CULTURA, CIENCIA Y DEPORTE

Accurate assessment of walking energy expenditure in the main seafront walking route of Las Palmas de Gran Canaria to promote health-related tourism

Evaluación precisa del gasto energético de la ruta peatonal del paseo marítimo de Las Palmas de Gran Canaria para promover el turismo relacionado con la salud

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Short title:
Assessment of walking energy expenditure at Las Canteras beach

How to cite this article:
Galván-Álvarez, M., Pérez-Suarez, I., Martín-Rincón, M., & Calbet, J.A.L. (2022). Accurate assessment of walking energy expenditure in the main seafront walking route of Las Palmas de Gran Canaria to promote health-related tourism. *Cultura, Ciencia y Deporte, 17*(54), 33-41. https://doi.org/10.12800/ccd.v17i54.1911

Received: 07 April 2022 / Accepted: 23 september 2022

Resumen

El objetivo de esta investigación fue determinar el gasto energético al caminar en la ruta peatonal más popular de Las Palmas de Gran Canaria. Se determinó la energía gastada en la ruta urbana principal a pie de Las Palmas de Gran Canaria (13 km en total, ida y vuelta) con un calorímetro indirecto portátil (COSMED K5) en 33 voluntarios de 21-69 años de edad (22 hombres y 11 mujeres). Se utilizó la geolocalización para determinar la velocidad de marcha (5.6 ± 0.5 y 5.2 ± 0.4 $km.h^{-1}$, para hombres y mujeres, P = 0.044) y el gasto energético exacto correspondiente a cada sector kilométrico y crear paneles informativos de interés para los caminantes para promover Turismo de salud. El gasto energético total (10.8 ± 1.0 y 10.4 ± 0.8 kcal.kg peso $corporal^{-1}$, respectivamente, P = 0.35) y las respuestas fisiológicas (frequencia cardíaca y variables respiratorias) durante las caminatas fueron similares en ambos sexos. El gasto energético y la contribución de la oxidación de grasas al gasto energético total aumentaron de forma similar con la distancia recorrida en ambos sexos. En conclusión, el gasto energético al caminar aumenta con la distancia recorrida y es similar para hombres y mujeres cuando se normaliza a la masa corporal total. La calorimetría indirecta portátil se puede utilizar para mapear con precisión el gasto de energía asociado con las rutas a pie para promover el turismo de salud.

Palabras clave: Ejercicio, obesidad, turismo de salud, actividad física.

Abstract

This investigation aimed to determine the energy expenditure incurred by males and females in the most popular walking route in Las Palmas de Gran Canaria using state-of-the-art methods. The energy expended in the main walking route of Las Palmas de Gran Canaria (13 km in total, round trip) was determined with a portable indirect calorimeter (COSMED K5) in thirty-three volunteers aged 21-69 yr (22 males and 11 females). Geolocalisation was used to determine the walking speed (5.6 ± 0.5 and 5.2 ± 0.4 $km.h^{-1}$, for males and females, p=0.044) and exact energy expenditure corresponding to each kilometric sector and create information panels of interest for walkers to promote health tourism. The total energy expenditure (10.8 ± 1.0 and 10.4 ± 0.8 kcal.kg body $weight^{-1}$, respectively, P = 0.35) and physiological responses (heart rate and respiratory variables) during the walks were similar in males and females. The energy expenditure and the contribution of fat oxidation to the overall energy expenditure increased similarly with the distance walked in both sexes. In conclusion, the energy expenditure for walking routes increased with the distance walked and is similar for males and females when normalized to whole-body mass. Portable indirect calorimetry can be used to accurately map the energy expenditure associated with walking routes to promote health tourism.

Keywords: Exercise, obesity, health-related tourism, physical activity.

Introduction

Vacation periods are associated with significant weight gains persisting over time (Cooper & Tokar, 2016; Yanovski et al., 2000). Therefore, tourists may be interested in burning calories to reduce their body fat or to compensate for some culinary excesses during the holidays could be keen on receiving some information regarding the amount of energy expended during the walks (Michimi & Wimberly, 2012) to adopt better-informed decisions regarding their calorie intake and plan their daily physical activity. However, no attempt has been made to quantify the energy required in specific walking routes, beyond the information provided by phone applications or distance covered, which depends on the terrain characteristics and the velocity of walking, among other factors (Looney et al., 2019a; Looney et al., 2019b; Pandolf et al., 1977). Moreover, general equations developed to estimate the energy cost of walking have mostly used indoor (treadmill) data, which underestimate by 2-18% the actual cost of walking observed outdoors on natural terrain (Fattorini et al., 2012).

Health-oriented tourism aims at improving or maintaining health (Ferrer et al., 2016) while enjoying some of the other benefits associated with touristic activity. For example, walking along coastal and marine destinations is appealing for many tourists (Carvache-Franco et al., 2020). This attractiveness may be even more significant when accompanied by additional values, such as clean and well-maintained blue waterfront (Garrett et al., 2019), areas for children's entertainment, stores and restaurants, and the possibility of combining urban and more natural areas in the walking route (Carvache-Franco et al., 2020; Hall & Ram, 2019; Ram & Hall, 2018). In addition, walking routes can be enhanced by adding touristic points of interest (Gomez-Martin, 2019; Worndl et al., 2017), as sightseeing points, informative panels with historical descriptions, and information regarding the surrounding nature.

Therefore, the primary aim of this research was to determine the total energy expenditure incurred by males and females in the walking route that extends along the urban beach of La Playa de Las Canteras (Las Palmas de Gran Canaria, Spain) and continues through the seafront to the wild neighbour beach of La Playa del Confital, ending in La Isleta natural park. Secondary aims were to determine whether the energy expenditure of walking increases with the duration of the walks and whether there are sex differences in the energy expenditure elicited by prolonged walks. This type of information can be incorporated in information panels to enhance the attractiveness of walking routed to promote health-related touristic activities.

Methods

Study design and participants

First, we defined a walking route extending along all the waterfront of la Playa de Las Canteras in Las Palmas de Gran Canaria, one of the city's main attractions. The beach has a wide walking avenue, with terraces, bars, restaurants, and numerous hotels and touristic apartments. In addition to the tourists residing nearby, the beach is often visited by tourists travelling from their residences in other areas of the Island of Gran Canaria as well as by travellers from the cruisers regularly visiting the city de Gran Canaria. The route has 6.5 km and extends from the Plaza de la Música, near the Auditorium Alfredo Kraus (28°07'46.3 "N 15°26'59.4 "W), along the length of the beach until La Puntilla and continues following the pedestrian street Blas de Lezo and the street Rodrigo de Manrique at the seafront, which leads to la Playa del Confital. The route extends all the length of La Playa del Confital, which is a protected wilderness area and finishes at the fence where a military area starts (28°09'58.6 "N 15°26'22.9 "W) (Fig. 1). Most of the route takes place on a flat pavement, while the last kilometre corresponds to a trail with some irregularities but high walkability (see Fig. 1 for more details regarding the altitude profile). Next, we determined accurately the amount of energy needed to complete a round trip in this route. The energy requirements may be influenced by the physical characteristics of the subjects and speed of walking (Ludlow & Weyand, 2017), and factors related to the features of the terrain (Pandolf et al., 1977). An accurate assessment of energy expenditure during prolonged outdoors activities has been a challenge until the developments of high-precision and accurate portable indirect calorimeters equipped with Global Positioning System (GPS), which allows precise geolocalisation and the assessment of the distance covered and the speed of walk. Therefore, we decided to use the most precise and accurate portable indirect calorimeter available for research purposes and recruited thirty-three volunteers of both sexes with different levels of assumed cardiometabolic fitness and a wide variation in the degree of adiposity and age, with volunteers ranging from lean to overweight and moderately obese, and from young to 69 years of age.

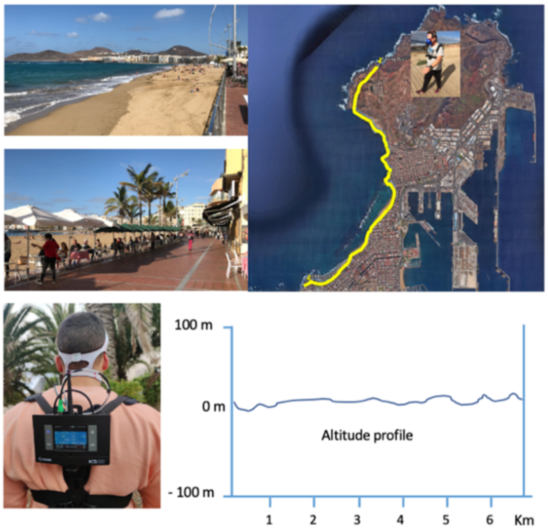

Figure 1. Some pictures of La Playa de Las Canteras walking route and the COSMED K5 device attached on the back of one of the volunteers

The route is marked in yellow, starting at the lowest part of the picture and ending in the upper part.

The study population was composed of fourteen physically active Sports Sciences students (11 male and 3 female) and nineteen sedentary volunteers with overweight or obesity (11 males and 8 females), as defined by a body mass index (BMI) ≥ 25, all of them residents in the Island of Gran Canaria. The general characteristics of males and females are reported in Table 1. Volunteers were accepted in the study under fulfilment of the following inclusion criteria: a) age from 18 to 70 years old; b) BMI > 19 $kg.m^{-2}$; c) no medical contraindications to exercise; d) smoking less than six cigarettes per day, and f) without joint or orthopaedic conditions that could limit their capacity to perform a lengthy walk lasting between 2-3 hours. The study was conducted by the Declaration of Helsinki after ethical approval (Hospital Universitario anonymised ethical committee reference number: 140187). Before giving their written consent, the volunteers received written and oral information regarding the study's purposes, risks, and benefits. In addition, participants were requested to avoid exercise other than their daily usual physical activity and to refrain from caffeinated, carbonated and alcohol- and taurine-containing beverages for the 48 hours preceding the measurements. All volunteers were non-smokers.

Table 1. Characteristics of the study population

	Males (n=22)					Females (n=11)					*p*-value
	Mean	±	SD	Range (min-max)		Mean	±	SD	Range (min-max)		
Age (years) *	33.8	±	12.5	20.9	68.5	39.0	±	10.9	24.9	55.7	.194
Weight (kg)	88.7	±	15.2	64.2	117.9	78.1	±	13.1	58.2	94.3	.060
Height (cm)	176.5	±	6.3	168.4	188.0	164.7	±	5.7	157.2	175.0	< .000
BMI ($kg.m^{-2}$) *	27.2	±	4.5	21.5	35.4	27.7	±	4.9	19.8	33.6	.779
Body fat (%)	26.6	±	8.8	11.8	41.3	38.7	±	8.7	23.1	50.7	< .001
Total lean mass (kg)	58.0	±	6.4	44.3	72.9	42.5	±	4.7	35.7	52.2	< .000
Total fat mass (kg)	23.5	±	11.0	8.7	43.7	29.8	±	10.5	12.9	45.0	.126

Analysis based on an unpaired two-tailed t-test.

***** Statistical analysis performed with logarithmically transformed variables.

BMI: body mass index; SD: standard deviation.

General procedures

Following a 12-h overnight fast, participants reported to the laboratory between 7:00 and 9:30 a.m. to assess their physical characteristics and body composition. First, their body height and mass were measured to the nearest 0.1 cm and 0.1 kg, respectively, while subjects wore light clothes and no shoes, using a balance scale (Seca, Hamburg, Germany) calibrated using certified calibration masses (class M1, Scheck, Germany). Subsequently, their body fat % and total lean body mass were assessed using a dual-energy X-ray absorptiometer (Lunar iDXA, General Electric, Wisconsin, USA) (Martin-Rincon et al., 2020).

On a different day, the energy expenditure during a round trip (13 km) extending the total distance of the walking route (6.5 km) was assessed between 7:00 and 14:00 after a 12-h overnight fast. For this purpose, the volunteers were equipped with a portable indirect calorimeter (COSMED K5, Rome, Italy) (Fig. 1). The portable indirect calorimeter measures oxygen uptake (VO_2), carbon dioxide production (VCO_2), respiratory exchange ratio, respiratory rate and pulmonary ventilation. This device also records environmental conditions (temperature and barometric pressure) and geolocalisation data (GPS). The environmental conditions were similar during the different walking days. The environmental temperatures ranging from 15 to 29 °C (mean ± SD: 22 ± 2 °C) with a low intra-day variation in temperature (in general less than 2-3 °C) while barometric pressures ranged between 756 to 771 mmHg (mean ± SD: 766 ± 3 mmHg). The accuracy and precision of the COSMED K5 were determined by comparison with a state-of-the-art stationary metabolic cart (Vyntus CPX, Jaeger-CareFusion, Hochberg, Germany) at exercise intensities eliciting a similar energy demand as that measured during walking (Perez-Suarez et al., 2018). The validity and reliability of the stationary Vyntus CPX were previously established using a butane combustion test and repeated measurements (Perez-Suarez et al., 2018). Before the tests, the COSMED K5 was warmed up for a minimum of 15 min and then calibrated with high-grade calibration gases provided by the manufacturers. The flowmeter, used to measure pulmonary ventilation, was calibrated with a 3 L calibration syringe, following the manufacturers' recommendations (COSMED, 2015). After calibration, the K5 was attached to the back of the subjects using a harness, and a face mask of appropriate size was carefully adjusted to avoid gas leaks. The reliability of the COSMED K5 was established in this same route by performing two measurements in fourteen volunteers separated by at least four days. The COSMED K5 was operated in the mixing chamber mode during the walks.

The walks were performed on non-raining days. Volunteers we asked to maintain a walking speed close to 5 $km.h^{-1}$. For this purpose, subjects were equipped with a heart rate strap (Garmin Forerunner 210, Garmin International Inc., Olathe, KS, USA) equipped with GPS connected to the K5. All volunteers were weighed immediately before and after walking (SECA 869, Hamburg, Germany) while wearing all equipment and clothes. The scale was calibrated with certified calibration masses of class M1. Participants were allowed to drink plain water *ad libitum* during the walks.

Calculation of the energy expenditure

Gas exchange data were averaged every 15 seconds and stored for further analysis. From the VO_2 and VCO_2 values, fat and carbohydrate oxidation rates and the energy expenditure were calculated using Peronnet and Massicotte tables (1991). These values were used to calculate the energy expenditure corresponding to each km interval and the entire round trip. Additional calculations were carried out adjusted for the bodyweight of the volunteers.

Statistical analysis

Data are reported as the mean (±SD) unless otherwise stated. Values were checked for normal distribution using the Shapiro-Wilks test. The BMI was determined as weight/ $height^2$. BMI and age were not normally distributed; therefore, these two variables were logarithmically transformed before further analyses. Student's t-tests for unpaired samples were run to determine between-sex differences in physical characteristics and overall energy expenditure. The impact of the distance covered on energy expenditure was determined with analysis of variance for repeated measures with one within-subjects factor (time, with 13 levels corresponding to each kilometre walked) and one between-subjects factor (sex, with two levels). The Mauchly's test of sphericity was run before the ANOVA. In the case of violation of the sphericity assumption, the degrees of freedom were adjusted according to the Huynh and Feldt correction. When a significant main effect or interaction was observed, specific pairwise comparisons were carried out with the Fisher's Least Significant Difference post-Hoc test. The statistical significance was accepted for .-values < 0.05. All statistical analyses were performed using IBM SPSS v.21.0 (IBM, New York, USA).

Results

The descriptive characteristics of the twenty-two males and eleven females that participated in the study are reported in Table 1. In addition, males and females had comparable age and BMI, while females had a greater body fat percentage than males. Males were taller and had a greater whole-body lean mass than females.

As shown in Table 2, the physiological responses were similar in males and females during the walks, as reflected by the heart rate and respiratory response, which were almost identical. Nevertheless, females walked at a marginally lower speed compared to males. Despite the marked differences in physical characteristics, the energy expenditure was similar in males and females (10.8 ± 1.0 and 10.4 ± 0.8 kcal.kg body $weight^{-1}$, respectively, p= .35). The total amount of carbohydrates and fats oxidized during the walks was similar in both sexes, after accounting for the differences in body mass (Table 2).

Table 2. Energy consumption and physiological responses to a round trip in La Playa de Las Canteras-Confital walking route (13 km)

	Men (n=22)					Women (n=11)					*p*-value
	Mean	±	SD	Range (min-max)		Mean	±	SD	Range (min-max)		
Walking velocity ($km.h^{-1}$)	5.6	±	0.5	4.8	6.4	5.2	±	0.4	4.6	5.7	.044
Stride cadence ($steps.min^{-1}$)	60.0	±	3.8	54.0	66.8	60.4	±	2.5	57.3	65.5	.517
Heart rate ($beats.min^{-1}$)	113.0	±	17.3	81.0	143.7	110.0	±	15.1	86.5	133.6	.627
Respiratory rate ($breaths.min^{-1}$)	29.5	±	6.9	20.4	50.1	28.3	±	5.0	22.4	37.0	.610
Total EE (kcal)	952	±	178	722	1400	810	±	119	572	959	.024
Total EE (kcal. kg body $mass^{-1}$)	10.8	±	1.0	9.1	12.9	10.4	±	0.8	9.1	11.6	.345
CHO burned (mg. kg body $mass^{-1}$)	1759	±	450	769	2581	1489	±	226	1218	2005	.072
Fat burned (mg. kg body $mass^{-1}$)	407	±	149	162	727	479	±	67	393	612	.065

EE: Energy expenditure; CHO: carbohydrates. Analysis based on two-tailed unpaired t-tests.

The amount of energy consumed after each km is reported in Table 3 and Fig. 2. Interestingly, the energy cost of walking increased with the distance covered ($p < .001$), being 9.2% higher in the first km sector during the return trip compared to that observed in this same sector at the start of the walk ($p < .001$). Likewise, the percentage of energy obtained from fat oxidation increased from 37.6 ± 14.8 to 55.1 ± 10.8 % from the first km to the same parkour in the return trip ($p < .001$).

Table 3. Energy consumption along the first 6 kilometers of La Playa de Las Canteras-Confital walking route at 5 km.h-1.

	Males body weight				
	60 kg	70 kg	80 kg	90 kg	100 kg
WAPI [a]	Energy expenditure in Kcal				
Km 1	45	52	60	67	75
Km 2	46	54	61	69	77
Km 3	47	55	63	70	78
Km 4	51	60	68	77	85
Km 5	53	61	70	79	88
Km 6	55	64	73	82	91
Total [a]	646	754	861	969	1077
Females body weight					
	50 kg	60 kg	70 kg	80 kg	90 kg
WAPI [a]	Energy expenditure in Kcal				
Km 1	37	37	37	37	37
Km 2	38	38	38	38	38
Km 3	38	38	38	38	38
Km 4	41	41	41	41	41
Km 5	41	41	41	41	41
Km 6	44	44	44	44	44
Total [a]	521	521	521	521	521

Data generated using the mean energy expenditure per kg of body weight recorded during the route for males and females, respectively.

WAPI: Walker's Point of Interest for walkers.
a Total: corresponds to the round trip (13 km).
Precise geolocalisation information available on request from the authors.

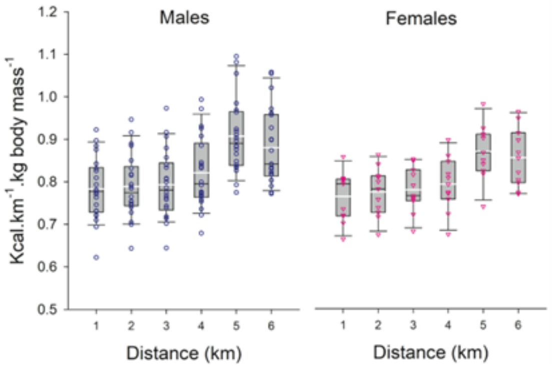

Figure 2. Mean energy expenditure in each km sector, after averaging the outgoing and the return trips for the first six kms.
Box and whisker plots and individual data for males (n = 22) and females (n = 11). The extremes of the whiskers represent the limits of the 5th and 95th percentiles, respectively; the white and black horizontal lines inside the boxes correspond to the mean and median values, respectively; and the lower and upper limits of the box delimit the 1st and 3rd quartiles, respectively. p = .345 for the difference between males and females (unpaired two-tailed t-test).

Discussion

This study shows that the energy expended during long outdoors walks is mostly determined by walkers' body weight and the distance covered for walking velocities

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ranging between 4.6 and 5.8 km.h^{-1} . These walking velocities elicit similar physiological responses and energy expenditure in males and females when adjusted for body weight.

Another aspect of interest is that we have demonstrated that the energy requirements increase slightly with the distance covered. Although this study is the first research to report such observation during prolonged walking, previous studies have seen a similar phenomenon in long-distance runners likely caused by mitochondrial respiration changes (Sahlin et al., 2010). Several published reviews on the mechanisms by which energy expenditure may be increased by prolonged exercise mention oxidative stress, hyperthermia and muscle damage. A detailed analysis of the physiological mechanisms explaining this response is beyond the scope of the present manuscript, and therefore the readers are addressed to several excellent reviews on this topic (Enoka, 2012; Nybo & Nielsen, 2001; Westerblad & Allen, 2011).

Although the energy expenditure of walking can be estimated using prediction equations or the Compendium of Physical Activities (Ainsworth et al., 2011), this may deviate from the actual energy expenditure, which depends in part on the duration of the walk and the characteristics of the terrain, as shown in the present investigation. For example, had we used the Compendium of Physical Activities (Ainsworth et al., 2011) we would have underestimated the actual energy expenditure of the whole route by 2.4 and 13% in males and females, respectively.

Accurate assessment of energy expenditure to promote health-related tourism

The touristic industry is greatly influenced by factors affecting lifestyle and health. Therefore, a continuous adaptation to the needs and wills of consumers is required to offer the best experience to visitors, including the possibility of satisfying their wish for a healthy lifestyle, in which physical activity is a central cornerstone. This entails applying evidence-based knowledge from related disciplines such as economy, sociology, psychology and health sciences to innovate (Darbellay & Stock, 2012). Here we have applied state-of-the-art techniques used in exercise physiology to measure the energy expenditure incurred during prolonged walks in the main walking avenue of one of the most relevant touristic destinations in Europe. We have also provided the stakeholders with information on how to carry out this type of assessment and provided a practical table (Table 3) with material that could be included in what we called "walker's points of interest " (WAPI) in specific information panels, mobile devices, apps, webpages or leaflets for tourists.

In a recent report, The European Travel Commission brings attention to the societal lifestyle trends that shape consumer attitudes, emphasising how "health tourism is expanding its purview to respond to the consumer's hunger for new ways to self-improve". This organisation postulates that health is a prominent issue in tourism, which encompasses travel-friendly concepts such as mental and emotional wellbeing, spiritual growth, adventure, and athleticism, among others (The European Travel Commission, 2016). A particular emphasis is placed on the fact that physical fitness is vital for a large part of the population and that weight and appearance management is a significant-top priority for the three Atlantic markets. Customers want to be healthy, but they also wish to look healthy (The European Travel Commission, 2016). Thus, tourism organisations should market destinations taking into consideration that destinations promoting a physically active lifestyle will be more appealing for most consumers, including the growing elderly population (Diekmann et al., 2020; Ferrer et al., 2016). Moreover, according to The European Travel Commission report, those clients more interested in travelling also confer high importance to their fitness (The European Travel Commission, 2016). Given the recommendations by the medical associations (Arnett et al., 2019; Powell et al., 2018) and the impact of social media messages regarding the importance of physical activity for health, growing demand for wellness offerings within the travel packages are expected in the coming years (Diekmann et al., 2020; Ferrer et al., 2016).

The reasons tourists decide to walk are very varied and encompass social and cultural aspects, a search for adventure, physical and mental health, wellbeing, contact with nature and wilderness, pilgrimage and spirituality, and others (Buckley, 2019, 2020; Carvache-Franco et al., 2020). Distinctive destination marketing can be achieved by creating routes for walkers and cyclists and adding energy expenditure values based on scientific evidence (Davies, 2018). For example, a trail including sightseeing points (Davies, 2018), some adventure (Bichler & Peters), blue spaces (Carvache-Franco et al., 2020; Garrett et al., 2019), nature-based wildlife observation points or areas (Carvache-Franco et al., 2020), architectural and historical attractions, accompanied by maps and short stickers-type messages may enhance the attractiveness and the possibility of creating a one-off experience. Here we have generated the information required to include in these WAPIs data on energy expenditure. These WAPIs could include a map of the route and some recommendations regarding walking velocity, hydration, and the number of calories burned depending on the distance covered (see Fig. 3, as an example). These WAPIs could use pre-existing points or new small panels, which could also have information with links to apps or QR codes, specifically developed to facilitate this information in several languages, if not included in leaflets at the hotels/resorts. In the case of Las Palmas de Gran Canaria, this would add to the great effort made to provide active alternatives to the city bus tours and promote urban routes profiting from pedestrianisation. During holidays, there is more tendency to walk and enjoy the culinary virtues of the destination. Increasing physical activity with some specific aims for energy expenditure would also allow the customers to feel less guilty regarding potential food excesses (Cohen & Avieli, 2004) to achieve a more satisfying holiday experience.

Figure 3. Representation of a Walker's Point of Interest with the information of the energy expenditure accumulated after the 1st, 2nd, 3rd and 4th km.

Conclusions

This investigation has shown that the energy expenditure of walking outdoors increases with the distance covered and is similar for males and females when normalized to whole-body mass, despite remarkable differences in body composition. Portable indirect calorimetry can be used to accurately map the energy expenditure associated with walking routes to promote health tourism. The information gathered can be used to create points of interest for walkers with accurate information regarding the energy expenditure corresponding to each km sector and recommendations for walking speeds.

Acknowledgments

This study was financed by a grant from ACIISI (ProID2017010106). The technical assistance of Jose Navarro de Tuero is much appreciated.

References

Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R., Jr., Tudor-Locke, C., Greer, J. L., Vezina, J., Whitt-Glover, M. C., & Leon, A. S. (2011). 2011 Compendium of Physical Activities: a second update of codes and MET values. *Medecine & Science in Sports & Exercise, 43*(8), 1575-1581. https://doi.org/10.1249/MSS.0b013e31821ece12

Arnett, D. K., Blumenthal, R. S., Albert, M. A., Buroker, A. B., Goldberger, Z. D., Hahn, E. J., Himmelfarb, C. D., Khera, A., Lloyd-Jones, D., McEvoy, J. W., Michos, E. D., Miedema, M. D., Munoz, D., Smith, S. C., Jr., Virani, S. S., Williams, K. A., Sr., Yeboah, J., & Ziaeian, B. (2019). 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation, 140*(11), e596-e646. https://doi.org/10.1161/CIR.0000000000000678

Bichler, B. F., & Peters, M. Soft adventure motivation: an exploratory study of hiking tourism [Article; Early Access]. *Tourism Review*, 16. https://doi.org/10.1108/tr-10-2019-0403

Buckley, R. C. (2019). Therapeutic mental health effects perceived by outdoor tourists: A large-scale, multi-decade, qualitative analysis. *Annals of Tourism Research,77*, 164-167. https://doi.org/10.1016/j.annals.2018.12.017

Buckley, R. C. (2020). Nature tourism and mental health: parks, happiness, and causation. *Journal of Sustainable Tourism, 28*(9), 1409-1424. https://doi.org/10.1080/09669582.2020.1742725

Carvache-Franco, M., Carvache-Franco, W., Carvache-Franco, O., & Hernandez-Lara, A. B. (2020). Analysis of Push and Pull Motivations and the Intentions to Return and Recommend a Coastal or Marine Destination. *Journal of Coastal Research, 36*(6), 1313-1322. https://doi.org/10.2112/jcoastres-d-20-00006.1

Cohen, E., & Avieli, N. (2004). Food in tourism - Attraction and impediment [Article]. *Annals of Tourism Research, 31*(4), 755-778. https://doi.org/10.1016/j.annals.2004.02.003

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Cooper, J. A., & Tokar, T. (2016). A prospective study on vacation weight gain in adults. *Physiology & Behavior, 156*, 43-47. https://doi.org/10.1016/j.physbeh.2015.12.028

COSMED. (2015). Calibration. In COSMED (Ed.), *K5 User manual* (I ed., pp. 45-47). COSMED Srl.

Darbellay, F., & Stock, M. (2012). Tourism as complex interdisciplinary research object. *Annals of Tourism Research, 39*(1), 441-458. https://doi.org/10.1016/j.annals.2011.07.002

Davies, N. (2018). Who walks, where and why? Practitioners' observations and perspectives on recreational walkers at UK tourist destinations. *Annals of Leisure Research, 21*(5), 553-574. https://doi.org/10.1080/11745398.2016.1250648

Diekmann, A., Vincent, M., & Bauthier, I. (2020). The holiday practices of seniors and their implications for social tourism: A Wallonian perspective [Article]. *Annals of Tourism Research, 85*, 13, Article 103096. https://doi.org/10.1016/j.annals.2020.103096

Enoka, R. M. (2012). Muscle fatigue--from motor units to clinical symptoms. *Journal of Biomechanics, 45*(3), 427-433. https://doi.org/S0021-9290(11)00741-X

Fattorini, L., Pittiglio, G., Federico, B., Pallicca, A., Bernardi, M., & Rodio, A. (2012). Workload comparison between hiking and indoor physical activity. *Journal of Strength and Conditioning Research, 26*(10), 2883-2889. https://doi.org/10.1519/JSC.0b013e318242a61e

Ferrer, J. G., Sanz, M. F., Ferrandis, E. D., McCabe, S., & Garcia, J. S. (2016). Social Tourism and Healthy Ageing [Article]. *International Journal of Tourism Research, 18*(4), 297-307. https://doi.org/10.1002/jtr.2048

Garrett, J. K., White, M. P., Huang, J., Ng, S., Hui, Z., Leung, C., Tse, L. A., Fung, F., Elliott, L. R., Depledge, M. H., & Wong, M. C. S. (2019). Urban blue space and health and wellbeing in Hong Kong: Results from a survey of older adults. *Health & Place, 55*, 100-110. https://doi.org/10.1016/j.healthplace.2018.11.003

Gomez-Martin, M. B. (2019). Hiking Tourism in Spain: Origins, Issues and Transformations. *Sustainability, 11*(13), Article 3619. https://doi.org/10.3390/su11133619

Hall, C. M., & Ram, Y. (2019). Measuring the relationship between tourism and walkability? Walk Score and English tourist attractions. *Journal of Sustainable Tourism,27*(2), 223-240. https://doi.org/10.1080/09669582.2017.1404607

Looney, D. P., Potter, A. W., Pryor, J. L., Bremner, P. E., Chalmers, C. R., McClung, H. L., Welles, A. P., & Santee, W. R. (2019a). Metabolic Costs of Standing and Walking in Healthy Military-Age Adults: A Meta-regression. *Medecine & Science in Sports & Exercise, 51*(2), 346-351. https://doi.org/10.1249/MSS.0000000000001779

Looney, D. P., Santee, W. R., Hansen, E. O., Bonventre, P. J., Chalmers, C. R., & Potter, A. W. (2019b). Estimating Energy Expenditure during Level, Uphill, and Downhill Walking. *Medecine & Science in Sports & Exercise, 51*(9), 1954-1960. https://doi.org/10.1249/MSS.0000000000002002

Ludlow, L. W., & Weyand, P. G. (2017). Walking economy is predictably determined by speed, grade, and gravitational load. *Journal of Applied Physiology, 123*(5), 1288-1302. https://doi.org/10.1152/japplphysiol.00504.2017

Martin-Rincon, M., Perez-Valera, M., Morales-Alamo, D., Perez-Suarez, I., Dorado, C., Gonzalez-Henriquez, J. J., Juan-Habib, J. W., Quintana-Garcia, C., Galvan-Alvarez, V., Pedrianes-Martin, P. B., Acosta, C., Curtelin, D., Calbet, J. A. L., & de Pablos-Velasco, P. (2020). Resting Energy Expenditure and Body Composition in Overweight Men and Women Living in a Temperate Climate. *Journal of Clinical Medecine, 9*(203), 1-20. https://doi.org/10.3390/jcm9010203

Michimi, A., & Wimberly, M. C. (2012). Natural Environments, Obesity, and Physical Activity in Nonmetropolitan Areas of the United States [Article]. *Journal of Rural Health, 28*(4), 398-407. https://doi.org/10.1111/j.1748-0361.2012.00413.x

Nybo, L., & Nielsen, B. (2001). Hyperthermia and central fatigue during prolonged exercise in humans. *Journal of Applied Physiology, 91*(3), 1055-1060. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11509498

Pandolf, K. B., Givoni, B., & Goldman, R. F. (1977). Predicting energy expenditure with loads while standing or walking very slowly. *Journal of Applied Physiology,43*(4), 577-581. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=908672

Perez-Suarez, I., Martin-Rincon, M., Gonzalez-Henriquez, J. J., Fezzardi, C., Perez-Regalado, S., Galvan-Alvarez, V., Juan-Habib, J. W., Morales-Alamo, D., & Calbet, J. A. L. (2018). Accuracy and Precision of the COSMED K5 Portable Analyser. *Frontiers in Physiology, 9*, 1764. https://doi.org/10.3389/fphys.2018.01764

Peronnet, F., & Massicotte, D. (1991). Table of nonprotein respiratory quotient: an update. *Canadian Journal of Sport Sciences, 16*(1), 23-29.

Powell, K. E., King, A. C., Buchner, D. M., Campbell, W. W., DiPietro, L., Erickson, K. I., Hillman, C. H., Jakicic, J. M., Janz, K. F., Katzmarzyk, P. T., Kraus, W. E., Macko, R. F., Marquez, D. X., McTiernan, A., Pate, R. R., Pescatello, L. S., & Whitt-Glover, M. C. (2018). The Scientific Foundation for the Physical Activity Guidelines for Americans, 2nd Edition. *Journal of Physical Activity and Health*, 1-11. https://doi.org/10.1123/jpah.2018-0618

Ram, Y., & Hall, C. M. (2018). Walk Score and tourist accommodation. *International Journal of Tourism Cities, 4*(3), 369-375. https://doi.org/10.1108/ijtc-11-2017-0066

Sahlin, K., Shabalina, I. G., Mattsson, C. M., Bakkman, L., Fernstrom, M., Rozhdestvenskaya, Z., Enqvist, J. K., Nedergaard, J., Ekblom, B., & Tonkonogi, M. (2010). Ultraendurance exercise increases the production of reactive oxygen species in isolated mitochondria from human skeletal muscle. *Journal of Applied Physiology, 108*(4), 780-787. https://doi.org/10.1152/japplphysiol.00966.2009

The European Travel Commission. (2016). *Lifestyle Trends and Tourism. How Changing Consumer Behaviour Impacts Travel to Europe*. Brussels, Belgium: European Travel Commission

Westerblad, H., & Allen, D. G. (2011). Emerging roles of ROS/RNS in muscle function and fatigue. *Antioxidants and Redox Signaling, 15*(9), 2487-2499. https://doi.org/10.1089/ars.2011.3909

Worndl, W., Hefele, A., & Herzog, D. (2017). Recommending a sequence of interesting places for tourist trips. *Information Technology & Tourism, 17*(1), 31-54. https://doi.org/10.1007/s40558-017-0076-5

Yanovski, J. A., Yanovski, S. Z., Sovik, K. N., Nguyen, T. T., O'Neil, P. M., & Sebring, N. G. (2000). A prospective study of holiday weight gain. *New England Journal of Medicine, 342*(12), 861-867. https://doi.org/10.1056/NEJM200003233421206