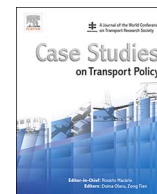




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## Temporal variation in walking behavior: An empirical study

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## ARTICLE INFO

## Keywords:

Walkability  
Outdoor activities  
Physical activities  
Seasonal variation

## ABSTRACT

This study provides a baseline for understanding the variation in walking behavior with respect to seasonal conditions in a hot weather country in the Arabian Gulf region. A busy neighborhood with different land-use patterns in Qatar was observed for the different seasons during the year. Pedestrians' demographics and walking characteristics were determined and compared across the different seasons. A spatial distribution method was used to analyze and display the distribution of the pedestrian in the neighborhood. A majority of middle-age men were observed walking in the streets of the studied neighborhood. Limited female, old, and young pedestrians were observed. The different seasons highly affected the pedestrian volumes and various walking activities. The summer season showed the lowest pedestrian volumes, and the winter showed the highest. This study highlights the need for different strategies to be adopted throughout the year to promote walking in this region, especially during the summer season. Special strategies should target the female, old, and youth population.

## 1. Introduction

Qatar, a country within the Arabian Gulf region, is rapidly urbanizing with significant changes in its residents living standards, lifestyles, social behavior, and health. Doha, the state's capital, is growing exponentially leaving Doha's downtown heavily congested (Shaaban and Radwan, 2014; Khalil and Shaaban, 2012). People are not using the public transportation within the city and are becoming more car dependent than ever (Shaaban and Kim, 2016a; Shaaban and Hassan, 2014a). "Much of the city is devoid of sidewalks, bicycle lanes and tree-filled areas closed to automobile traffic. People are surrounded by buildings and, at peak times, congested roadways. To continue Doha's expansion without incorporating greenery and open spaces would increase Qatar's sustainability challenges" (Anon, 2011).

These existing conditions within the city caused significant health problems among its residents. In 2012, a study conducted by the Supreme Council of Health on 2500 Qataris between 18 and 64 years old found that most of the adults in Qatar get little physical activity and 70% of them are considered overweight (41.4% of them are considered obese). This situation increases the risk of getting diseases like diabetes, high blood pressure, and heart disease (Anon, 2012). Another alarming study by the International Association for the Study of Obesity has ranked Qatar at sixth position globally for the prevalence of obesity (Slackman, 2010). Health experts consider these results shocking and call for an urgent lifestyle change, including a major increase in the

physical activity among the population to alleviate this problem.

When it comes to Doha, it is a challenge and barrier to make people walk, jog, and/or bike inside their communities, especially during summer time when the weather is scorching sunny and sometimes the dusty winds make the conditions worse. However, in several months during the year, the weather is acceptable for outside physical activities. Over the course of the year, the temperature typically varies from 12 °C to 41 °C and is rarely below 11 °C or above 45 °C (Cedar\_Lake\_Ventures\_Inc, 2017).

In the past, many studies showed that the way existing residential neighborhoods are built affects the physical activity of residents in general (Richardson et al., 2012; Council, 2005; Van Dyck et al., 2013; Wei et al., 2010; Forsyth et al., 2009; Shigematsu et al., 2009). Healthy community design is one of the solutions introduced to improve the welfare of people and communities by creating more convenient, equitable, healthy, efficient, and attractive places for the residents (Dannenberg et al., 2003; Forsyth and Krizek, 2010). Several attempts were made to study various aspects of walking. In Sweden, a postal questionnaire survey was used to capture individuals' walking behaviors and their attitudes about walking and characteristics of the built environment (Lindelöw et al., 2014; Livi and Clifton, 2004).

In the city of Leeds in the United Kingdom, a computer-based tool was developed using stated preference surveys to determine the relative values of a range of factors in the pedestrian environment; an on-street survey to investigate values and attitudes towards different attributes of

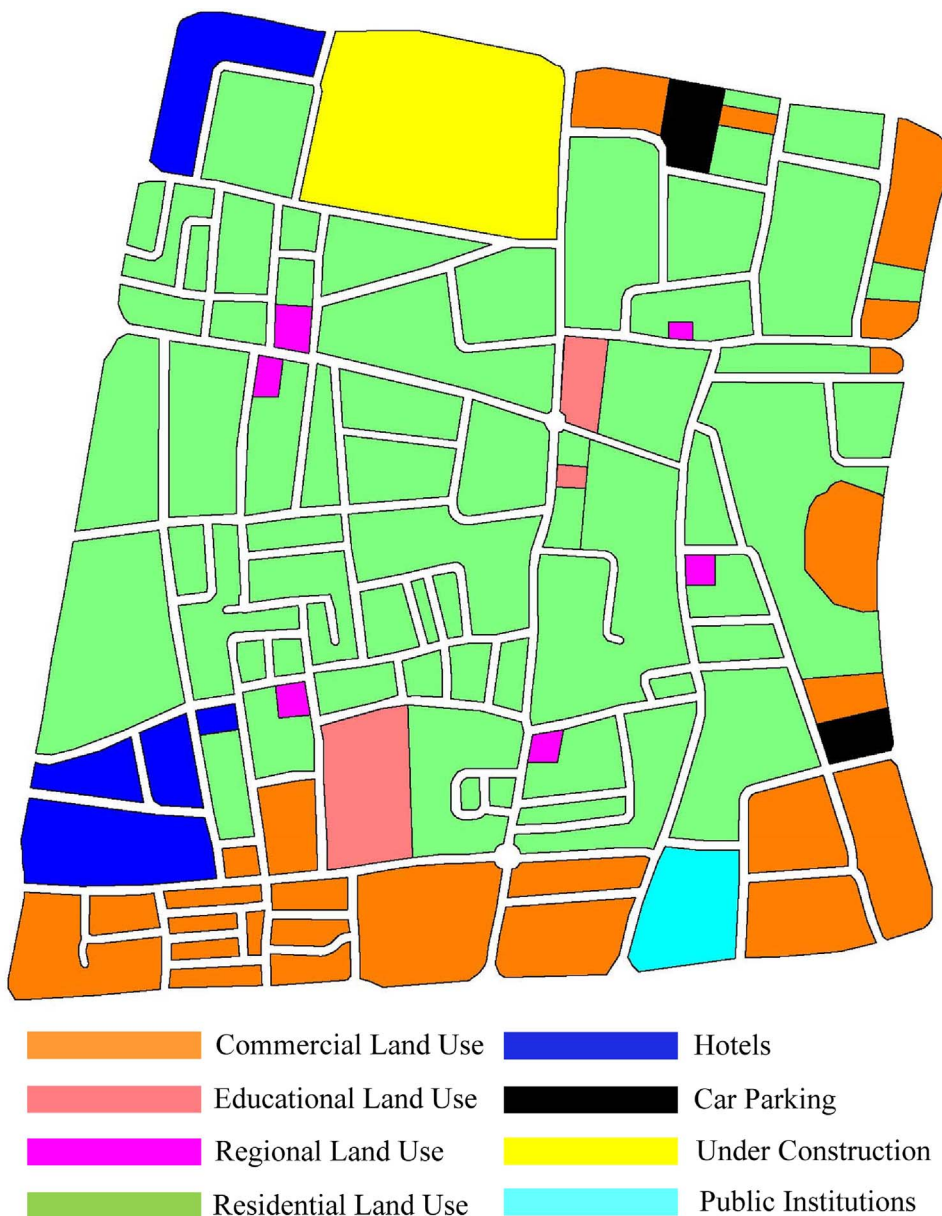
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Received 18 December 2015; Received in revised form 17 June 2017; Accepted 12 July 2017

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Fig. 1. Land Use Distribution of the Studied Neighborhood.



the pedestrian environment along a route; and finally an ‘on the move survey’ was conducted to get an actual account of their experiences as they walk (Kelly et al., 2011). Recently, the influence of social and built environment features on children walking to school was studied in Toronto, Canada (Rothman et al., 2014). An observational study was conducted, by tracking individual walking trips, for three residential areas in Stockholm to investigate the different types of walking activities and how they interact with the built environment (Choi, 2014).

A combined survey questionnaire and walkability audit to gauge the perception of the urban walking environment indicated that the proximity of destinations, good weather condition, safety and well-designed pedestrian facilities can significantly contribute to better perceptions of the walking environment (Ariffin and Zahari, 2013). A study investigated the association between walking and different environmental attributes including weather, aesthetics, safety, and accessibility using mail-out survey. The study showed that weather had the strongest association with walking for both male and female out of four environmental attributes (Humpel et al., 2004).

Weather significantly affects physical activity in a variety of populations (Chan and Ryan, 2009). Three weather sensitive models were used to explore the relationship between weather and home-based work

trips within the City of Toronto, focusing on active modes of transportation for non-captive commuters. Overall, the results confirmed that the impact of weather on active modes of transportation is significant enough to deserve attention in the research, data collection, and planning levels (Saneinejad et al., 2012).

A mail-out questionnaire survey was used to identify the barriers to walking and cycling in the cold climate community in Michigan to indicate that snow and lack of infrastructure as the greatest barriers (Westphal et al., 2012). In another study, the association of the temperature and precipitation on the walking of retired Americans was studied using a mail survey. The findings showed that the precipitation was not significantly associated with walking behavior while higher temperatures were associated with a higher probability of walking for females but have the opposite effect for males (Dunn et al., 2012). The results from past studies confirmed that precipitation has the largest correlation with physical activity. This correlation is negative, but snow may increase physical activity in men (Chan and Ryan, 2009).

The main limitation for most survey-based analysis is the fact that some respondents might be reluctant to provide truthful answers due to the pressure of providing a more socially acceptable answer. However, observational surveys give actual details reducing all errors and biases.

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