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GENDER DIFFERENCES IN PHYSICAL ACTIVITY AND SITTING TIME AMONG URBAN MALAYSIAN ADULTS

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Abstract: *Movement restrictions can disrupt everyday opportunities for physical activity, yet evidence from urban Malaysian communities remains limited. This study described physical activity and weekday sitting time during a COVID-19 restriction period and examined associations with gender, age and body mass index (BMI). This cross-sectional study analysed primary survey data collected in 2021 from 153 adults residing in Kota Damansara, Malaysia. Item-level responses to the International Physical Activity Questionnaire-Short Form (IPAQ-SF) were scored using its official data-processing rules. Group differences were evaluated with Mann-Whitney U and chi-square tests; associations were examined using Spearman correlation, Kruskal-Wallis tests and multivariable logistic regression. Participants were predominantly aged 18-29 years (98.7%); 105 were men and 48 were women. Median total physical activity was 664 MET-min/week (interquartile range [IQR] 264-2,520), and 71 participants (46.4%) were classified in the low IPAQ category. Men reported higher activity than women (median 924 vs. 396 MET-min/week; U = 3,263, p = .003, rank-biserial r = .295). Low activity was more common among women than men (62.5% vs. 39.0%), and the gender-by-category association was significant (χ^2 = 8.95, p = .011, Cramer's V = .242). Total activity was inversely correlated with weekday sitting time (Spearman rho = -.405, p < .001). In an adjusted model, female gender (adjusted odds ratio [aOR] = 2.29, 95% confidence interval [CI] 1.08-4.87) and each additional hour of sitting per day (aOR = 1.22, 95% CI 1.08-1.37) were associated with low activity. Age and BMI were not independently associated with the outcome. A substantial proportion of this mainly young sample occupied the low IPAQ category during the restriction period, with female respondents and those reporting longer sitting time at greater risk. The cross-sectional design does not establish that movement restrictions caused these patterns.*

Keywords: *gender; IPAQ-SF; physical activity; sitting time; urban community*

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Introduction

Regular physical activity supports cardiovascular, metabolic, musculoskeletal and mental health across adulthood, while prolonged sedentary behaviour contributes to preventable health risk. The World Health Organization recommends that adults accumulate 150-300 minutes of moderate-intensity aerobic activity, 75-150 minutes of vigorous-intensity activity, or an equivalent combination each week, together with muscle-strengthening activity on at least two days (Bull et al., 2020; World Health Organization, 2020). The public-health importance of movement behaviour extends beyond planned exercise: transport, occupational, domestic and recreational activities all contribute to total physical activity, whereas extended sitting can coexist with otherwise active lifestyles.

The COVID-19 pandemic created an unusual, large-scale disruption of these movement opportunities. Closure of campuses, workplaces, sport facilities and recreational spaces, together with restrictions on travel and social contact, altered the environmental and social cues that support activity. Systematic reviews consistently found that physical activity declined and sedentary behaviour increased during lockdown periods, although the magnitude and direction of change varied substantially between populations and study designs (Stockwell et al., 2021; Wilke et al., 2022). Device-based data from multiple countries similarly documented abrupt reductions in daily steps (Tison et al., 2020). These findings are best interpreted as population-level evidence of behavioural disruption rather than proof that every restricted population became less active.

University-focused evidence showed a similar disruption: an early systematic review reported widespread reductions in student physical activity, while a Canadian study documented concurrent changes in activity, sitting and diet (Bertrand et al., 2021; López-Valenciano et al., 2021).

Malaysian evidence indicates that local context matters. In a longitudinal study of a low-income, semi-rural population, movement restrictions were accompanied by reduced physical activity, but the response differed across sociodemographic groups (Salway et al., 2021). Research among older Malaysians also showed heterogeneous activity and coping patterns during the Movement Control Order (Murukesu et al., 2021). Before the pandemic, nationwide Malaysian data had already identified gender, age, urban residence, employment and other social factors as correlates of physical-activity participation (Cheah & Poh, 2014). Therefore, a restriction period may interact with existing inequalities in access, time, safety, domestic responsibilities, social support and confidence rather than exerting a uniform effect.

Gender is especially relevant in a predominantly young sample. Malaysian undergraduate research has reported higher overall and leisure-time activity among men (Sutan et al., 2022), while qualitative and survey evidence among female undergraduates highlights time constraints, low motivation, limited facilities, safety concerns and preference for accessible, socially supportive exercise options (Othman et al., 2022). International university data likewise show that physical activity and sedentary behaviour differ by gender and stage of study (Edelmann et al., 2022). Yet community-level evidence from urban Malaysia during restriction periods remains limited, and many early studies relied on self-reported scores without describing protocol-based cleaning or effect sizes.

The present cross-sectional study analysed primary item-level IPAQ-SF data from an urban Malaysian community. The objectives were to: (i) estimate total activity, weekday sitting time

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and protocol-defined IPAQ activity categories; (ii) compare activity profiles between male and female respondents; and (iii) examine whether gender, age, BMI and sitting time were associated with low activity. It was hypothesised that female gender and longer sitting time would be associated with lower activity, while age and BMI were treated as exploratory correlates because of the restricted age distribution and cross-sectional design.

Methods

Study Design and Setting

This cross-sectional online survey was conducted in 2021 among residents of Kota Damansara, an urban township in Selangor, Malaysia. Primary data were collected using a structured online questionnaire to examine physical activity during the COVID-19 period. Data were collected during May and June 2021, spanning Malaysia's third Movement Control Order (MCO 3.0) and the subsequent Full Movement Control Order (FMCO). Reporting follows the principles of the Strengthening the Reporting of Observational Studies in Epidemiology statement for cross-sectional studies.

Participants and Recruitment

Eligible participants were adults aged 18 years or older who resided in Kota Damansara and could understand Malay or English. A non-probability convenience approach was used. The survey link was circulated online through WhatsApp and Facebook, with Instagram also identified in the original recruitment plan. Participation was voluntary, and 153 records containing the core demographic and IPAQ-SF variables were available for analysis. Because the survey link could be forwarded and the number of people who viewed it was not recorded, a conventional response rate could not be calculated.

Measures

Participants self-reported gender, age, body weight and height. BMI was calculated as weight in kilograms divided by height in metres squared and classified as underweight (<18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²) or obese (at least 30.0 kg/m²). The dataset contained two gender response categories, male and female; the manuscript therefore uses the variable label reported in the source survey.

Physical activity was assessed with the IPAQ-SF, which records the frequency and duration of vigorous activity, moderate activity and walking undertaken for at least 10 minutes at a time during the previous seven days, together with weekday sitting time (Craig et al., 2003). The Malay IPAQ has shown acceptable test-retest reliability for population research, although self-report estimates should be interpreted cautiously (Chu & Moy, 2015). Validation studies show that the IPAQ-SF may overestimate activity relative to device-based measures; consequently, the present estimates are treated as self-reported movement behaviour rather than objective energy expenditure (Lee et al., 2011).

IPAQ-SF Data Processing

Raw responses to the IPAQ-SF were scored according to the official IPAQ data-processing and categorical-scoring protocol (IPAQ Research Committee, 2005). When a respondent answered 'No' to the screening item for vigorous activity, moderate activity or walking, the corresponding days, duration and MET-minutes were set to zero, even if values remained in follow-up fields. Time entries in the source dataset were stored in an hours.minutes format; these were converted to minutes (for example, 1.30 became 90 minutes and 0.45 became 45 minutes). Bouts shorter

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than 10 minutes were set to zero, and durations longer than 180 minutes per day within an intensity were truncated at 180 minutes. No participant exceeded the protocol's exclusion threshold of more than 960 total activity minutes per day.

Weekly MET-minutes were computed as 8.0 x vigorous minutes x days, 4.0 x moderate minutes x days and 3.3 x walking minutes x days, then summed. The IPAQ categories were assigned using the protocol's combined frequency, duration and MET criteria. High activity required either vigorous activity on at least three days accumulating at least 1,500 MET-min/week, or seven days of any combination accumulating at least 3,000 MET-min/week. Moderate activity required any of the following: at least three days of vigorous activity for 20 minutes per day; at least five days of moderate activity or walking for 30 minutes per day; or at least five days of any combination accumulating at least 600 MET-min/week. Participants not meeting moderate or high criteria were classified as low. Weekday sitting time was converted from the same hours.minutes format to minutes per day.

Statistical Analysis

Continuous variables were summarised with medians and interquartile ranges (IQRs) because activity scores were right-skewed; means and standard deviations were retained for descriptive context where useful. Categorical variables were summarised with frequencies and percentages. Total MET-min/week and sitting time were compared between gender groups using two-sided Mann-Whitney U tests, with rank-biserial correlations as effect sizes and Hodges-Lehmann median differences. Gender differences in IPAQ category were tested using Pearson's chi-square test and Cramer's V. Spearman correlations examined total MET-min/week in relation to age, BMI and sitting time, and a Kruskal-Wallis test compared activity across BMI categories.

A multivariable binary logistic regression model estimated the odds of being in the low IPAQ category (low = 1; moderate/high = 0). Predictors were female gender (male as reference), age in years, BMI in kg/m² and weekday sitting time in hours per day. Adjusted odds ratios (aORs), 95% confidence intervals (CIs) and two-sided p values are reported. A sensitivity analysis restricted the sample to participants aged 18-29 years. Statistical significance was set at $p < .05$. Analyses were performed using IBM SPSS Statistics, version 30.0 (IBM Corp., Armonk, NY, USA).

Results

Participant Characteristics

All 153 records had complete core variables. The sample included 105 men (68.6%) and 48 women (31.4%), and 151 participants (98.7%) were aged 18-29 years. Median age was 22 years (IQR 22-23), and median BMI was 22.48 kg/m² (IQR 19.72-25.76). Based on standard BMI categories, 24 participants (15.7%) were underweight, 88 (57.5%) had normal weight, 23 (15.0%) were overweight and 18 (11.8%) were obese. Median weekday sitting time was 420 minutes per day (IQR 300-600). Women reported a median of 480 sitting minutes per day compared with 420 minutes among men; the difference was not statistically significant (U = 2,151.5, p = .139). Participant characteristics are presented in Table 1.

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Table 1: Participant characteristics overall and by gender (N = 153)

Characteristic	Overall (N = 153)	Men (n = 105)	Women (n = 48)
Age, years, median (IQR)	22 (22-23)	22 (21-23)	23 (22-23)
Age 18-29 years, n (%)	151 (98.7)	104 (99.0)	47 (97.9)
BMI, kg/m², median (IQR)	22.48 (19.72-25.76)	23.20 (20.20-26.70)	20.99 (19.04-23.46)
Underweight, n (%)	24 (15.7)	13 (12.4)	11 (22.9)
Normal weight, n (%)	88 (57.5)	58 (55.2)	30 (62.5)
Overweight, n (%)	23 (15.0)	20 (19.0)	3 (6.3)
Obese, n (%)	18 (11.8)	14 (13.3)	4 (8.3)
Weekday sitting, min/day, median (IQR)	420 (300-600)	420 (300-600)	480 (300-615)

Note. BMI = body mass index; IQR = interquartile range. Percentages within gender columns use the column total.

Physical-Activity Profile

Using protocol-based scoring, median total activity was 664 MET-min/week (IQR 264-2,520). Walking contributed the most consistently reported activity: 122 participants (79.7%) recorded non-zero walking MET-minutes, compared with 61 (39.9%) for moderate activity and 54 (35.3%) for vigorous activity. Seventy-one participants (46.4%) were classified in the low IPAQ category, 47 (30.7%) in moderate and 35 (22.9%) in high. Thus, 82 participants (53.6%) occupied the combined moderate/high categories.

Men had higher total activity than women (median 924 vs. 396 MET-min/week). The Mann-Whitney comparison was significant (U = 3,263, p = .003), with a small-to-moderate rank-biserial effect (r = .295) and a Hodges-Lehmann male-female difference of 396 MET-min/week. Activity categories also differed by gender: 62.5% of women were in the low category compared with 39.0% of men, while 10.4% of women and 28.6% of men were in the high category. The association was statistically significant, $\chi^2 = 8.95$, p = .011, Cramer's V = .242. Table 2 and Figure 1 show the gender-specific profile.

Table 2: IPAQ-SF physical-activity profile overall and by gender

Indicator	Overall (N = 153)	Men (n = 105)	Women (n = 48)
Total MET-min/week, median (IQR)	664 (264-2,520)	924 (320-3,150)	396 (198-967.5)
Vigorous MET-min/week, median (IQR)	0 (0-1,080)	0 (0-1,440)	0 (0-0)
Moderate MET-min/week, median (IQR)	0 (0-720)	0 (0-960)	0 (0-210)
Walking MET-min/week, median (IQR)	330 (165-660)	396 (165-693)	280.5 (148.5-412.5)

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Indicator	Overall (N = 153)	Men (n = 105)	Women (n = 48)
Low category, n (%)	71 (46.4)	41 (39.0)	30 (62.5)
Moderate category, n (%)	47 (30.7)	34 (32.4)	13 (27.1)
High category, n (%)	35 (22.9)	30 (28.6)	5 (10.4)

Note. IPAQ-SF = International Physical Activity Questionnaire-Short Form; IQR = interquartile range; MET = metabolic equivalent of task. Category assignment used the official combined frequency, duration and MET criteria.

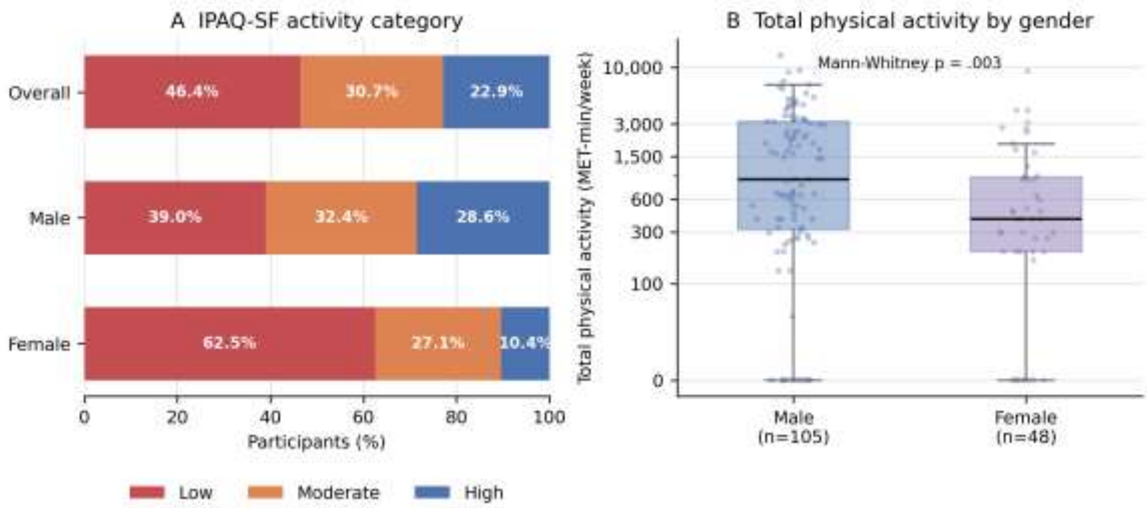

Figure 1: Physical activity by gender. Panel A shows the distribution of IPAQ categories. Panel B shows total MET-min/week on a symmetric log scale with individual observations and box plots. Mann-Whitney U = 3,263, p = .003

Associations with Age, BMI and Sitting Time

Total MET-min/week was not associated with age (rho = -.049, p = .546) or BMI (rho = .079, p = .333). Activity also did not differ across BMI categories, H(3) = 1.31, p = .728. In contrast, weekday sitting time showed a moderate inverse association with total activity (rho = -.405, p < .001). The gender difference in sitting time itself was not statistically significant.

In the multivariable model, women had 2.29 times the adjusted odds of low activity compared with men (95% CI 1.08-4.87, p = .030). Each additional hour of weekday sitting was associated with 22% higher adjusted odds of low activity (aOR = 1.22, 95% CI 1.08-1.37, p < .001). Age and BMI were not independently associated with low activity. A sensitivity analysis restricted to participants aged 18-29 years produced consistent gender findings for total MET-min/week (p = .006, rank-biserial r = .279) and activity category (p = .016, Cramer's V = .234). Table 3 summarises the association analyses.

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Table 3: Associations with IPAQ-SF physical activity

Analysis	Effect estimate	95% CI	p value
Men vs. women: total MET-min/week	U = 3,263; rrb = .295	-	.003
Gender x IPAQ category	χ^2 = 8.95; V = .242	-	.011
Age vs. total MET-min/week	rho = -.049	-	.546
BMI vs. total MET-min/week	rho = .079	-	.333
BMI category vs. total MET-min/week	H(3) = 1.31	-	.728
Sitting vs. total MET-min/week	rho = -.405	-	<.001
Adjusted low-activity model: female vs. male	aOR = 2.29	1.08-4.87	.030
Adjusted low-activity model: age, per year	aOR = 1.01	0.93-1.09	.879
Adjusted low-activity model: BMI, per kg/m^2	aOR = 0.99	0.93-1.06	.810
Adjusted low-activity model: sitting, per hour/day	aOR = 1.22	1.08-1.37	<.001

Note. aOR = adjusted odds ratio; BMI = body mass index; CI = confidence interval; H = Kruskal-Wallis statistic; IPAQ = International Physical Activity Questionnaire; rho = Spearman correlation; rrb = rank-biserial correlation; U = Mann-Whitney statistic; V = Cramer's V. Logistic regression outcome: low IPAQ category = 1; moderate/high = 0.

Discussion

Principal Findings

This study found that 46.4% of respondents were in the low IPAQ category during the historical restriction period, while 30.7% were in the moderate category and 22.9% were in the high category. The median total activity of 664 MET-min/week was only slightly above the 600 MET-min/week criterion that contributes to the moderate classification, although category assignment also depends on frequency and duration. The sample therefore showed substantial heterogeneity: walking was common, yet vigorous and moderate activity were zero for many respondents, while a smaller subgroup accumulated very high scores. This pattern supports reporting medians, IQRs and protocol categories rather than relying on arithmetic means alone. The prevalence reported here should not be interpreted as evidence that restrictions caused inactivity. The study did not include a comparable pre-restriction IPAQ-SF baseline or an unrestricted control group. Nevertheless, the finding is consistent with the wider evidence that disruption of transport, work, study and recreation reduced activity opportunities for many people during COVID-19 restrictions (Stockwell et al., 2021; Wilke et al., 2022). It also complements longitudinal Malaysian evidence showing reduced activity during movement restrictions in a low-income semi-rural cohort (Salway et al., 2021). The present study contributes a distinct urban community profile and shows why protocol-based processing is important when self-reported item responses are used.

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Gender Disparity in Physical Activity

Female respondents reported lower total activity and were more frequently classified in the low category. The effect was not only statistically significant but visible across complementary metrics: the median difference was 396 MET-min/week, the rank-biserial correlation was .295, the gender-category association had a Cramer's V of .242, and female gender remained associated with low activity after adjustment for age, BMI and sitting time. The age-restricted sensitivity analysis yielded the same direction and similar effect size, indicating that the two older respondents did not explain the result.

This pattern accords with Malaysian population research in which women were less likely to participate in physical activity (Cheah & Poh, 2014), as well as findings among Malaysian undergraduates showing higher overall and leisure activity among men (Sutan et al., 2022). The present study cannot identify the mechanism, but plausible contextual explanations include unequal domestic responsibilities, safety concerns, reduced access to preferred facilities, limited private space, lower social support and fewer acceptable activity options during restrictions. Malaysian female undergraduates have specifically identified lack of time, motivation and facilities as barriers, alongside a preference for accessible, enjoyable and socially supported programmes (Othman et al., 2022). These explanations remain hypotheses because the source survey did not measure them directly.

Sitting Time and Low Activity

Weekday sitting time was inversely correlated with total activity and independently associated with the low IPAQ category. Each additional hour of sitting corresponded to 22% higher adjusted odds of low activity. This finding is behaviourally plausible in a period when online study, remote work and home-based leisure displaced active transport and organised recreation. It also reinforces the value of considering physical activity and sedentary behaviour together. Prospective device-based evidence shows that the health risks associated with higher sedentary time are greatest among less active adults, while higher moderate-to-vigorous activity can attenuate some of that risk (Ekelund et al., 2020). The current cross-sectional association is not evidence that sitting reduced activity, or vice versa, but it identifies a practical intervention target.

Age, BMI and Implications for Practice

Neither age nor BMI was associated with total activity or low-activity status. The null age finding is unsurprising because 98.7% of participants were aged 18-29 years, leaving little variability for detecting an age gradient. The BMI result should also be interpreted cautiously: anthropometrics were self-reported, the cross-sectional design cannot establish temporal ordering, and physical activity may influence body composition without producing a simple contemporaneous relationship with BMI. These null findings therefore do not imply that age and adiposity are unimportant to population physical activity.

The practical priority suggested by the data is to protect routine movement opportunities during periods of disruption. Public-health and community programmes should combine sitting-reduction strategies with accessible activity options that do not depend on gyms or organised sport. Short walking breaks, home-based resistance sessions, safe neighbourhood walking routes, remote group exercise and flexible schedules may be useful. A systematic review of university populations likewise indicates that interventions should address multiple capability, opportunity and motivation influences rather than knowledge alone (Brown et al., 2024). Because women showed a higher likelihood of low activity, programme development should

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involve female participants directly and address the barriers they identify rather than assuming that a single digital exercise message will be equally feasible for everyone.

Strengths and Limitations

A major strength was the calculation of IPAQ-SF scores from primary item-level responses using the official screening, minimum-bout, truncation and categorical rules. The analysis also reported effect sizes, confidence intervals and an adjusted model rather than p values alone, and findings were robust when restricted to participants aged 18-29 years. These steps improve transparency and reproducibility relative to relying on stored summary variables.

Several limitations are important. First, convenience recruitment through social media limits representativeness, and the sample was imbalanced by gender and overwhelmingly young. Findings should not be generalised to all adults in Kota Damansara or Malaysia. Second, all measures were self-reported and susceptible to recall, interpretation and social-desirability biases; IPAQ-SF scores can overestimate activity compared with objective measures (Lee et al., 2011). Third, weight and height were self-reported, and a verified data-entry error in body weight was corrected before analysis. Fourth, only weekday sitting was measured, and no information on screen time, occupation, household composition, caregiving, access to facilities or psychological determinants was available. Fifth, the cross-sectional design and absence of a comparable pre-restriction measure preclude causal or within-person change claims. Finally, restriction intensity varied across the May-June 2021 data-collection period, which may have influenced participants' activity opportunities.

Conclusion

Nearly half of this predominantly young urban Malaysian sample was classified in the low IPAQ category during a COVID-19 movement-restriction period. Female respondents reported lower total activity and were more likely to have low activity, while longer weekday sitting time was independently associated with low activity. Age and BMI were not associated with activity within this sample. The findings support gender-responsive strategies that preserve accessible opportunities for movement and interrupt prolonged sitting during future disruptions to daily routines. Because the evidence is cross-sectional, it describes activity patterns observed during restrictions and does not establish that the restrictions caused inactivity.

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Journal of Islamic, Social, Economics and Development (JISED)
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