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Correlation between Physical Activity Time Reported by the IPAQ and Accelerometer in Syrian Adults

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SUMMARY

Background: The accelerometer and self-report questionnaires have been recommended as efficient methods to measure physical activity (PA). The aim of this work is to investigate issues associated with PA assessment using the ActiGraph WGT3X-BT (AG) accelerometer and the Syrian version of the International Physical Activity Questionnaire-short form (IPAQ-SF-SY) in adults living in Damascus city.
Methods: A sample of 52 (age 18- 60 years) Syrian men (17) and women (35) in a cross-sectional study wore the AG accelerometer for seven days and completed the IPAQ-SF-SY on the seventh day. Total PA, time spends in standing and sitting assessed by IPAQ-SF-SY and AG accelerometer were compared.
Results: The IPAQ-SF-SY overestimates PA time among Syrian adults. IPAQ-SF-SY reported more time of total PA [763(660) vs 607(149) min, p=0.003], vigorous PA [29(1) vs 1(0.2) min, p=0.524], moderate PA [94(76) vs 42(22) min, p=0.032], MVPA [122(106) vs 43(22) min, p=0.019], and significantly less sedentary time than AG accelerometer [447(180) vs 643(93) min, p=0.728], mean (SD) respectively. Some differences were noticed in the correlations by gender, age, BMI, education statues, and smoking for PA and sedentary behavior (SB). For all correlations, there were no significant differences between sub groups.
Conclusions: Data suggest that it is important to improve the specificity and sensitivity of the IPAQ-SF-SY with Arabic-speaking subjects and further study is needed to approve the utilization of PA self-report in Arabic.

Keywords: Questionnaire; Self-report; Acigraph; Sitting time; Measurements; MVPA.

INTRODUCTION

Regular physical activity (PA) is well documented as a critical component of a healthy lifestyle and disease prevention [1]. However, public health care organizations, and others involved in an intervention project should have valid and reliable methods for measuring PA [2]. Accurate PA assessment is essential to determine baseline PA degrees and to set up goals for increasing PA [3]. Measurement of PA behavior can be performed in many ways, including the implementation of direct, (subjective) based on accelerometer usage, and indirect (objective) based on self-report questionnaires [4]. The validity of the accelerometer as a direct and quantitative measurement of PA has been confirmed [4,5]. Questionnaires as an indirect tool are the preferred method for determining large-scale monitoring and observational studies [6]. Limitations of indirect assessment of PA behavior have been well documented including desirability bias [7].

Scientific groups have worked toward standardizing self-report assessments of PA and thus the International Physical Activity Questionnaire (IPAQ) [3,8] has been widely implemented. IPAQ can provide both researchers and physicians with estimate of PA behavior for adults aged [9]. The validation and reliabilities of the IPAQ as a population indicator tool was examined and reported in an international study of several countries [10]. In general, epidemiological studies usually use questionnaires to measure PA

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levels, because it is easy, inexpensive and a useful tool in determining high and low levels of PA [11]. The validity and reliability of IPAQ has been determined in several countries; however, most of the studies that have validated the IPAQ by comparing its results with those of accelerometer tools were performed in developed countries [10, 12]. Therefore, it needs to be examined in other regions and with various target groups [13].

In light of the beneficial effects of PA on health, more insight into the PA behavior of populations is needed. The IPAQ might be a successful method towards providing this information. However, no studies has used the direct based on using accelerometer, or indirect based on self-report questionnaires to detect intervention related changes in Syria. Also, there has been no research conducted to quantify the PA of youth or adult Syrian population. Therefore, this study aimed to investigate the time spent in standing and sitting postures to measure the PA behavior to the sensitivity and specificity of the IPAQ-SF-SY compared with AG accelerometer for detecting intervention related to PA in Syrian adults.

MATERIAL AND METHODS

Participants and study design

A random population sample of 61 adults (41 females; 20 males) aged between 18 and 60 years was selected from various workplaces within the Syrian Atomic Energy Commission (SAEC) in Damascus, Syria. The study protocol was approved by the Atomic Energy Human Ethics Committee. The research was conducted in compliance with the guidelines outlined in the Helsinki Declaration of the World Medical Association. Prior to participation, each participant provided informed consent following a comprehensive explanation of the study protocol.

Participant characteristics

Participants who met the study's criteria were those willing to wear an AG accelerometer for seven consecutive days and complete the IPAQ-SF-SY in Arabic. To be included in the analysis, participants needed a minimum of 600 minutes of valid daily monitor wear on at least four days. Nine individuals (6 females, 3 males) were excluded from the analysis for not meeting the required accelerometer wear time. The final sample comprised 52 participants (17 men, 35 women) who successfully completed the physical activity log and recorded steps for seven days. The participants had a mean (SD) age of 40.6 (9.1) years and a mean Body Mass Index (BMI) of 28.5 (4.6) kg/m2. The majority were overweight or obese (39 subjects, 75%). Most participants were married and cohabiting with their partners (42 subjects, 80.8%), while a few were single and living alone (10 subjects, 19.2%). The majority had completed secondary school or higher education (47 subjects, 90.4%), with a small number having lower levels of education (5 subjects, 9.6%) [4].

Measurements

All participants with comprehensive data on objectively measured physical activity (PA), height, and weight were incorporated in the present analysis. Height measurements were taken to the nearest 0.5 cm using a wall-mounted stadiometer (Seca, Model: 225 1721009; Germany). Body weight was recorded to the nearest 0.1 kg utilizing a portable battery-operated digital scale with a maximum capacity of 130 kg (Seca, Model: 7671321004; Germany), regularly calibrated. Participants were weighed barefoot and lightly dressed. The collected weight and height measurements were utilized to calculate Body Mass Index (BMI, kg/m2)

Accelerometer processing

Participants were eligible for the study if they agreed to wear an AG accelerometer for at least seven consecutive days. The study employed a triaxial accelerometer (ActiGraph GT3X +, ActiGraph, Pensacola, FL. 32502 USA) to assess physical activity (PA). The device was configured to record data on PA, including activity counts, energy expenditure (kcal), steps, and activity intensity (as metabolic equivalents (METs))[14]. Participants were advised to wear the accelerometer on their left hip for seven consecutive days during waking hours, excluding contact, washing, bathing, swimming, or sleeping activities[15]. Subjects were asked to remove the device before aquatic activities like showering, swimming, or bathing. The AG accelerometer data was processed using ActiLife 6 software and exported to Microsoft Excel format. Within Microsoft Excel, minutes of PA, including light, moderate, vigorous, and sitting time, were calculated as mean minutes per day. ActiLife 6 software was used to initialize the accelerometer and download results, and raw data was converted with Freedson cut points (i.e., Sedentary <100 counts/minute, Light: 100–1951, Moderate: 1952–5724, Vigorous: >5724 counts/minute)[16]. Average daily time in moderate-to-vigorous physical activity (MVPA) (min/day) and sitting time (min/day) were calculated[17]. The daily average was multiplied by seven to create a weekly total [18].

The International Physical Activity Questionnaire (IPAQ)

Participants meeting the study's criteria were those willing to complete surveys in Arabic. The

Syrian version of the International Physical Activity Questionnaire Short Form (IPAQ-SF-SY) was selected to evaluate physical activity (PA) behaviors in the study population. This questionnaire is structured to facilitate comparisons with national and international PA guidelines. A 7-item IPAQ-SF-SY was employed to record self-reported PA over the preceding seven days, a widely used tool for assessing PA levels[8]. After wearing AG accelerometers for a week, participants completed the IPAQ-SF-SY survey, providing information on demographic details (age, gender, relationship status, anthropometric data, education level, and smoking habits). Following the IPAQ-SF-SY scoring guidelines, data from the questionnaire were aggregated for each item over the past week (light, moderate, vigorous intensity, moderate-to-vigorous intensity PA, and sitting time)[8]. Total activity minutes were calculated by summing the reported weekly PA minutes from the IPAQ-SF-SY.

The Arabic-translated IPAQ-SF-SY had been previously utilized by other Arab populations as an interview short form in Arabic [19,20]. It assessed walking, moderate, and vigorous PA levels across various domains like work, transportation, household chores, gardening activities, and leisure time on both weekdays and weekends. Trained research assistants conducted all measurements in person following standardized protocols.

Statistical analysis

Participants included in the analysis had data from both the IPAQ-SF-SY and AG accelerometer. Statistical analyses were conducted using the Statistical Package for Social Science (SPSS) software (Version 24, 2016, SPSS Inc., Chicago, USA). Continuous variables were presented as mean ± standard deviation (SD), while categorical variables (such as total PA, moderate PA, vigorous PA, moderate-to-vigorous intensity PA (MVPA), and sitting time) across different demographics like sex, age, BMI, education, and smoking categories were expressed as frequencies and percentages. Statistical significance was set at $p \leq 0.05$. To address skewed distributions of many accelerometer factors, log transformation was applied before analysis. Given the non-normal distribution of IPAQ and accelerometer measurements, descriptive statistics including mean, median, and interquartile ranges (IQR) were utilized [18].

RESULTS

Objective and self-reported PA and sitting time

The mean minutes per day for the PA variables (total PA, vigorous PA, moderate PA and moderate-to-vigorous intensity PA (MVPA) and sitting time) assessed by IPAQ-SF-SY and AG accelerometer are presented in Table 1. The variations were significant with PA being over-estimated and sitting time under-estimated in the IPAQ-SF-SY. Compared to AG accelerometer derived total PA (mean of 607 min per day; IQR 488–681), and MVPA (mean of 43 min per day; IQR 27–52), participants under-estimated their self-reported IPAQ derived levels of total PA (mean of 763 min per day; IQR 303–1069), and MVPA (mean of 122 min per day; IQR 36–169) (Table 1).

When analyses were carried out by gender, both men and women under self-estimated their level of total PA and MVPA. Males reported a mean of 996 minutes (IQR 405–1448) and 148 minutes (IQR 13–240) of total PA and MVPA per day, respectively. Whereas, the AG accelerometer recorded a mean of 670 min (IQR 521–812) of total PA, and 60 min (IQR 46–72) of MVPA. Females reported a mean of 650 minutes (IQR 297–910) of total PA and 110 (IQR 43–137) of MVPA per day using the IPAQ-SF-SY, whereas, the AG accelerometer recorded a mean of 576 min (IQR 467–649) of total PA, and 35 minutes per day (IQR 22–47) of MVPA per day (Table 1).

When analyses were carried out by age groups, all groups (18 – 29 years), (30-45 years), and (>45 years) under self-estimated their level of total PA and MVPA. (18-29 years) reported a mean of 306 minutes per day (IQR 206–473) of total PA, and 49 minutes per day (IQR 26–69) of MVPA using the IPAQ-SF-SY, whereas the AG accelerometer recorded a mean of 37 min per day (IQR 32–47). The age of (30-45 years) reported a mean of 861 minutes per day (IQR 346–1177) of total PA, and 131 minutes per day (IQR 28–176) of MVPA, whereas the accelerometer recorded a mean of 598 min per day (IQR 477–681) of total PA, and 39 min per day (IQR 24–52) of MVPA. While, the age of (>45 years) reported a mean of 790 min per day (IQR 387–1268) of total PA, and 138 minutes per day (IQR 69–210) of MVPA, whereas the accelerometer recorded a mean of 633 min per day (IQR 481–732) of total PA, and 51 min per day (IQR 29–61) of MVPA.

Table 1 compares total time spent on PA reported in the IPAQ-SF-SY to AG accelerometer readings, by subgroup according to BMI (more or less than 25). On every variable, the self-report questionnaire produced much higher measurements of time spent in vigorous, moderate and total PAs than the objective device. Normal weight participants (BMI>25) reported a mean of 539 min per day (IQR 289–780) of total PA, and 87 minutes per day (IQR 26–120) of MVPA, whereas the accelerometer recorded a mean of 598 min per day (IQR 547–654) of total PA, and 43 min per day (IQR 33–54) of MVPA. While overweight or obese participants (BMI>25) reported a mean of 838 min per day (IQR 366–1211) of total PA, and 134 (IQR 34–180) of MVPA using the IPAQ, whereas the accelerometer recorded a mean of 610 min per day (IQR 467–726) of total PA, and 43 minutes per day (IQR 23–52) of MVPA (Table 1).

The average differences in reported physical activity (PA) times between IPAQ-SF-SY and AG accelerometer readings, categorized by education levels, are detailed in Table 1. Participants with lower education levels (<secondary school) reported higher total PA (1195 minutes per day) (IQR 527–1922) and moderate to vigorous physical activity (MVPA) (180 minutes per day) (IQR 77–296) on IPAQ-SF-SY compared to AG accelerometer readings of 703 minutes per day for total PA (IQR 497–891) and 55 minutes per day for MVPA (IQR 36–75). Conversely, the discrepancies between IPAQ-SF-SY and AG accelerometer data were less significant among participants with higher education levels. For instance, those with secondary education reported 366 minutes per day of total PA (IQR 93–523) and 49 minutes per day of MVPA (IQR 9–88), while participants with >secondary education reported 801 minutes per day of total PA (IQR 317–1245) and 132 minutes for MVPA (IQR 56–195), compared to AG accelerometer readings of 612 minutes per day for total PA (IQR 508–670) and 42 minutes per day for MVPA (IQR 23–52).

When stratified by smoking status, both smoking and non-smoking participants underestimated their total PA and MVPA levels. Smoking participants self-reported a mean of 704 minutes per day of total PA (IQR 122–1181) and 104 minutes per day of MVPA (IQR 13–171), while the accelerometer recorded means of 611 minutes per day for total PA (IQR 546–630) and 41 minutes per day for MVPA (IQR 27–51). Non-smoking participants reported a mean of 798 minutes per day of total PA (IQR 311–1052) and 133 minutes of MVPA (IQR 60–171) using IPAQ, whereas the accelerometer captured means of 604 minutes per day for total PA (IQR 474–719) and 44 minutes per day for MVPA (IQR 28–55) as shown in Table 1.

The results indicated an underestimation of sitting time by the tested sample (Table 1). The average sedentary time reported using IPAQ-SF-SY was 447 minutes per day (IQR 315–600), which was lower than the objective AG accelerometry findings showing an average sedentary time of 643 minutes per day (IQR 595–693) (Table 1).

In Figure 1, the distribution of weekly moderate-equivalent minutes of physical activity (PA) from self-reported data (IPAQ-SF-SY) and AG accelerometer measurements is depicted. The figure illustrates a wide variation in PA levels across the sample, with a significant number of participants exhibiting low activity levels during the week and a notable percentage engaging in relatively high levels of activity. The self-reported PA data from IPAQ-SF-SY displayed a broader range of values compared to the AG accelerometer data, with notably higher values. For instance, based on self-reports, 34.6% of participants reported 960 or more minutes of PA, whereas less than 1% reached this level based on AG accelerometer data. The skewed distribution indicates that relying on mean values for correlational analysis between the two measures can be misleading.

Figure 2 illustrates the impact of outlier values on the estimated mean PA minutes from self-reports (IPAQ-SF-SY). The mean weekly PA minutes reported through self-assessment were considerably higher than those determined by AG accelerometers. However, median values were more aligned, suggesting that outlier values influenced the agreement between the two measurement methods. Even when considering medians, self-reported PA minutes exceeded those captured by AG accelerometers, indicating an overestimation in self-reported PA minutes.

DISCUSSION

The present study aimed to measure factors related to time spend in different PA intensities using IPAQ-SF-SY and AG accelerometers in a population-based sample. We used a common metric (minutes per week) to compare the outcome variables. Comparing the AG accelerometer and IPAQ-SF-SY our results found, in general, higher values of PA with IPAQ-SF-SY than with AG accelerometer, but lower time in sitting time activities on the IPAQ-SF-SY. This figure is also confirmed by the study of [21], and shows a tendency to overestimate PA carried out. However, Barnaba et al [22] found lower results in general with IPAQ-SF; these participants spent on average of 257.1 min (females 201.9, males 325.7) with vigorous and 348.9 with moderate activity weekly. If we convert our result, Syrian adults spent 203 min with vigorous and 658 with moderate activity weekly when determined by IPAQ-SF-SY. Time spent in moderate-to-vigorous PA was 2.8 times more according to the IPAQ-SF-SY than to AG accelerometers. Accumulated results over 7 days (min per week) as measured by AG accelerometer and IPAQ-SF-SY were total MVPA 330 vs 1086, vigorous PA 41 vs 645 and moderate PA 289 vs 441 respectively. Comparing the accelerometer and IPAQ data, several studies reported higher vigorous and moderate activities in questionnaire compared to objective results [23,24]. Comparably, several other studies found the self-report vigorous category to report the largest discrepancy in mean min per week of PA when compared with accelerometer [1,18,25]. However, population-based estimations of PA are based on self-reported dated, which indicated overestimation [7,25,26]. At the same time the AG may have underestimated PA level, and it is possible that the accelerometer, unlike IPAQ was unable to measure or underestimated the specific PA such as heavy lifting, bicycling, household work… that could have been performed [18], also, the accelerometer is not waterproof and therefore cannot be worn during water activities such as swimming [27]. Accelerometers are known for being not enough when determining steps at the low speeds that some of the participants may walk at [28,29].

These results indicate that the IPAQ-SF-SY

overestimation of PA practice should be taken into account in prevalence studies and hence consistent efforts are necessary to correct this limitation. Results from this study extend previous findings by using both objective and self-reported measures, and by explicitly investigating PA intensity [22,25,30,31].

Analyzing the data to SB activities differences vs. time are observed and these outcomes are similar to those reported by Hagstromer et al. [32], who reported also an overestimation of sedentary activity and an increase of the differences in relation to time.

Larger IQRs were found for PA and sitting time when measured by the IPAQ-SF-SY in comparison to the accelerometer. This may indicate that the IPAQ-SF-SY may not be the applicable method to use on an subject basis when aiming to measure PA or sitting time in adults. Nevertheless, it is moderate acceptable when used in large population studies. it may possible to more strengthen the validity scores by providing more detail of the kinds of activities and behaviors. This is in line with recommendations from Cleland et al. [7] who suggested the addition of relevant examples to provide clarity.

We observed some differences in the correlations by gender, Age, BMI, education statues, and smoking (for total PA, vigorous PA, moderate PA, MVPA and sitting time). BMI was related to less time spent in low-intensity activity. Higher education was related to less time spent in MVPA intensity activity. For all correlations, there were no significant differences between sub groups.

Unexpectedly, our investigation found no significant difference in standing and sitting time between normal weight (BMI<25) and overweight (BMI>25) groups. There are some possible reasons why these overweight individuals spent more time in standing than did the normal weight subjects. It is possible that the measured time period in this assessment may have been too short. It should be indicated that, for standing, because all of the participant in this work were initially sedentary, the expected variations, between the overweight and normal weight subjects are not showed in these data [33].

We found differences between genders according to the AG accelerometer and IPAQ-SF-SY. According to both methods, men spent more time in vigorous, moderate, and MVPA intensity of activities. Sitting time was slightly higher in men than in women for both IPAQ-SF-SY and AG accelerometer measured variables. The overestimation factor of total PA in the IPAQ-SF-SY compared to AG accelerometer data was 1.5 in men and 1.1 in women. Males are generally more active than females, and PA is lower in successive age groups. Acs et al. [22] presented their findings with respect to age and found similar activity patterns in the group of adults. The higher activity levels in boys in our experiment is in agreement with previous study indicated that boys were more physical active than girls, as they accumulated MVPA [26].

AG Accelerometer and IPAQ-SF-SY data revealed that those over 45 years were most active than younger individuals for all PA variables. Thus, overestimation in the IPAQ-SF-SY compared to AG accelerometer data was highest in the oldest age group (more than 45 years) (1.2) and lower in the younger age group (30-45 years) (1.4). While, the underestimation in the IPAQ-SF-SY compared to AG accelerometer data was observed in the youngest age group (18-29 years). Both IPAQ-SF-SY and AG accelerometer data showed that the oldest age group was more active in vigorous, moderate and total PA compared to younger age groups. AG accelerometer sitting time was almost 1.4 times as high as IPAQ-SF-SY sitting time. Both the IPAQ-SF-SY and old age substantially over-reported the total mean time spent in MVPA when compared with the AG accelerometer and young age. We found that higher age was associated with more time spent in MVPA. These results are in agreement with previous results from cross-sectional and longitudinal research's, including 24h-accelerometry-based data [34,35].

Compared to never smoking, current smoking spent less time in MVPA. These findings are acceptable, given the negative impact of smoking on cardio vascular diseases and oxygen metabolism [34]. A previous study indicated that smoking versus non-smoking is synchronized with a lower likelihood of being persistently moderately or vigorously active [35]. This assumption is supported by our observation that former compared to never smokers tended to spent less time in PA; however, this association was not statistically significant

Strength

This assessment's robustness lies in the utilization of a validated accelerometer with established cut points and the administration of a physical activity (PA) self-report questionnaire in Arabic, the participants' native language. Furthermore, a quality control protocol was implemented, involving random validity checks conducted by the authors to assess the precision of individual interviews.

Limitations

The study utilized an equation to predict physical activity (PA), a method that may introduce errors requiring thorough scrutiny. It is imperative to conduct further evaluations of the questionnaire across diverse age groups, occupations, and various populations in Arab-speaking regions. The study's limitations stem from a relatively small sample size confined to one location in Damascus, limiting the generalizability of the findings to other Syrian populations with differing characteristics. Moreover, the AG accelerometer has notable drawbacks, including its lack of waterproofing, rendering it ineffective during water-related activities like swimming or showering. Additionally, accelerometers fail to account for the energy expenditure of strenuous

upper body movements or water-based exercises. [36].

CONCLUSION

The current research reveals a significant disparity in physical activity (PA) and sedentary time when assessed using IPAQ-SF-SY versus AG accelerometers, irrespective of the activity pattern. There is notable over-reporting and overestimation of PA duration (minutes per week) with IPAQ-SF-SY. In the Syrian population, PA levels determined by IPAQ-SF-SY compared to AG accelerometers vary based on gender, age, employment status, education level, body mass index (BMI), and smoking habits. Inaccurate PA levels pose a critical public health challenge, necessitating further studies to enhance PA adherence to recommended standards. Future research focusing on identifying individuals with low PA levels and tailoring interventions for these specific groups could greatly benefit health officials.

CONFLICT OF INTEREST

The authors declare no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Table 1. Descriptive physical activity data from IPAQ-SF-SY and Actigraph, by sex, age, BMI, education and smoking; median and interquartile Ranges (IQR).

	Total PA*		Vigorous PA		Moderate PA*		MVPA*		Sitting*	
Variables	**IPAQ MET min.d-1**	**Actigraph† counts.min-1**	**IPAQ min.d-1**	**Actigraph† min.d-1**	**IPAQ min.d-1**	**Actigraph† min.d-1**	**IPAQ min.d-1**	**Actigraph† min.d-1**	**IPAQ min.d-1**	**Actigraph† min.d-1**
All‡	763 (660)	607 (149)	29 (57)	1 (0.2)	94 (76)	42 (22)	122 (106)	43 (22)	447 (180)	643 (93
Median (IQR)	552 (303; 1069)	552 (488; 681)	2 (0; 32)	1 (0.2; 1)	77 (26; 127)	42 (27; 52)	103 (36; 169)	42 (27; 52)	450 (315; 600)	631 (595; 693)
Sex										
Men‡	996 (793)	670 (181)	49 (74)	2 (2)	98 (99)	58 (25)	148 (134)	60 (25)	383 (217)	647 (71)
Median (IQR)	889 (405; 1448)	649 (521; 812)	13 (0; 73)	1 (0; 2)	60 (5; 206)	52 (44; 68)	137 (13; 240)	55 (46; 72)	360 (240; 510)	655 (593; 706)
women‡	650 (564)	576 (122)	19 (44)	1 (1)	91 (64)	34 (15)*	110 (90)	35 (15)	478 (152)	641 (102)
Median (IQR)	480 (297; 910)	582 (467; 649)	0 (0; 17)	0 (0' 1)	77 (34; 120)	34 (22; 44)	94 (43; 137)	34 (22; 47)	480 (360; 600)	624 (596; 692)
Age										
18-29‡	306 (132)	575 (161)	8 (9)	1 (2)	41 (31)	36 (11)	49 (32)	37 (12)	446 (124)	684 (199)
Median (IQR)	297 (206; 373)	604 (481; 649)	3 (0; 17)	1 (0; 3)	26 (17; 69)	37 (31; 46)	43 (26; 69)	38 (32; 47)	480 (300; 540)	631 (577; 803)
30-45‡	861 (736)	598 (130)	34 (64)	1 (1)	98 (78)	39 (17)	131 (122)	39 (17)	449 (188)	627 (61)
Median (IQR)	684 (346; 1177)	603 (477; 681)	6 (0; 34)	0 (0; 1)	82 (26; 158)	36 (24; 52)	110 (28; 176)	37 (24; 52)	480 (300; 600)	622 (592; 682)
>45‡	790 (600)	633 (177)	29 (56)	2 (2)	109 (81)	49 (30)	138 (88)	51 (30)	445 (193)	651 (71)
Median (IQR)	499 (387; 1268)	639 (481; 732)	0 (0; 42)	1 (0; 3)	103 (39; 150)	46 (28; 57)	120 (69; 210)	48 (29; 61)	360 (360; 600)	655 (595; 722)
BMI (kgm-2)										
< 25‡	539 (404)	598 (112)	19 (50)	1 (1)	68 (69)	43 (14)	87 (70)	43 (14)	439 (126)	673 (133)
Median (IQR)	373 (289; 780)	616 (547; 654)	0 (0; 12)	0 (0; 1)	60 (4; 120)	43 (33; 53)	89 (26; 120)	44 (33; 54)	480 (300; 540)	631 (586; 695)
> 25‡	838 (715)	610 (161)	32 (59)	1 (2)	102 (78)	41 (24)	134 (114)	43 (24)	450 (196)	633 (74)

Median (IQR)	605 (366; 1211)	582 (467; 726)	4 (0; 34)	1 (0; 1)	86 (34; 171)	38 (23; 52)	111 (34; 180)	39 (23; 52)	420 (360; 600)	631 (595; 687)
Education										
< Secondary‡	1195 (912)	703 (203)	58 (104)	2 (2)	122 (59)	53 (23)	180 (144)	55 (23)	336 (178)	622 (78)
Median (IQR)	1074 (527; 1922)	737 (497; 891)	0 (0; 145)	3 (1; 4)	120 (69; 176	53 (33; 73)	154 (77; 296)	55 (36; 75)	360 (180; 480)	651 (543; 687)
Secondary‡	366 (258)	529 (116)	3 (6)	1 (1)	46 (41)	37 (11)	49 (41)	38 (11)	460 (167)	646 (61)
Median (IQR)	408 (93; 523)	566 (419; 634)	0 (0; 7)	1 (0; 1)	60 (3; 82)	38 (28; 44)	60 (9; 88)	39 (28; 45)	480 (330; 600)	638 (597; 700)
> Secondary‡	801 (657)	612 (143)	31 (55)	1 (2)	101 (81)	41 (23)	132 (106)	42 (24)	459 (182)	645 (101)
Median (IQR)	579 (317; 1245)	609 (508; 670)	6 (0; 34)	0 (0; 1)	82 (26; 140)	42 (23; 52)	120 (56; 195)	43 (23; 52)	480 (345; 600)	627 (595; 694)
Smoking										
Yes‡	704 (6040	611 (165)	22 (41)	1 (2)	83 (74)	40 (23)	104 (92)	41 (24)	508 (148)	622 (61)
Median (IQR)	488 (122; 1181)	604 (546; 630)	3 (0; 17)	1 (0; 2)	77 (9; 129)	34 (26; 51)	94 (13; 171)	34 (27; 51)	540 (360; 600)	606 (577; 667)
No‡		604 (142)	33 (64)	1 (1)	100 (79)	43 (21)	133 (114)	44 (21)	412 (189)	655 (106)
Median (IQR)	565 (311; 1052)	616 (474; 719)	0 (0; 34)	0 (0; 2)	86 (38; 125)	43 (28; 53)	111 (60; 171)	44 (28; 55)	420 (270; 570)	651 (596; 695)

**- Significant difference between IPAQ-SF-SY-Actigraph tested for total PA, vigorous, moderate, Moderate-to-Vigorous PA, and sitting, respectively, using T- test, $p \leq 0.05$; †_Cut-off values for sitting, moderate and vigorous were <100, 1952–5724, and >5724 counts, respectively; ‡_ Mean (±Standard deviation); _ IQR_ Interquartile range; BMI_ Body Mass Index; PA_ Physical Activity.*

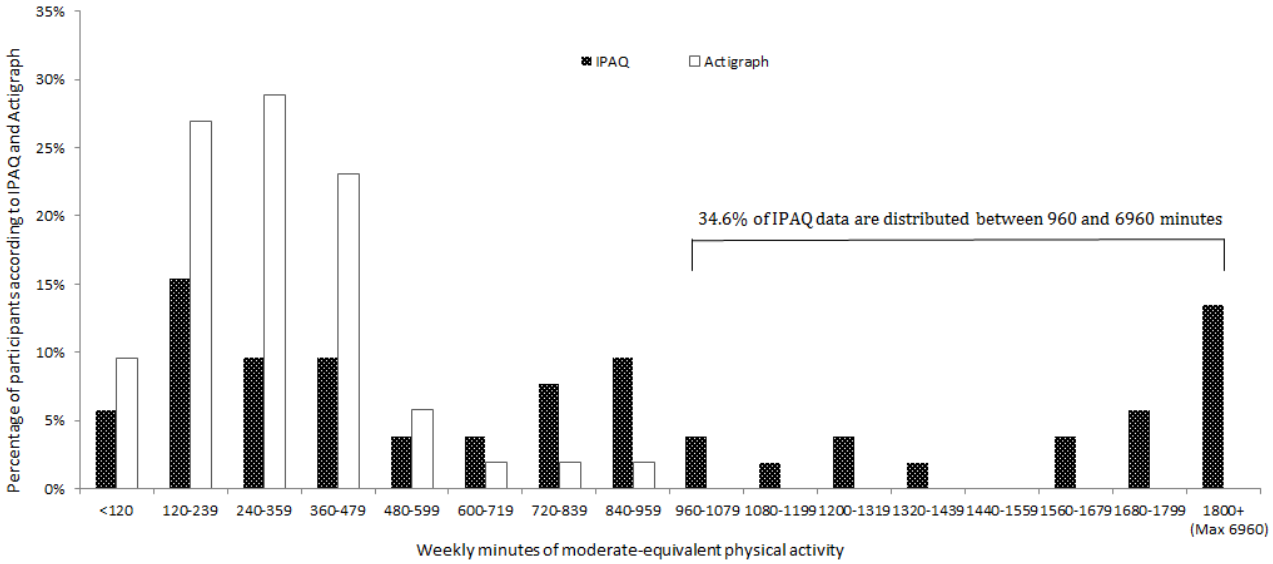

Figure 1. Distribution of weekly moderate-equivalent minutes as measured by IPAQ and Actigraph

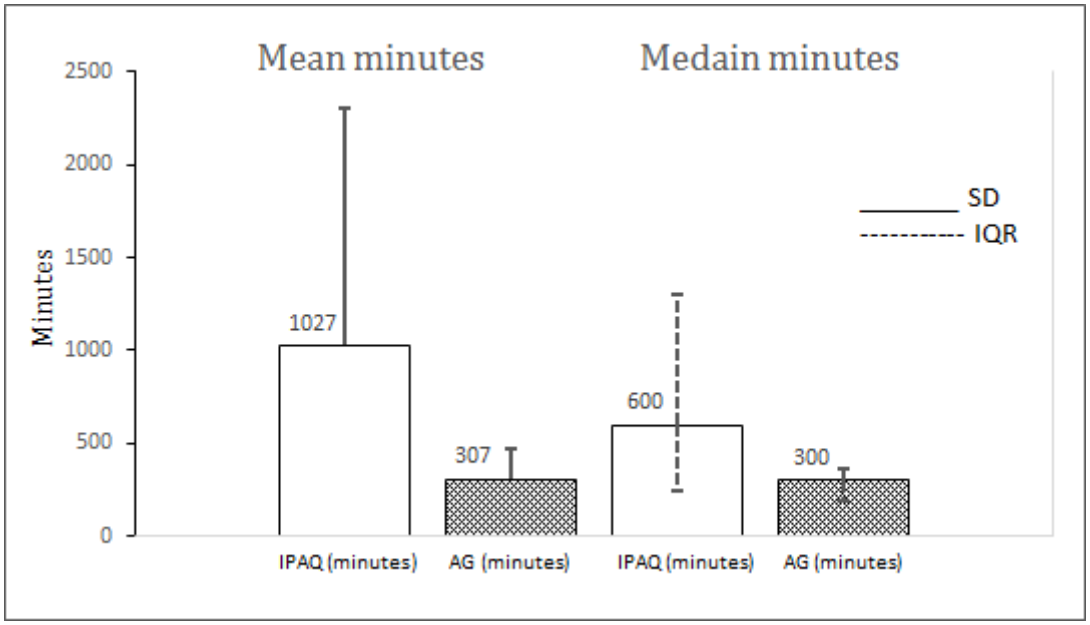

Figure 2. Physical Activity by Actigraph and IPAQ (mean and median weekly minutes)