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Daily Total Energy Expenditure Associated with Playing Pokémon Go.

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ABSTRACT

International Journal of Exercise Science 12(5): 1179-1186, 2019. Approximately 51% of American adults do not meet weekly physical activity (PA) recommendations. Pokémon Go (PoGo) popularity and its required PA participation shows potential for improved daily PA. The primary aim of this study was to objectively measure daily energy expenditure (DEE) of PoGo players and identify whether DEE differs from non-players. A secondary aim was to assess potential motivational factors to play PoGo. Local Middle Tennessee participants (n = 25) were identified as "players" or "non-players" based on current PoGo usage from August till November 2016. Participants donned a SenseWear Armband (SWA) for 7 days. SWA data were included in the analysis if wear time was ≥ 4 days with each day having ≥ 12 hours of wear time. Mean DEE differences between players and non-players were examined using a one-way between groups ANCOVA. Body weight was included in the ANCOVA as a potential extraneous variable. Five participants were excluded from analysis due to < 4 days SWA wear time (players = 9, non-players = 11). We found DEE was not significantly different for players (2735 ± 666 kcal) versus non-players (2274 ± 474 kcal), when controlling for body weight [F (1, 20) = 2,195, η = 0.114, p = 0.157]. In conclusion, interactive mobile games (i.e. PoGo) may be an effective method to increase DEE in individuals interested in mobile gaming.

KEY WORDS: Exergaming, physical activity, caloric expenditure

INTRODUCTION

Total energy expenditure (TEE) consists of a combination of an individual's basal metabolic rate, diet-induced thermogenesis, and energy expended during physical activities (19). Increasing TEE via physical activity (PA) provides protective health benefits from many chronic maladies such as cardiovascular disease, hypertension, type 2 diabetes mellitus, obesity, and colon cancer (11). Furthermore, a consensus statement by the American College of Sports Medicine (ACSM) suggests expending 1000 kilocalories (kcal) per week in PA is associated with as much as 30% reduction in all-cause mortality (11). Unfortunately, most adults are not expending enough energy to become eligible for many of these benefits (8, 18).

As of 2015, approximately 50.9% of American adults do not meet activity recommendations of achieving 150 minutes a week of moderate-intensity aerobic PA or 75 minutes a week of

vigorous-intensity aerobic PA or a combination of the two equivalent to 150 minutes a week (5). It has been suggested that among these individuals who are not regularly active, exercising less is not possible and cannot cause further rates of age-adjusted overweight/obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease (7). However, further deficiency of non-exercise activity (e.g. standing or walking) is capable of increasing due to occupational sitting and television viewing (7, 16). Thus, increasing TEE via enhanced leisure time physical activity (LTPA) or non-exercise activity thermogenesis (NEAT) is beneficial for sedentary individuals (13). Furthermore, a comprehensive review of NEAT suggests that reversing obesity can be obtained by increasing standing and ambulating time 2.5 hours per day. (14). For those who are sedentary, further novel approaches may be necessary to encourage better health (7). Such novel approaches include the use of smartphone applications to promote PA.

In recent years, smartphone interventions have focused on behavior change techniques and increasing awareness of health-related goals (4, 15). An alternative approach to promoting PA, via smartphone applications, is the development of interactive games requiring Global Positioning System (GPS) tracked walking and running. The most recent of these applications is Pokémon Go. This augmented reality game requires players to physically search real world locations while interacting with their smartphone screen. Mobile game applications requiring human ambulation, such as Pokémon Go, have led to increased PA levels of participants (2, 3, 9, 20). Of the studies assessing mobile applications, only one reported objective PA measurements among Pokémon Go players, showing increased step count during a 30 day period (2). Studies using subjective measures, such as surveys, also suggest increased PA among Pokémon Go players (3, 25).

When Pokémon Go was released, its popularity was well above other mobile gaming applications. Advocators for health recognize that Pokémon Go is capable of boosting PA outdoors as well as increasing social interactions (12). Given the global popularity of Pokémon Go and its potential for improving health benefits among active players, it is important to identify energy expenditure (EE) differences between those who play and do not play this application. The primary purpose of this study was to objectively measure daily EE of Pokémon Go players and identify whether differences in daily EE existed versus their non-player counterparts. A secondary purpose was to assess potential factors that motivate individuals to play Pokémon Go.

METHODS

Participants

A power analysis was not conducted prior to data collection. Following approval of the Institutional Review Board, 25 male and female participants were recruited locally via flyers, word of mouth, and social media. To be included in the study, participants were required to 1) be 18 to 55 years of age, 2) be capable of walking without mechanical limitations, and 3) have a smartphone with a data plan. Individuals who responded to recruitment efforts were scheduled for an initial visit.

Protocol

Upon arrival, participants completed an informed consent form followed by questionnaires assessing current Pokémon Go usage, PA level, and health risk classification (ACSM). Participants were identified as either "players" if they currently played Pokémon Go or "non-players" if they had not played Pokémon Go for the 2 weeks prior to participation. Non-players did not play Pokémon Go during the PA assessment while players continued to play.

After completing the forms and questionnaires, participants were asked to remain seated for a resting blood pressure assessment using an inflatable cuff and stethoscope. Two resting blood pressure measurements were taken. If the two readings were not within 4 mmHg, a third blood pressure assessment was completed 5 minutes later. Height and weight measures were then taken using a wall-mounted stadiometer and digital scale (Seca Scale Corp., Munich, Germany), respectively. Waist circumference was measured using a Gulick tape measure (Lafayette Instrument Co, Lafayette, IN) and obtained at the narrowest portion of the torso between the umbilicus and xiphoid process.

After completing the anthropometric measures, participants received a SenseWear Armband (SWA: BodyMedia, Inc., Pittsburgh, PA, USA) along with clear instructions for device wear. The SWA is a multisensor PA monitor worn over the right triceps muscle and has been validated to assess EE during free-living activity (10). The device enables continuous collection of various physiological and movement parameters through multiple sensors, including a triaxle accelerometer and sensors measuring heat flux, galvanic skin response, skin temperature, and near body ambient temperature. Data from these sensors are combined with sex, age, smoking status, weight, and height to estimate EE, PA intensity, and step count using algorithms developed by the manufacturer. All participants were encouraged to continue normal daily activity while wearing the accelerometer. After 7 days, participants returned the SWA and completed an additional set of questionnaires. In addition, players were also asked to rate their motivation for playing the game and being active using a 5 point Likert scale ranging from "no motivation" to "strong motivation".

Table 1. Participant characteristics.

	Players (n = 9)	Non-players (n = 11)
Age (yrs)	27.9 ± 6.6	25.7 ± 3.9
Weight (kg)	78.9 ± 16.0	73.0 ± 12.4
BMI (kg/m2)	27.7 ± 4.2	24.7 ± 3.7
Waist circumference (cm)	89.6 ± 11.2	81.1 ± 11.5
Blood pressure	125/82	118/76

Note: BMI: body mass index. All numbers are means ± standard deviations.

Statistical Analysis

When analyzing the SWA data, an inclusion criteria of at least 4 days of wear time for a minimum of 12 hours per day were used to ensure device reliability of reporting daily EE and time spent in light and moderate intensity PA (17). Mean differences in daily energy expenditure (DEE) between players and non-players were examined using a one-way between groups ANCOVA. A statistical difference of $p \leq 0.05$ was determined a priori. Body weight was included in the ANCOVA model to determine its effect as an extraneous variable. Group differences in

light and moderate intensity PA were examined using independent sample t-tests. All statistical analyses were performed using SPSS v. 23 software (IBM Corp., Armonk, NY). Frequency tables were created to examine questionnaire data for motivational factors among players. Thirteen players and 12 non-players participated in this study. Five participants were removed from the analysis because they had fewer than 4 days of wear time. This left 9 players (females = 4) and 11 non-players (females = 7) in the analysis (Table 1).

RESULTS

Daily EE was not significantly different between players and non-players when controlling for weight [F (1, 20) = 2,195, η = 0.114, p = 0.157] (Figure 1). There was not a significant difference in hours of light intensity [p = 0.232] or moderate intensity PA [p = 0.146] between groups (Table 2). Self-reported data for Pokémon Go playing frequency for the 9 players ranged between 1 to 20 times daily with most players (i.e. eight) reporting single session durations equivalent to or greater than 30 minutes.

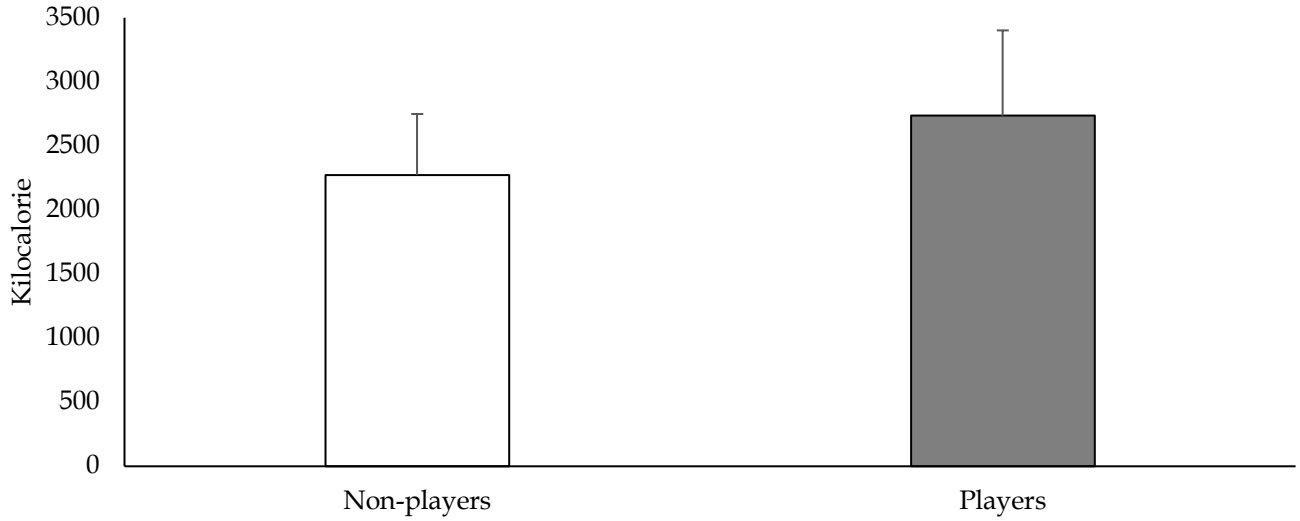

Figure 1. Average daily energy expenditure between Players and Non-players.

Table 2. Daily physical activity.

	Players	Non-players
Activity monitor		
Light (hrs)	6.0 ± 3.3	4.7 ± 1.3
Moderate (hrs)	2.2 ± 1.3	1.5 ± 0.7
Vigorous (hrs)	0.1 ± 0.2	0.1 ± 0.1
Step Count	11109.5 ± 3847.8	8473.8 ± 2901.8
Self-reported		
Moderate (min)	105.0 ± 97.3	62.7 ± 63.0
Vigorous (min)	42.8 ± 38.3	47.3 ± 28.5

Note: self-reported data was obtained during initial visit.

Questionnaire data for motivational factors (n = 8) were coded on a continuum from "No Motivation" = 1, "Moderate Motivation" = 3, to "Strong Motivation" = 5 (Table 3).

Table 3. Number of player motivational responses (n = 8)

Motivational factors for playing Pokémon Go	
Playing with friends	3.13 ± 1.46
Gathering Pokémon	2.38 ± 1.60
Gathering supplies at Pokéstops	4.25 ± 1.04
Creating stronger Pokémon	3.75 ± 1.39
Battling/leaving Pokémon at a gym	3.38 ± 1.30
Hatching an egg	3.00 ± 1.20
Gathering candy	4.13 ± 1.13
Gathering stardust	3.38 ± 0.92
Interest in Pokémon in general	3.25 ± 1.39
Playing with family	4.25 ± 1.04
Motivational factors for being active	
Playing with friends	3.00 ± 1.60
Gathering Pokémon	2.13 ± 1.55
Gathering supplies at Pokéstops	4.00 ± 1.41
Creating stronger Pokémon	3.88 ± 1.64
Battling/leaving Pokémon at a gym	2.88 ± 1.25
Hatching an egg	2.88 ± 1.55
Gathering candy	3.88 ± 1.46
Gathering stardust	2.75 ± 1.17
Interest in Pokémon in general	3.13 ± 1.46
Playing with family	3.75 ± 1.58

Notes: 1 = No motivation, 3 = moderate motivation, 5 = strong motivation

DISCUSSION

Pokémon Go interest and its required PA shows potential for interactive smartphone-based videogames to improve daily PA amongst users. Playing Pokémon Go is associated with increased PA, outdoor time, and social interaction but not without concern of potential injury, trespassing, or robbery (8). This study sought to accurately determine whether DEE differed between healthy Pokémon Go players ages 18 to 55 years and their healthy non-player counterparts during a 7-day time span. To the best of our knowledge, this is the first study to objectively measure DEE of both Pokémon Go players and non-players via valid accelerometry. This study found that Pokémon Go players did not exhibit a significantly greater amount of DEE compared to the non-playing control group (Figure 1). There was no significant difference between the amounts of light and moderate intensity PA between players and non-players (Table 2). Between both groups, all but two participants surpassed the minimum requirements of 150 minutes of weekly moderate intensity PA. In spite of the control group being physically active, there was a trend of greater energy expenditure for the individuals who played Pokémon Go. Furthermore, the active control group potentially led to a lack of statistical significance in the light and moderate intensity levels between groups.

According to the 2011 Compendium of Physical Activities, a 70-kg individual walking at 3.0 miles per hour (3.5 METs), as one might while playing Pokémon Go, for 30 minutes would expend approximately 122.5 kcal (70kg x 3.5 MET x 0.5 hr) (1). The same individual walking at 3.5 miles per hour for 2 hours would expend approximately 490 kilocalories. On average, DEE for Pokémon Go players was 461 kcal more than control, which is nearly 2 more hours of daily moderate intensity PA, according to the 2011 Compendium of Physical Activities (1). Although not statistically significant, the players in our study accumulated approximately 30 minutes more moderate intensity PA and approximately 90 minutes more light intensity PA per day than the control group (Table 2). Thus, if the players in our study accumulated the majority of their PA while playing Pokémon Go, then it is reasonable to suggest that "enjoyable" augmented reality games have great potential of increasing PA participation and DEE.

Recent studies using self-reported PA or mobile phone application data have found that Pokémon Go players exhibited substantial, but short term, increases in step count (2, 3, 9). Howe et al. (9) reported that within the first week of installing Pokémon Go, players were associated with an increase of 955 steps daily, but the amount of daily steps gradually returned to baseline after 6 weeks of participation. Althoff et al (2) reported that more strongly engaged players gradually decreased their number of daily steps, but to an amount greater than baseline (30 days later). These data suggest that players with a stronger interest in a game may regularly play while popular interest in the game fades. At the time of participation in the current study, all but one player had been playing the game longer than 6 weeks. While the participants' pre-Pokémon Go EE were not measured, these players, with sustained Pokémon Go participation, likely have increased daily EE compared to their baseline levels. If this is the case, continued player participation in active smartphone gaming may provide long-term health benefits. At the minimum, the data suggests that those continuing to play Pokémon Go (≥6 weeks) are capable of exhibiting beneficial levels of DEE.

A secondary interest was to assess potential factors that motivate individuals to play Pokémon Go. Playing with friends, gathering Pokémon, gathering supplies at Pokéstops, creating stronger Pokémon, battling/leaving Pokémon at a gym, hatching an egg, gathering candy, gathering stardust, and interest in Pokémon in general were each motivational factors for players to play Pokémon Go and to be active. Frequency data such as this may be important to identify specific motivational factors that can be targeted to help improve population PA participation. For instance, the data suggest that certain facets of Pokémon Go were motivational factors for players to be physically active, despite having played the game for more than 6 weeks. Thus, it seems important for future games to provide aspects pertinent to social bonding (playing with friends), rewarding achievements (catching Pokémon, hatching eggs, gathering supplies), and competitive elements (battling Pokémon).

There were some limitations to the current study. While all participates were instructed and encouraged to continue their normal daily routines, it is possible that wearing the PA monitor produced some reactivity in both the control and experimental groups. Furthermore, many participants were recruited to participate in a Pokémon Go study. Therefore, it is possible that

regular players may have increased their playing time and, therefore, their activity time during the measurement week.

CONCLUSION

This study showed that healthy adults playing Pokémon Go, a mobile game based on an augmented reality, do not expend greater amounts of DEE compared to active non-playing adults. To the best of our knowledge, this is the first study to objectively measure and report objective calorimetric data involving Pokémon Go. Interactive mobile games, such as Pokémon Go, may be an effective method to increase EE in individuals interested in mobile gaming.

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