THE IMPACT OF WEATHER CHANGES TO PEDESTRIAN RAIL COMMUTERS: AN OVERVIEW

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Abstract
Purpose - Residential site within 5 – 10 minutes walking distance from the rail station encourages higher pedestrian commuters to use the public transport. Studies have shown that the demand to use the rail system particularly for the rail pedestrian commuters were influenced not only by the physical environment of the walkways but also vulnerable to the changes in weather condition. The paper attempts to understand the impact of weather condition to the level of rail ridership. Secondly, the paper looks at the possible solutions to encourage rail pedestrian commuters to continue using the public transport even during high temperature and heavy rainfall.
Methodology - The paper analyses the previous literatures which emphasis on the weather elements that affect walking for transport.
Findings - Findings from the literature demonstrated mix results due to different topography and location where the study were being carried out. Daily temperature and unpredictable rainfall affect the pedestrian rail commuters on their travel decision.
Research Limitation - Literatures have shown that weather changes influenced the level of walking. Yet, there is still scarce of data that associates weather effects with the demand for walking to the rail system.
Practical implication - The paper facilitates the transport policy maker and planners in understanding how weather elements influenced pedestrian to access transit station and the effect to rail ridership and public transport modal share.
Originality - This paper addresses the problems on the affect of weather towards pedestrian rail commuter access public transport station experiencing hot and humid condition.
Keywords Weather, pedestrian rail commuter
Paper type Concept paper

Introduction

Rail transportation has been proven in its ability to transport passengers in high volume in one time. The efficiency of rail transport system is also able to overcome the current phenomenon of urban traffic problems and very effective to reduce the number of vehicles on the road especially during peak hours. The current trend in rail transportation is experiencing a decreasing in its modal share as the usage of private vehicles is increasing. The lack of public transport facilities, poor integration system, unpunctuality of services, and poor accessibility had hindered the public transport users and thus, motivates the usage of private transportations. Therefore, in an attempt to increase the modal share of rail based public transport, it is pertinent to increase the accessibility especially to the people who lives within 400 metres around the station.

It has been noted that the most practical mode to access transit station that involve short distance is by walking. Findings from previous study by Hamid (2009) in evaluating the park and ride system in Kuala Lumpur has demonstrated that more than 80 percent of the rail commuters walk to the train stations. Most journey to and from rail based public transport involve walking (Rietveld, 2000), but the importance of the mode of transport is always underestimated and seldom be planned pro actively (Semler and Hale, 2010). Findings from the literature reported that improvement in physical environment such as distance, sidewalk, street connectivity, station facilities and increase of safety will encourage users to walk from home to the transit station.

Nevertheless, the natural environmental factor – bad weather has been stated as one of factors that deterred rail transit ridership (Stover and McCormack, 2012). According to Hall *et al.* (2009) weather and season are factors that affect pedestrians in some level of degree.

Studies that investigate the effects of weather or climate change on rail transport and infrastructure are scarce. Research on the effect of weather on transit ridership is receiving more attention but there are still rare studies performed to discuss the effect of weather especially to the pedestrian rail commuters.
Measuring the impact of weather will allow planners and managers to consider the weather as a factor to lengthen the pedestrian transportation and take steps to encourage walking during bad weather (Hall *et al.*, 2009).
Tucker and Gilliland (2007), defined weather as refer to meteorological conditions, such as temperature, wind, clouds and precipitation. According to Nankervis (1997), weather is defined by rainfall and climate variable refers to temperature and precipitation.
Guo *et al.*, (2007) studied the impact of 5 weather elements – temperature, rain, snow, wind and fog on daily bus and train ridership. McGuinn *et al.* (2007) studies weather elements – temperatures, dew point, standard pressure, wind speed and precipitation.
Zhou (2011) on the other hand, has categorised cold days when the temperature is less than 60F and warm days if the temperature more than 60F. Whereas Cools *et al.* (2009) refer the temperature below 0^{o}C or 32^{o}F as cold and warm temperature is above 28^{o}C or 82.4^{o}F.

Methods
This study intends to adopt a fully quantitative approach with observations and dissemination of questionnaires. This paper reviews previous literatures and discuss the association of weather and transport. The literature has also been extended to identify the relationship of weather to the physical activity as it refers to walking activity. Research pertaining to weather and its effect to transit ridership has also been included in this paper.

Results
According to the literatures, studies in the transportation field have found contradictory results pertaining to the effect of weather to the level of physical activities (Tucker and Gilliland, 2007).
McGuinn *et al.* (2007), studied the relationship between transportation activity with the natural environment that consists of weather, hills and trees for shade and exhaust fumes may effects the physical activity. The study demonstrated those who perceived weather is a problem or a barrier, more like to engage in any transportation activity as compare to those who perceived weather was not a barrier to perform their physical activity. The study also revealed that there is no interaction between age factor and neighbourhood perception of weather as barrier to physical activity.
Hall *et al.* (2009) reported that weather such as cold temperature or precipitation consistently reduces aggregate level of walking by moderate amount (less 20%).
Guo *et al.* (2007) found that bad weather directly influenced the transit riders as well as the transit riders' behaviour. The study explained that more people use the rail system during good weather compare to when there was a bad weather day. As a result, bad weather can reduce the transit ridership.
Kalkstein *et al.* (2009) examined the air masses which include the elements of temperature, humidity, cloud cover and wind speed had significant impact on the transit ridership. The study found that precipitation, extreme cold and hot temperature discourage people to travel by public transport.
Zhou, (2011) mentioned when the temperature went up people tend to make few trips. Nevertheless if the temperature goes up more than 70F, people less likely to travel. In extreme cold days the study found that people are less likely to make trips as most of trips are for passenger pick up or dropped off or to change mode of transport.
Clifton and Livi, (2004) reported that the level of walking for both men and women will decrease slightly by 40% during bad weather and 12 – 15% will stopped walking in Maryland.
Alfonzo (2005) stated that people who live in a region with temperate climates are more motivated to walk compared to residents who live in a more frigid climate region. Tucker and Gilliland (2007) in the study in US focusing in Texas where the population experienced hot and humid temperature. It is reported that there is a decrease in physical activity during summer compared when there is winter. In developing countries, although weather is indicated as a barrier to walk, (Hook, 2003) but the study found that the average temperature in most Asian cities are about the same as summer in Europe, where walking and cycling are very popular at this time. Thus the streets in hot region need to be shaded and protected from the heat of the sun (Hook, 2003).
Stover and McCormack, (2012) found in their studies that adverse weather conditions have statistically significant effect on the transit ridership. The rainy weather in the local study area increase

discomfort to passenger especially if no shelter is provided. As bad weather will make travel unpleasant, thus people tend to switch to private automobile during rainy day. Khattak and De Palma (1997) reported that in Brussels, about half of the private transport commuters have switch their travel pattern as there is increase in transit ridership during adverse weather.
Most of the scholars in literatures have agreed that weather has been indicated to give influenced on the physical activity but some studies found conflicting results. Nankervis (1999) found that the inclement weather has low effect to the commuting trips. According to Aaheim and Karen (2005) ,bad weather is not generally an obstacle to travel. Studies on the Bergen in Norway demonstrated that weather relatively would not affect the travel pattern of the local people who switched from public to private transport. Badland *et al*. (2011) extents the study on the adults' overall physical activity in Perth where the weather condition were relatively constant across all seasons. In line with the previous findings, the report revealed that there is a non-significant or negative correlations existed for temperature and hours of sun- light with transport-related physical activity engagement.

Impact of weather to rail transportation

Evidence of the potential impacts of bad weather had been briefly discussed in the transportation literature. Sumalee *et al*. (2011) explained that extreme hot and wet day increase inconvenience to public transport users. Kalkstein *et al*. (2009) explained that weather condition have been recognised to affect people to travel in comfort, thus make travel by public transport less appealing. Bad weather may decrease the satisfaction level of travellers. In some places, the rain makes the transit station to be wet and slippery thus, increase discomfort in the waiting area.
The transit operator noted that bad weather might create disruptions on the rail service system (Koetse and Rietveld, 2009). In turn, reduce the quality of the overall rail services. Bad weather decrease in frequency and reliability in rail transport services due to flood. To the passengers, this situation might affect the travel decision and involves the need for rescheduling the travel time. Bad weather such as storm and lightning increase the possibility of infrastructure failure as there is possibility for the rail system delayed and stopped due to lack of power or electricity.
Bad weather such as heavy rain, extreme hot temperature and storm will make the passage to the transit station inaccessible. Pedestrian might experience difficulties in accessing the transit station as some of the walkways might be flooded due to heavy rain. On the other hand, high temperature might cause pedestrians to sweat more with unpleasant odours.

Conclusion

Understanding the impact of weather is essential to transport planners and engineers to incorporate possible solutions and improvement to ensure seamless travel experience and continuous support to public transportation. Upgrading the transport infrastructure such as covered pedestrian walkways, sheltered transit station and real time weather information will increase commuters' satisfaction level along their journey from home to their workplace.
As the literature on the effect of weather to transport and physical activity indicated mix results due to difference geographical climate, thus it is important to encompass this factor in physical activity related to research (Tucker & Gilliland, 2007).

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