Acceptable trip distance for walking in mass religious gatherings—A case study of world's largest human gathering Kumbh Mela in Ujjain, India

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ABSTRACT

The optimum location of various facilities in mass religious gatherings, which are of common occurrence in countries like India, is affected by characteristics of walking that include the acceptable trip distance and the accessibility of various facilities based on this acceptable tripdistance. An understanding of this acceptable trip distance would help in developing various planning strategies that could promote the sustainable mode of walking in such mass religious gatherings, and thereby also possibly improving crowd control and management. Aptly, the present study focuses on analysing the various socioeconomic factors that affect the walking behaviour of people in mass religious gatherings and also develops a formula to calculate the acceptable walking distance.Kumbh Mela which is considered as the world's largest gathering was the case study for this research. The data was collected during Kumbh Mela 2016 held in Ujjain, India during 22nd April to 21st May 2016. The study found trip purpose having a greater influence on traveller's decision to walk. The results revealed that primary activities including 'offering prayer' have a greater acceptable trip time/distance than secondary activities like 'having food'. Further, the study also elicited the highest acceptable time for 'holy dip' among all primary activities.

1. Introduction

Walking has been one of the most basic forms of transportation and is categorisedas Non-Motorized Transportation (Allsop, 2005; Nurul Habib, Han, & Lin, 2014). Since the earliest of times, humans have been moving from one place to another via walking, and even in the course of time with the invention of wheels and vehicles, subconsciously, walking has been an integral part of our day-to-day activities.

Sustainable mobility is an important component of sustainable cities. Sustainable mobility emphasizes on meeting the travel needs of the present without compromising the needs of the future. There have been many studies conducted on the topic of active travel, which include walking and cycling, with an overarching goal of achieving sustainable mobility (Boine & Demers, 2018; Etminani-Ghasrodashti, Paydar, & Ardeshiri, 2018; Fenton, 2017). Some of these studies develop methods that help cities plan for walking and cycling (Lopez & Attanayake, 2016; Trope, 2017). Such planning has a potential for positively influencing the sustainability byreducing the private motor-vehicle usage

and subsequently, energy consumption and emission (Maleki, Zain, & Ismail, 2012; Ortolani & Vitale, 2018).As an active mode of travel, walking, while being the cheapest mode of transportation, also helps to a significant extent in energy conservation and environmental protection (Arasan, Rengaraju, & Rao, 1994; Liu, Wei, Guan, & Ma, 2003; Nurul Habib et al., 2014; Rahul & Verma, 2013; Rastogi, 2009; Replogle, 1991; Rietveld, 2001). Walking also has lot of health benefits (Cervero, 2002; Litman, 2003) as it in itself becomes one of the daily workouts. However, walking is still neglected in the civic policy formulation as there is a very little understanding of a person's decision on the acceptable trip distance he or she is willing to walk (Rahul & Verma, 2014).

Short trip distances are preferred for walking (Koh, Leow, & Wong, 2015; Scoppa, Bawazir, & Alawadi, 2018). Not only the trip distance because of the existing built environment, but also a natural tendency among individuals to walk influences the acceptable trip distance (Maleki & Zain, 2011; Nurul Habib et al., 2014). An acceptable distance can be defined as the maximum trip distance of slow modes like

walking beyond which a person chooses a faster mode of travel (Arasan et al., 1994).Few studies around the globe have analysed the acceptable trip distance and the various factors influencing it. Hatamzadeh, Habibian, and Khodaii, (2017) studied factors influencing choice of walking as a commute mode among different job groups. Gender and travel distance were among significant explanatory variable affecting the choice of walking as a commute mode. Almost all the studies have found demographical and socio-economic factors to be affecting the walking distance (Koushki, 1988; Tanaboriboon et al., 1986; Seneviratne, 1985; Jinyong, Meiping, & Xiaoguang, 2009; Jiang, Zegras, & Mehndiratta, 2012; Rahul & Verma, 2014).

It has been seen that behavioral characteristics of the users provide a useful input in coming up with the planning and optimization of various facilities in regard to urban transport systems (Koushki, 1988). Etminani-Ghasrodashti et al. (2018) studied the active travel behaviorin the coastal city of Kish and identified factors that could improve the propensity of an individual to cycle.Meng, Koh, Wong, and Zhong, (2014) compared cycling level of four different cities and analyzed cycling development level. Comparisons were made in reference with urban structure, transport policy, public transport service and cycling infrastructure.The analysis of walking behavior of the users accessing a public transport facility, say MRT (Mass Public Transit), can greatly influence the planning of other feeder systems to it, such as location of parking facility near it as well as the location of feeder mode, if any, such that they fall within the acceptable walking distance of the users (Jain & Tiwari, 2016). Good infrastructure facilities including footpaths, separate cycle lanes, shades, cycle parking and renting facilities and road crossing facilities at regular intervals have been reported to promote the use of Non- Motorized Transport like walking and cycling (Bowman, Vecellio, & Haynes, 1994; Krizek, Barnes, & Thompson, 2009; Noland & Kunreuther, 1995; Rahul & Verma, 2014; Randall & Baetz, 2001; Rietveld & Daniel, 2004; Rodríguez & Joo, 2004). McBain and Caulfield (2017) analysed the factors affecting trip time variation in the city of Cork, Ireland. It aimed at assisting policy makers and system operators in their planning processes of public bike system.Similarly, Scoppa et al. (2018) analyzed walkability within ten superblocks in Abu Dhabi with an aim to contribute to urban design theory and policy making.Similarly, as one would see in the later sections, the concept of Acceptable Trip Distance can be used to plan for various facilities in mass religious gatherings like Kumbh Mela.

Many studies calculated acceptable trip distance as the mean or the median of the individual trip distances (Koushki, 1988; Tanaboriboon, Hwa, & Chor, 1986). Stating this as adrawback, a methodology for finding the acceptable distance using cumulative trip distance frequency was proposed by Seniviratne (1985). Author computed the acceptable trip distance at a point where there is a maximum negative change for the slope of cumulative distribution and analysedhow the acceptable trip distance is influenced by demographic factors like age, gender, trip type etc. Arasan et al. (1994) and Arasan, Rengaraju, and Rao, (1996) also adopted this methodology.A Non-Motorized transportation guideline was formulated by Rahul and Verma (2014) for the city of Bangalore, India, by using statistical analysis and acceptable trip distance.

Among the numerous mass religious gatherings across the world, the largest ones are the Maha Kumbh Mela, the Hajj and the Arba'een Pilgrimage (Hariharan, Aparna, & Verma, 2017). As all these mass gatherings attract a crowd which is spiritually motivated towards religious activities, withthe Holy dip being one of the major attraction of the Kumbh Mela, circling the black stone in Kaaba being a major a part of the tawaf at The Hajj (Ahmed, 1992) and making a journey by foot to the revered ground in Karbala being an attraction during Ashura (Pierre, Hutchinson, & Abdulrazak, 2007). The motivations of people attending these mass religious gatherings aresimilarirrespective of the place of mass religious gatherings,and it was observed that people are goal-bound, spiritually motivated and well-informed, suggesting their-well-definedpurpose. In such mass religious gatherings, people perform

a number of activities with each activity having its own time constraint.Because of these factors like motivation, well-defined goal and time constraint for activity, it can be asserted thatinferences drawn from this paper can be reasonably applied to other mass religious gatherings.

Such mass religious gatheringspose an extreme challenge to the local administration and organisationinterms of managing and planning perspective.A major challenge faced by theevent organizers is to decide on the "optimal" locations for various facilities like food center, toilets, drinking water, shopping centers, yoga centers,parking facilities etc.,-while giving due thought to the environmental perspectives, such that the cooperation between these land uses is encouraged with least power of travelboth in number as well as length of trips.The optimal locationof various facilities is affected by characteristics of walking including the acceptable trip distance (Arasan et al., 1994; Seneviratne, 1985).

India is a land of festivals because of its different religions and cultures (Gupta, 2002). Kumbh Mela is the biggest Hindu pilgrimage in which more than 100 million people is estimated to gather during a month (maximum of estimated 10 million in a single day) to worship God and take a holy dip in the sacred river with a belief that it cleanses their souls leading to salvation (Hariharan et al., 2017). The main purpose ofvisiting Kumbh Mela is to witness and partake in various activities, which include "primaryactivities" and "secondary activities". Primary activities categorically include any such activity that the visitor is predetermined to participate in. Generally, in Kumbh Mela, being a spiritual/religious event, primary activities are spiritual/religious in nature. Thus, activities such as offering prayer, holy dip, visiting spiritual camps, listening to *bhajans*(spiritual songs) fall in the primary activity bracket.Apart from these, there are a number of other activities that are performed simultaneouslyalong with the primary activities or are done once the primary activities are completed. Visitors are not bound on partaking in such activities. They aredone either due to a natural tendency to indulge or as a necessity. These activities are classified as secondary activities and include,eating, drinking, shopping and other such basic functions. Hence, facilities for secondary activities also become an important part while planning such events on such a large-scale.Keeping the above observations in mind, the present study elicits the trip distance characteristics of individuals, with walking as their main mode of transport in mass religious gatherings. The objectives of the present study are set as follows.

It is observed from the literature review that acceptable distance studies conducted so far have been focusing on the regular mandatory (commute trips) and non-mandatory (non-work trips) trips in an urban environment. The trip purpose and activity types in such an urban setup are strikingly different from those of a setup like the Kumbh Mela area.Studies in the context of walking behaviour in a mass religious gathering has not beenreported in the research literature so far. Therefore, the data and the results reported in this paper will be unique in bringing new knowledge on this topic.Further, development of a universal equation is carried out to arrive upon the acceptable trip distance.

2. Study area, data collection, and sample characteristics

Kumbh Mela is organised typically once every three years (every 12 years in the same place) at four specific cities in India, namely Haridwar, Allahabad, Nasik and Ujjain which are situated on the banks of theriver(s)that are considered sacred by Hindus.The Kumbh Mela in Ujjain is organised in every 12 years on account of a specific configuration of planets when Sun is in zodiac Aries and Jupiter is in zodiac Leo, which happens only once in every 12 years. Owing to the references of the Jupiter being in Zodiac Leo, ("Simha" in Sanskrit), the Kumbh Mela at Ujjain is named asSimhastha (Government, M.P., 2016b).

Ujjain is one of the most spiritualand ancient cities in India, which also shrines Mahakaleshwar (also called as Mahakal), one of the twelve