

# ARC '16

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## Health and Biomedical Pillar

<http://dx.doi.org/10.5339/qfarc.2016.HBPP2473>

### Characteristics of Preferred Walking Patterns in Young Qatari Adults

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#### Background and Objectives

Walking is the most natural and important activity of daily living as it refers to the primary type of terrestrial human locomotion. Analyses of gait patterns typically examine the speed and manner in which people prefer to walk. Even though humans can walk at speeds ranging from near 0 km/h to 9 km/h, they typically only use a very limited range of speeds around 4.5 km/h in their daily life (Bohannon & Andrews, 2011). The preferred walking speed (PWS) is used in clinical settings as an indicator of a person's mobility. For example, elderly people, or those suffering from osteoarthritis prefer to walk at slower speeds. Therefore, improving their PWS is considered as a significant clinical goal.

Many studies on gait analysis tried to identify the basic parameters of normal unconstrained gait in different populations. Despite the fundamental common shared characteristics, walking patterns may vary from a person to another according to several factors such as age, gender, physical characteristics, etc. In a study examining the "pace" of random pedestrians in 31 cities around the world, differences in the walking speed were found to be linked to parameters such as climate, economic variables, size of population and cities (Levine & Norenzayan, 1999). More recently, a study has put forward the impact of the cultural background on walking norms by revealing several significant differences in basic gait parameters between young Kuwaiti and Swedish adults (Al-Obaidi et al., 2003). Specifically, the authors presented the first evidence concerning walking patterns in a population from the Gulf region and proposed an interpretation to the found differences that is linked to traditional clothing and foot wear. This reveals the need for a specific normative database targeting healthy young Qataris. Creating such databases for Qatar is desirable for rehabilitation purposes for people with impaired walking patterns (e.g., elderly fallers, people suffering from stroke consequences, hemiplegia, Parkinson disease, etc).

**Cite this article as:** Majed L, Bouhsine R, Ghazi W, Elhams M, Riahi MA, Yazdandoost M, Hansen C, Kneffel Z. (2016). Characteristics of Preferred Walking Patterns in Young Qatari Adults. Qatar Foundation Annual Research Conference Proceedings 2016: HBPP2473 <http://dx.doi.org/10.5339/qfarc.2016.HBPP2473>.

For instance, the aim of this study is to evaluate the preferred walking speed and manners in which young male and female Qatari adults walk as compared to non-Qatari participants with similar physical characteristics. To characterize walking patterns we used spatiotemporal kinematic indicators such as stride length, stride frequency and support phase duration. The associated physiological cost and perceived exertion of walking at a preferred pace will also be examined to test for possible differences. We expect to see differences between the preferred walking patterns of Qatari and non-Qatari participants as proposed by Al-Obaidi and collaborators (2003).

## Methods

34 healthy volunteers participated in the experiment and were distributed in four groups according to their gender and ethnic cultural background (wearing cultural clothing or not): 9 Qatari females ( $21.33 \pm 2.11$  years), 9 Qatari males ( $24.00 \pm 2.40$  years), 9 non-Qatari females ( $22.00 \pm 1.49$  years) and 7 non-Qatari males ( $22.83 \pm 1.73$  years). Participants were asked to perform two sessions on the same visit with a total duration of 1.5 hours. The first session started after 10 minutes of familiarization and warm-up on a medical treadmill (Lode Valiant, the Netherlands) and consisted of a determination test of the preferred walking speed (PWS) using a standardized protocol (Jordan, Challis, and Newell, 2007). In the second session, participants walked at their PWS for three minutes. Using a gas analyzer (Metalyzer 3B, Cortex, Germany) and a synchronized heart rate monitor (Polar, Finland), the relative oxygen uptake ( $\text{VO}_2$ ,  $\text{mlO}_2/\text{kg}/\text{min}$ ) and heart rate (HR, beats/min) were collected at the last minute when a steady state was reached and the metabolic cost of transport (MCT,  $\text{mlO}_2/\text{kg}/\text{km}$ ) was computed according to the individual PWS. Furthermore, the rating of perceived exertion (RPE) was collected using the Borg Scale (6–20). Spatiotemporal kinematic data such as stride length (SL, cm/stride), stride frequency (strides/sec) and contact phase duration within a stride (Contact, sec) were computed using a video analysis and modeling tool (tracker 4.91) from 15 strides filmed in the middle of the three-minute trial at PWS with a sampling frequency of 25 Hz. Using independent t-tests, comparisons were made for Qatari men versus non-Qatari men and for Qatari women versus non-Qatari women for each of the eight variables. All statistical analyses were performed in Statistica 7.1 package with a level of significance set at  $p < .05$ .

## Results

No significant differences were found in the physical characteristics (i.e., body height and body weight) between Qatari male and non-Qatari male groups or between Qatari female and non-Qatari female groups (Table 1). This validates the fair investigation of differences in other variables. As shown in Table 1, no significant differences in all tested variables were noted between Qatari and non-Qatari female participants. However, results revealed a significantly lower PWS and CPD for Qatari males compared to non-Qatari males (Table 1). Furthermore, Qatari males had a significantly lower SF compared to non-Qatari male participants (Table 1). All other tested variables were non-significantly different between Qatari and non-Qatari male groups.

## Conclusions

Our results showed significant differences in the preferred walking patterns between Qatari and non-Qatari as expected. Surprisingly, these differences only concerned male groups while female groups exhibited non-significant differences in the speed or the manner in which they preferred to walk. Specifically, the slower walking pattern of Qatari male participants doesn't seem to be explained by any of the tested physiological (metabolic) or perceptual factors. Spatiotemporal parameters however seemed to be better candidates in explaining the discrepancy in the preferred walking speed. Results on stride characteristics indicate that the time required to perform one stride and the time where the foot is in contact with the ground (within one stride) was significantly longer for Qatari male participants compared to non-Qataris in the same gender group. Although all participants were wearing their sports outfits during the experiment, results could be interpreted as long-term adaptations in gait patterns to wearing traditional clothing and/or footwear. Indeed, male (i.e., thobe) and female (i.e., abaya) cultural clothing in Qatar are not similar in their structure and material which might explain why differences were only found in male and not female volunteers. This interpretation was also proposed in a previous study on

Kuwaitis walking patterns (Al-Obaidi et al., 2003) that suggested a need to include diverse cultural background when developing databases on normal walking for different ethnic groups. Further investigations would be needed to create a larger database with a bigger sample and extend the findings of this pilot study.

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