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Investigation of weather impacts on pedestrian volumes

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Abstract

This study investigates the impacts of temporal and weather characteristics on pedestrian volumes in a hot climate condition. A major neighborhood located in an urban area in Doha, Qatar was chosen as a case study site. The pedestrian volume data was gathered for three seasons, two days in each season, and three time periods for each day using observations from video recordings for the entire neighborhood. Overall, low pedestrian activity was noticed for all seasons. Pedestrians walked more during the weekday in the winter season, and during the weekend in the summer and spring seasons. Generally, the pedestrian volume was higher during the evening time. The results of a multiple linear regression analysis showed that the pedestrian volume had a log-linear relationship with the weather characteristics. The temperature was the only significant parameters affecting the pedestrian volume. This research is one of the first to study the effect of weather conditions on the pedestrian volumes in a hot weather climate environment.

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Keywords: walking; pedestrian volume; weather impact; temporal impact; observational survey

1. Introduction

Walking is an important physical activity suitable for all age groups irrespective of their physical conditions. Some studies indicated that the weather has a significant impact on pedestrian walking behavior (Westphal, 2012;

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Chan and Ryan, 2009). However, little is known about the effect of weather conditions on the walking behavior and specifically about the pedestrian volumes. Pedestrian volumes are not studied widely due to the difficulty involved in collecting reliable data. In addition, no study has assessed the weather impact on pedestrian volumes for extreme hot climate conditions. The main objective of this paper is to study the variation in pedestrian volumes for different times of the day, type of day, and seasons for a hot climate region for an entire neighborhood and further explore the relationship between pedestrian volume and weather characteristics. For the purpose of this study, pedestrian volume denotes the number of people seen on the streets walking or performing any outdoor physical activity.

2. Background

Due to lack of studies on the pedestrian volumes and weather conditions; studies related to transit ridership and bicycle counts also mentioned as they involve some walking and outdoor physical activity. Recently, two studies analyzed the variation in transit ridership with weather to find that the number of trips was reduced due to rain and wind, and increased with the rise in temperature in Spain (Arana et al., 2014) and non-commuter trips with time flexibility were highly affected by weather activity than fixed time commuter trips (Singhal et al., 2014). Also, bicycle counts studied by Nosal and Miranda-Moreno (2013) for urban cycle facilities in various cities, indicated that non-linear relationship existed between temperature and relative humidity with positive and negative trends respectively for hourly and daily bicycle counts. Rain also showed significant negative impact which increased with increase in the rain intensity.

Suminski et al. (2008) investigated the association between physical activity and meteorological conditions by studying activities on sidewalks, streets, and outdoor oval tracks. The counts of people performing various activities were made through observations. A group of twelve census blocks was selected from an urban area in Columbus, Ohio. Hourly meteorological data were obtained from the local airport. Descriptive statistics, student t-tests, Pearson Product Moment Correlation coefficients were determined, and multiple linear regression models were developed. The temperature was found to have a positive relation with the number of users using the track, but no relation was found with the number of users on sidewalk and streets. More users were seen on the sidewalks, streets, and tracks on the weekdays compared to the weekends. Further, the meteorological conditions were found to be related with physical activities undertaken on the weekdays but were not related to activities performed on the weekends. Overall, in an open air setting, a significant relationship existed between the physical activity and environmental factors.

Aultman-Hall et al. (2009) merged the automated pedestrian counts and weather reports for a single location at the Montpelier Vermont downtown for an entire year to study the effect of weather variability on pedestrian volumes using linear regression method. Four weather parameters, temperature, depth of precipitation, relative humidity, and wind were considered for analysis. The results showed that weather and season affected the pedestrian volumes. The precipitation reduced the average hourly volume of pedestrians by about 13% while winter months reduced the volumes by 16%. The weather was found to have a maximum variation of 30% in hourly pedestrian volumes.

Attaset et al. (2010) evaluated the effect of weather (temperature, precipitation, wind, and cloud cover) on the pedestrian volumes using linear regression analysis. The hourly pedestrian data was collected from thirteen sidewalk locations in Alameda County, California for a year with the help of automatic counters, and weather data was obtained from nearby weather stations. The results showed that precipitation had the largest effect on the pedestrian volume with 35% to 56% reduction in pedestrian volume; the effect was more on weekends. The cloud cover, higher winds, hot and cold temperatures reduced the pedestrian volumes. Relative humidity and dew point did not have a significant impact on the pedestrian volumes.

Kim and Yamashita (2011) investigated the relationship between built environment characteristics, such as landscaping, cleanliness, amenities such as curb ramps and seating, shade, street furniture condition, paving materials quality, sidewalk continuity, and environmental quality, such as odors and noise, and other elements such as presence of hawkers, solicitors, and vendors for a tourist destination Waikiki in Honolulu, Hawaii. The data was collected for 87 sidewalk segments using hand counting devices for two years. Descriptive statistics, correlation coefficients and General Linear Modeling (GLM) technique was used to assess the relationship between pedestrian volume and various variables. The volume of pedestrians was varying greatly with seasonal, temporal, and weather