activity (PA) and exercise routines among adults in Southeast Asia during the heatwave season remains underexplored. As Southeast Asia experiences increasingly frequent and intense heatwaves, localised data becomes crucial to physical activity guidelines. The scarcity of such data complicates the efforts to develop targeted policies to safeguard exercise practices during the hot season, leaving existing exercise guidelines overly general and ineffective in addressing the heat-related health risks. Hence, the main objective of this study was to determine the patterns of PA and exercise routines of young adults during the heatwave season. Since males and females are biologically different, the gender differences in the levels of PA and exercise routines during the aforementioned season were also examined.

Material and Methods

Study setting and design

This study employed a population-based cross-sectional study design. The study population was obtained from a teaching institution in the east coast region of Malaysia. The study was conducted during the heatwave season, when the daily maximum temperature surpassed 35°C. These ambient temperatures were not measured by the researchers but were obtained from the official website of the Malaysian Meteorological Department, which provides validated national weather forecasts. The utilisation of validated national meteorological data ensures a reliable and standardised reference for environmental conditions during the study period.

Participants and sampling

Participants were invited to participate in the survey through digital messaging platforms, namely WhatsApp and Telegram. Those who were between 18 and 30 years old, had no disability, and had not suffered from severe chronic disorders (such as heart failure, kidney disease, cancer, and chronic respiratory diseases) were eligible to participate in the survey. As the International Physical Activity Questionnaire (IPAQ) questionnaire measures PA over the previous seven days, those who were hospitalised or had an acute illness during the survey period were not eligible to participate. In addition, those who were engaged in exercise training for sport competitions or were participating in any trials involving exercise interventions were excluded from the survey.

The sample size was determined using G*Power software version 3.1.9.4. An effect size of 0.3 and an alpha level of 0.05 were employed in the calculation, indicating that a minimum sample of 220 was required for the survey. All eligible participants were recruited through a convenience sampling technique where the selection was based on participants' availability during the survey period. While this method limits the generalizability of the study findings, it was a deliberate and methodologically sound choice for exploratory research conducted in a localised environment.

Data collection

A survey link was created and distributed through the group WhatsApp and Telegram channels. To increase the response rate, the link was sent twice to the targeted WhatsApp and Telegram groups. Nevertheless, the survey was configured to allow only one submission per participant. All responses were automatically recorded and secured using a designated spreadsheet within a secure database account. Participants were invited to contact the principal researcher through the designated communication channels outlined in the survey invitation for any necessary clarification regarding the survey questionnaire.

An electronic survey was chosen because it provided a stress-free approach for the participants. This method preserves participants' anonymity and provides flexibility to the respondents to answer the questions at their own pace and at a convenient time. Moreover, this method enables real-time data collection and reliable data management as it minimises the risks of data loss and reduces the probability of errors during data transfer[13].

The participants were requested to complete three sets of questionnaires, covering demographic information, PA levels, and exercise routines. The demographic questionnaire collected information on participants' age, gender, race, nature of study, history of musculoskeletal injury, and body mass index.

The second questionnaire was the short-form version of the International Physical Activity Questionnaire (IPAQ), which gathered data on PA patterns through the specific classifications of light-, moderate-, and vigorous-intensity activities. According to the IPAQ instrument, vigorous activity refers to any activity that requires strenuous physical effort, causing an increase in breathing effort more than usual, while moderate activity refers to any activity that requires moderate physical effort, which may lead to somewhat harder breathing than usual. As for light activity, it refers to any walking activities such as walking at work and home, walking to travel from place to place, and any other walking performed for recreation, sport, exercise, or leisure. The IPAQ questionnaire allowed the researchers to assess the time participants spent in light, moderate, and vigorous activities, the metabolic equivalent (MET) expenditure for each type of activity, and the levels of PA.

The calculation of physical activity was performed through metabolic equivalent of task (MET) values, based on three categories of activities: 1) walking=3.3 METs, 2) moderate activity =4 MET, and 3) vigorous activity =8 MET[15]. The total physical activity was calculated in MET-minutes per week (MET-min/week) using the following formula: minutes of activity/day×days/week×MET value for each activity category. Total MET-min/week represents the sum of all three categories[14]. The scores were subsequently classified into three groups of physical activity, which were low levels of PA (<600 MET-min), moderate levels of PA (≥600 MET-min), and high levels of PA (≥3000 MET-min)[15]. The activity of "sitting" in the IPAQ was used to determine the time spent in sedentary activities per week and is not included as part of the physical activity scores.

As for the exercise routines questionnaire, the items were extracted from studies conducted by Alkatan et al. (2021) and Alkhateeb et al. (2019)[16,17]. These studies had previously established the reliability and validity of the original questionnaires. The adapted questionnaire consisted of eight closed-ended items focused on exercise routines during the heatwave season. To ensure linguistic appropriateness for the local population, the adapted version was reviewed by two experienced physiotherapists.

Data analysis

The data were analysed by using the Statistical Package for the Social Sciences (SPSS) version 20 for Windows. Descriptive statistics were used to describe the demographic data. Gender differences in the energy expenditure were analysed using the Mann-Whitney U test, while differences in the PA levels and exercise routines were tested using the Chi-square test. Statistical significance was accepted at $\alpha \leq 0.05$.

Ethical considerations

Ethical approval was obtained from the institution's research ethics committee (Reference number: IIUM/310/14/11/2). Informed consent was obtained from each participant. The research procedures and protocol conformed to the ethical principles outlined in the Declaration of Helsinki.

Results

Demographic characteristics

A total of 220 participants (32 males and 188 females) participated in the survey (Table 1). The mean age standard deviation (S.D.) of the participants was 21.09 (±1.68) years, ranging from 19 to 30 years old, with Malay students constituting the majority of the study population. Most of the participants were final-year students in the Allied Health Sciences programme. In terms of clinical characteristics, the mean body mass index of the participants was within the normal body weight category (23.16±5.52 kg/m^2), and the majority of participants reported no history of musculoskeletal injury.

Physical activity patterns

The PA patterns in this study were determined by: 1) the amount of time spent in light-, moderate-, and vigorous-intensity activities per day, 2) the total of energy expenditure in light-, moderate-, and vigorous-intensity activities in a week, and 3) the overall level of PA. Regarding time spent in PA, the average duration of moderate-intensity and vigorous-intensity activities was less than one hour, at 39.91 (±48.24) minutes and 26.36 (±45.07) minutes per day, respectively. In contrast, the average time spent in light-intensity activities exceeded one hour, totalling 62.93 (±60.14) minutes per day, which is almost three times longer compared to the vigorous-intensity category. In terms of

Table 1 Characteristics of the participants

Variable	All (n=220)	Male (n=32)	Female (n=188)
Mean age (S.D.)	21.09±1.68	21.44±2.03	21.03±1.614
Program of study			
Nursing	37 (16.80%)	2 (6.20%)	35 (18.60%)
Dentistry	6 (2.70%)	1 (3.10%)	5 (2.70%)
Medicine	16 (7.30%)	5 (15.60%)	11 (5.90%)
Pharmacy	36 (16.40%)	5 (15.60%)	31 (16.50%)
Allied Health Sciences	89 (40.50%)	14 (43.80%)	75 (39.90%)
Science	36 (16.40%)	5 (15.60%)	31 (16.50%)
Race			
Malay	215 (97.70%)	30 (93.80%)	185 (98.40%)
Others	5 (2.30%)	2 (6.20%)	3 (1.60%)
BMI (kg/m^2)	23.16±5.52	23.54±5.48	23.10±5.53
History of musculoskeletal injury			
Yes	43 (19.50%)	10 (31.20%)	33 (17.60%)
No	177 (80.50%)	22 (68.80%)	155 (82.40%)

BMI=body mass index, S.D.=standard deviation

the volume of energy expenditure during the heatwave season, the mean MET for light-intensity activity was higher than that of the other activity categories, indicating that participants engaged less in PA during the hot season. As for PA categorisation, two-thirds of the participants had low to moderate levels of PA during the heatwave season. The details of the PA patterns are shown in Table 2.

Table 2 Physical activity patterns during the heatwave season (n=220)

Variable	Mean (S.D.)
Time spent in three classifications of physical activity (Mean duration in minutes/day)	
Vigorous-intensity activity	26.36 mins (±45.07)
Moderate-intensity activity	39.91 mins (±48.24)
Light-intensity activity	62.93 mins (±60.14)
Energy expenditure in three classifications of physical activity (Mean MET-minute/week)	
Vigorous-intensity activity	517.82 MET-min (±1,128.36)
Moderate-intensity activity	447.91 MET-min (±763.27)
Light-intensity activity	1,173.65 MET-min(±1,303.19)
Categorization of PA N (%)	
High level of PA	57 (25.90%)
Moderate level of PA	96 (43.60%)
Low level of PA	67 (30.50%)

MET=metabolic equivalent of task, Min=minute, PA=physical activity, S.D.=standard deviation

Exercise routines

Table 3 illustrates the participants' exercise routines during the heatwave season, and the findings indicate that the majority of participants did not engage in regular exercise during this season. Only less than half of the participants reported exercising more than once a week (36%), while the remaining did not meet the exercise recommendation for maintaining health outlined by the World Health Organisation. According to the participants' responses, fitness and health maintenance had become the main reasons for exercise, followed by managing body weight, either to reduce or maintain the weight, at 39% and 31%, respectively. The most favoured types of exercises during the hot season were brisk walking/jogging (49%) and swimming (28%), while running was the least favoured (5%). Furthermore, many participants chose to exercise in private spaces such as around the house and in their room (53%). Participants in this study preferred to engage in PA in the

Table 3 Participants' exercise routines during the heatwave season

Variable	N (%)
Regularly exercise	
Yes	41 (18.60)
No	179 (81.40)
Frequency of exercise	
Daily	5 (2.30)
Once a week	112 (50.90)
Twice a week	49 (22.30)
Thrice a week	28 (12.70)
4 times a week	1 (0.50)
5 times a week	1 (0.50)
Once a month	2 (0.90)
Once in two weeks	1 (0.50)
Rarely	21 (9.50)
Reasons to exercise	
To keep fit and healthy	165 (38.60)
To lose weight	76 (17.80)
To have fun	109 (25.50)
To maintain weight	56 (13.10)
For competition	16 (3.70)
To release stress	5 (1.20)
Reasons to stop exercise	
Lack of motivation	89 (18.10)
The weather is bothering	155 (31.40)
Easily feeling tired in the hot temperature	136 (27.60)
Easily get sweat in the hot temperature	104 (21.10)
Others (to prevent sunburn/fainting/fever, busy schedule)	9 (1.80)
Type of exercise	
Brisk walking/ jogging	154 (49.20)
Running	16 (5.10)
Swimming	88 (28.10)
Weight lifting training	34 (10.90)
Others (indoor exercise, sports)	21 (6.70)
Place to exercise	
Own room	105 (30.30)
In the house/ around house	78 (22.50)
Exercise training/fitness facilities	40 (11.60)
Open area/public space/outdoor playground	123 (35.50)
Time to exercise	
Morning (6 am–11 am)	28 (12.70)
Afternoon (2 pm–6 pm)	55 (25.00)
Evening (7 pm–10 pm)	74 (33.60)
Late evening (after 10 pm)	10 (4.50)
No-specific time	53 (24.10)
Accompany	
Alone	99 (45.00)
Friend	116 (52.70)
Parents	2 (0.90)
Partners/spouse	1 (0.50)
Cousins/siblings	2 (0.90)

evening between 7 PM and 10 PM (34%) compared to the morning (13%) and afternoon (25%), and many preferred to have a companion during their exercises (63%). This study also found that the majority of the participants were concerned about continuing their exercises due to the burdensome effects of hot temperatures, such as heavy sweat, sunburn, extreme fatigue, fainting, and fever (82%).

Gender differences in physical activity patterns and exercise routines

Table 4 illustrates the amount of MET values between male and female participants. During the heatwave season, the MET of males and females differed significantly, with male participants exhibiting higher energy expenditure compared to female participants in vigorous and moderate activity categories (p-value<0.01). As male participants exhibited greater energy expenditure, the levels of PA between the two genders also differed (p-value<0.01), with males having significantly higher levels of PA during the heatwave season.

With regard to the exercise routines (Table 5), the data indicated that there were significant differences between male and female participants, with male participants regularly engaging in exercise (p-value<0.01). The frequency of exercise varied across genders (p-value<0.01), with females predominantly favouring exercising once a week, while males were inclined to exercise more than once a week. There was a significant difference in the types of exercises preferred by each gender, as male participants preferred

high-intensity exercises, such as running and weightlifting (p-value<0.05), whereas female participants preferred brisk walking or jogging during the heatwave season (p-value<0.01). In terms of reasons for discontinuing the exercise, males had no particular reason, while females claimed to sweat rapidly when exercising in a hot ambient temperature (p-value<0.01).

The data also showed a statistically significant difference in terms of preferred exercise location between

Table 4 Energy exp-valueenditure and p-valuehysical activity levels between males and females

Variables	Male (n=32) Mean (S.D.)	Female (n=188) Mean (S.D.)	p-value
Mean MET (MET-min/week)			
In vigorous-intensity activity	1,386.25 (±298.20)	370.00 (±67.96)	0.001**
In moderate-intensity activity	800.00 (±143.29)	387.98 (±54.02)	0.001**
In light-intensity activity	1,343.20 (±259.80)	1,144.78 (±92.97)	0.728
Levels of p-value			
High level	14 (43.80)	43 (22.90)	0.002*
Moderate level	16 (50.00)	80 (42.60%)	
Low level	2 (6.20)	34 (42.60%)	

*=p-value-value<0.01, **=p-value<0.001, MET=metabolic equivalent of task, PA=physical activity, S.D.=standard deviation

males and females, with males preferring facilities equipped with exercise equipment (p-value<0.05). Moreover, males would rather exercise in the afternoon while females preferred the evening (p-value<0.05). Regarding exercise with a companion, both males and females preferred to be accompanied during exercise (p-value<0.05).

Discussion

The volume of PA can be measured either subjectively through a self-reported questionnaire or objectively with specific devices such as an accelerometer. In this study, a self-reported questionnaire was chosen as it captures several dimensions of PA, which are energy expenditure across different activity levels, the amount of time spent in three different activity categories, and overall levels of PA.

According to the World Health Organisation's guideline on the minimum energy expenditure per week, an adult needs to achieve a minimum of 600 MET-minutes in a week[18]. Even though participants in this study had met the recommendation, energy expenditure was high in the low-intensity activity category. In contrast, the MET scores in the moderate- and vigorous-intensity activities did not meet the minimum energy expenditure standards. Consequently, the participants spent more time in light-intensity activities than in moderate- and high-intensity activities.

These findings could be explained by the capacity of the body to acclimate to high temperatures. Physiologically, the human body has an efficient thermoregulatory mechanism to adapt to the climate. However, the capacity to tolerate extreme temperatures is limited to a certain degree and duration of exposure. To avoid thermo-threatening events, a hot climate prompts humans to engage in any activity that carries a low risk of overheating and dehydration[19,20]. As the population in this study lives in daily temperatures ranging from 27 °C to 32 °C, temperatures above 35 °C are considered unusually high. During such unusual hot temperatures, the heatwave alerts are immediately issued by the local meteorological department to ensure the population embraces adequate preventive and safety measures[19,20]. The negative impact of the heatwave season was evident in Malaysia, as the local health ministry reported over 50 cases of heat stroke and several deaths due to heat-related consequences in the past two years[21,22].

The World Health Organisation (WHO) recommends that adults perform exercises at least two times a week to maintain their health[23,24]. However, during the heatwave season, the majority of the participants in this study reported not exercising regularly, and only one-third exercised more than once a week. A substantial number of participants in this study were reluctant to engage in regular exercise during the hot climate, as they felt that the hot ambient

Table 5 Gender differences in exercise routines during the heatwave season

Variable	Male (n=32) (%)	Female (n=188) (%)	p-value
Regularly exercise			
Yes	15 (46.90)	26 (13.80)	0.001**
No	17 (53.10)	162 (86.20)	
Frequency of exercise			
Daily	2 (6.20)	3 (1.60)	0.001**
Once a week	9 (28.10)	103 (54.80)	
Twice a week	11 (34.40)	38 (20.20)	
Thrice a week	9 (28.10)	19 (10.10)	
4 times a week	1 (3.10)	0 (0.00)	
5 times a week	0 (0.00)	1 (0.50)	
Once a month	0 (0.00)	2 (1.10)	
Once in 2 weeks	0 (0.00)	1 (0.50)	
Rarely	0 (0.00)	21 (11.20)	
Reasons to exercise			
To maintain fitness and health	26 (81.20)	139 (73.90)	0.508
To lose weight	10 (31.20)	66 (35.10)	0.695
To have fun	20 (62.50)	89 (47.30)	0.129
To maintain weight	6 (18.80)	50 (26.60)	0.390
To prepare for competition	5 (15.60)	11 (5.90)	0.063
To relieve stress	1 (3.10)	4 (2.10)	0.548
Reason to stop exercise			
Lack of motivation	18 (56.20)	71 (37.80)	0.054
The weather is bothering	25 (78.10)	130 (69.10)	0.403
Easily feeling tired in the hot temperature	17 (53.10)	119 (63.30)	0.326
Sweat quickly in the hot temperature	5 (15.60)	99 (52.70)	0.001**
Others (sunburn/fainting/fever, busy schedule)	1 (3.10)	8 (4.30)	1.000
Type of exercise			
Brisk walking/ jogging	15 (46.90)	139 (73.90)	0.003**
Running	6 (18.80)	10 (5.30)	0.016*
Swimming	13 (40.60)	75 (39.90)	1.000
Weight lifting	14 (43.80)	20 (10.60)	0.001**
Others	5 (15.60)	16 (8.50)	0.201
Place to exercise			
Own room	15 (46.90)	90 (47.90)	0.012*
In the house/ around house	11 (34.40)	67 (35.60)	
Exercise/ fitness facilities	13 (40.60)	27 (14.40)	
Open area/ public space	19 (59.40)	104 (55.30)	
Time to exercise			
Morning (6 am – 11 am)	3 (9.40)	25 (13.30)	0.012*
Afternoon (2 pm – 6 pm)	15 (46.90)	40 (21.30)	
Evening (7 pm – 10 pm)	11 (34.40)	63 (33.50)	
Late evening (after 10 pm)	1 (3.10)	9 (4.80)	
No-specific time	2 (6.20)	51 (27.10)	
Accompany			
Alone	11 (34.40)	88 (46.80)	0.629
Friend	21 (65.60)	95 (50.50)	
Parents	0 (0.00)	2 (1.10)	
Partners/spouse	0 (0.00)	1 (0.50)	
Cousins/siblings	0 (0.00)	2 (1.10)	

*=p-value<0.01, **=p-value<0.001

temperature elicits detrimental effects such as heavy sweating, fatigue, sunburn, fainting, and fever. In a hot climate, heavy sweating arises as a physiological response of the thermoregulation mechanism[25].

Regardless of climate conditions, exercise increases the body's internal temperature due to muscle contraction activity[25]. However, exercising in high temperatures may cause excessive heat gain in the body. To dissipate the heat away from the body, the blood flow to the skin increases, leading to heavy sweating and evaporation of the sweat[26]. In addition to heavy sweating, immense blood flow to the skin poses substantial stress on the cardiovascular system, which in turn leads to fatigue during exercise[10]. Consequently, during the heatwave season, the majority of the participants in this study preferred to perform light-intensity exercises, such as brisk walking or jogging, while many others favoured swimming.

Previous research indicates that engaging in moderate PA, such as brisk walking for 30 minutes daily, is closely linked to an extended lifespan[27]. However, when the climate exceeds the usual high temperatures, the likelihood of heat injury is elevated. Therefore, indoor exercise should be the safer alternative. This alternative was adopted by our participants as the majority of them opted to exercise indoors during the heatwave season. Besides, many participants preferred to exercise in the evening when the ambient temperature was lower compared to the afternoon. Exercise in the evening could enhance psychological well-being by decreasing stress hormones and promoting the release of endorphins, which collectively contribute to fostering a sense of relaxation[28]. This study also found that the majority of the participants preferred to have companions during exercise due to several advantages, mainly psychological benefits, as companionship boosts motivation to exercise, enhances enjoyment, and heightens social relationships[29].

With regard to gender differences in the MET scores and PA levels, males exhibited high MET scores and higher levels of PA compared to females during the heatwave season. These findings are supported by a previous study conducted by McCarthy et al. (2022), which found that females exhibited lower energy expenditure during the heatwave season and were less involved in moderate-to-vigorous PA compared to males[30]. These discoveries can be attributed to weather discomfort, particularly noticeable among females, as females biologically have lower skin blood flow when compared to males. This physiological condition diminishes their ability to regulate heat dissipation, thereby elevating their susceptibility to heat-related illness during PA[31]. The physiological differences between males and females could be one of the possible reasons male participants in this study had a higher exercise frequency and intensity than female participants. While high-intensity exercises during the heat season are conceivable, extra precautions are needed to minimise the risk of critical health emergencies caused by dehydration and hyperthermia[32].

The data showed a statistically significant difference in the place, setting, and time to exercise between males and females. Males were more adaptable to exercise in outdoor spaces and fitness facilities, with a preference for exercising in the afternoon. Meanwhile, females tended to exercise in closed and private areas and opted to exercise in the evening. It has been reported that the temperature comfort threshold for exercise routines is typically during the early morning and late afternoon[33]. Hence, it is considerably safer to perform outdoor PA during suitable times. Nevertheless, during the heatwave season, indoor exercises are highly recommended.

The study findings suggest that tailored seasonal exercise guidelines are needed to support individuals in maintaining regular exercise during heatwave seasons while minimising heat-related health risks. Such guidelines should be integrated into broader public health campaigns to raise awareness about safe exercise practices in hot environments. This initiative is expected to contribute to the reduction of heat-related morbidity while promoting overall public health and physical fitness.

Similar to other survey-based studies, this study has several limitations. First, participants were recruited exclusively from a single geographic region, which may limit the generalizability of the findings. Second, the study population was restricted to young adults, further narrowing the scope of applicability. Third, due to budgetary and logistical constraints, the study did not employ objective PA monitoring tools, such as accelerometers or pedometers, which could have provided more accurate and reliable estimates of PA levels. As the levels of PA were measured subjectively using an online self-report questionnaire, there is a risk of recall bias and a potential for either overreporting or underreporting by participants. To mitigate this bias, participants were given a seven-day window to complete and submit their responses. Last but not least, ambient temperatures were retrieved from the national weather forecast website rather than measured directly on-site, which may reduce the precision of environmental exposure assessments and potentially influence the study's findings. Nevertheless, to enhance data validity, daily on-site ambient temperatures were cross-verified using a mobile weather application. Future studies need to address these limitations to enhance the generalizability and robustness of the findings.

Conclusion

Even though the participants in this study met the minimum weekly energy expenditure recommendations, the frequency of exercise during the heatwave season was found to be low and did not fulfil the exercise recommendations outlined by many international guidelines. Consequently, the level of PA among some of the participants was found to be low. The participants expressed concerns about the adverse effects of hot weather on their exercise routines. Gender differences in the levels of PA and exercise routines were notable, with females having a lower level of PA and having less rigorous exercise routines compared to males. Since adults should engage in regular PA regardless of the seasons, future studies are recommended to extend the findings of this study by exploring the optimal parameters of exercise in extreme heat, along with the best strategies to promote safer exercise practices in such challenging conditions.

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Conflict of interest

The authors declare no conflict of interest.

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