Examining Ways to Enhance Active Transportation and the Impact on Commuters’ Health, Wellbeing and Sustainable Development

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ABSTRACT

Active transportation and physical activity is a major remedy to health-related problems in our society. According to the World Health Organization, the lack of physical activity is one of the leading risk factors for global mortality as well as health problems such as diabetes, cardiovascular complications and other diseases that are threatening public health. To reduce the health risks of physical inactivity, active transportation, and in general physical activity have recently gained great interest in our modern societies. This paper investigates the main factors that enhance active transportation and the impact on commuters’ health, wellbeing and urban sustainability. As a result, a theoretical framework is developed that explores the relevant variables that influence commuter’s willingness for active mobility.

INTRODUCTION

Nowadays, the development of smart cities, which focus on generating positive social impact, has created and established a plethora of multiple transportation modes in almost every country around the world (Kohl 3rd et al., 2012). The technological advancement of the last century as well as significant environmental and economic changes, led to the massive production of private and public transportation means, such as cars, buses, trains and metro lines, in order to facilitate citizens’ mobility (Bok and Kwon, 2016). Although these transportation modes give the opportunity to commuters for easy and quick travel on a daily basis, negative consequences also arise for the natural environment, and for citizens’ health and well-being, as a result, of Physical Inactivity (PI) (Beirão and Cabral, 2007). This PI is due to the general belief that walking, running and cycling are more tiresome and time consuming for reaching someone’s destination (Yang et al., 2012). Furthermore, PI can also be due to the lack of appropriate conditions and infrastructure in the urban pedestrian network (Hallmann and Petry, 2013).

Physical inactivity can be correlated with a sedentary life, and it is indisputable that it has become a global health issue. It is estimated to be the fourth leading cause of death (Kohl 3rd et al., 2012). Based on the definition of the World Health Organization (Bull et al., 2004) PI can be classified into two levels the “inactive” and the “insufficiently active” (Ezzati et al., 2004). It seems that PI increase through the years and specifically it is estimated that the prevalence of physical inactivity in the United States (US) is approximately 86%, categorizing it as one of the top unhealthy conditions in the US. This percentage does not differ much in others countries worldwide. Further, it is important to note that 6–10% of worldwide deaths from noncommunicable diseases are due to PI (Lee et al., 2012). According to the () WHO (2017), physical inactivity has been identified as the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths globally. It is very important to mention that in the US alone during the year 2014, healthcare cost of PI is estimated to be approximately $333.3 Billion of the total U.S. health care costs (Centers for Medicare & Medicaid Services, 2016). Additionally, an inactive lifestyle can be
correlated with obesity, depression, and anxiety (Humphreys et al., 2013) and cardiovascular diseases (Booth et al., 2017), as well as decreased job satisfaction and productivity (Loong et al., 2017). This is due to the fact that physical activity is associated with physical and mental wellbeing, positive emotions and moods (Humphreys et al., 2013).

It is reported by the US Physical Activity Guidelines Advisory Committee (2015) that physical activity contributes to better health through its direct effects on decreasing disease risk as well as its indirect effects on losing weight and reducing obesity, morbidity, and mortality (Sahlqvist et al., 2012). Furthermore, physical activity and active transportation can contribute to reducing chronic diseases (Booth et al., 2017). There is a growing awareness that a significantly physically active way of living benefits health and the natural environment as it reduces the use of vehicle transportation and promotes the shift to active transport, with walking and cycling (REF). Further, it is widely accepted that increasing physical activity can reduce the risk of heart disease, diabetes, stroke, high blood pressure and osteoporosis (Booth et al., 2017). Also, physical activity can prevent the appearance of some chronic diseases, such as musculoskeletal and cardiovascular complications or even prevent certain types of cancer (Yang et al., 2012). It is important to note that physical activity is directly related to active transportation, which in turn can yield all the above benefits for human health. Additionally, active transportation can lead to congestion reduction, cost-effective travel and reduce noise and air pollution (Lawson et al., 2013b).

This paper examines the main factors that are related to active transportation. Particularly, our study investigates the provision of relevant information about the conditions of the pedestrian network, such as connectivity, safety, comfortable mobility as well as individual’s physical condition. The level of active transportation of commuters, as well as their willingness to physically active in their everyday life, are examined. Specific factors investigated include the role of information, walkability conditions, culture, individual characteristics, health aspects, commuters’ willingness for active transportation in relation to wellbeing at work, productivity, job satisfaction and quality of life.

SURVEY METHODOLOGY

A literature review was contacted on relevant studies that examine the variables that influence and enhance active transportation as well as the impact on commuters’ health and wellbeing. For the choice of articles, we have followed a process of identification, screening, eligibility and inclusion. The relevant articles were identified by searching multiple databases. Search terms included "physical inactivity", "walking", "pedestrian", "active commuting", "active transportation", and "walkability".

For the purpose of this literature review, factors influencing active transportation and physical activity were investigated in relation to active transportation and physical activity. Then, variables were grouped into a conceptual framework exploring what leads to the "Willingness for Active Transportation", "well-being at work", "job satisfaction", "productivity", "health status" and "quality of life" which is presented in a later section of this paper.

FACTORS AFFECTING ACTIVE TRANSPORTATION

Variables that influence active transportation and physical activity

There has been a great research interest in recent years on identifying the variables that influence active transportation and physical activity. Also, it is important to explore the benefits of active transportation and the necessary prerequisites for engaging commuters in active modes of transport. Many of the studies are investigating the different levels of satisfaction of adults from the use of different transportation modes, as well as the factors that affect their choice for a specific transportation mode (Páez and Whalen, 2010). Significantly higher level of satisfaction from travel has been reported for pedestrians and cyclists but also for train commuters rather than for drivers and bus and metro users (St-Louis et al., 2014). Further, it seems that the choice of transportation mode depends on the weather conditions, as when weather conditions are good people prefer to walk or to cycle, but when weather conditions are adverse, then people tend to use their cars or the public transport (St-Louis et al., 2014). Apart from the weather, other factors that affect the choice of transportation mode is travel cost, safety and route flexibility (Nordfjærn et al., 2014). The ones who want to be more flexible choose to commute by car and those who prioritized safety and comfort prefer to use the public transport. Also, it is wrongly believed that high-risk perception is related to car use (REF). Specifically, Loong et al. (2017), showed that commuters who use their car should revisit their choice as they bound to experience low levels of punctuality. This is contrary to the
intuitive belief that the car mode of transport will provide commuters higher efficiency of travel. Further, the commuters’ choice and decisions seem to be shaped by the constantly changing and fluid nature of commuters’ social activity (Guell et al., 2012).

Demographic, socioeconomic, household and trip specific characteristics are also influencing the choice of transportation mode and active traveling (Littanakool et al., 2006). More specifically, a large effect on the use of non-motorized transport is observed to be correlated with gender, car ownership, and journey distance. Further, manual related professions and families with children experience the lowest likelihood of non-motorized commuting. Also, cycling is the preferable commuting mode and specifically cycling is three times more likely to be chosen by males (Lawson et al., 2013a). Another factor that influences active transportation is population-level patterns (Hankey et al., 2017). Based on spatial estimates of cyclists and pedestrians, traffic has been shown to be correlated with street functional class and proximity to high traffic roads. Also, it is seen that the highest rates of active travel are in neighborhoods with high levels of population density, land use mix, open space, and retail area (Hankey et al., 2017). Similarly, Mathews et al. (2009) support that there are significant differences among gender and age when it comes to being physically active as well as the type, location, and purpose of the activity. Furthermore, men engage in the walking activity for going to work while women are more likely to walk for escorting their children to school and running errands (Mathews et al., 2009). Age also plays an important role in being active (Lee et al., 2017) since young people tend to walk more and use their bicycles more than older people. Further, inactivity tends to rise with age, and it is relatively high level in high-income countries (Hallal et al., 2012). In addition, Yang et al. (2012) found that men are cycling more than women. A study by Hallal et al. (2012) showed that a large percentage of 95% of adults are physically inactive, while women and boys are more active than men and girls. Therefore, it is recommended that walking and cycling can be enhanced through infrastructure development and built environment enhancements as well as workplace programs.

Benefits of physical activity

A plethora of scientific evidence exist, expressing the numerous benefits of physical activity for physical and mental health when people regularly participate in some kind of active transportation. A more active lifestyle seems to have a positive linear relationship with health status, as physical activity and fitness can result in additional improvements in human health (Hills et al., 2015). Moreover, a positive association exists between physical activity and the Health-Related Quality of Life (HRQL) as it promotes health behavior change. Furthermore, active commuting is associated with high levels of physical wellbeing (Humphreys et al., 2013). In addition, the relationship between active travel and psychological wellbeing has also been examined by Martin et al. (2014), by providing important information about the positive impact on the overall psychological wellbeing by switching to an active travel mode. This study showed that there is a strong relationship between overall psychological wellbeing and active travel as well as public transport when compared to car travel, time spent for walking and driving, and switching from car travel to active travel. Additionally, active travel was associated with reductions in the likelihood of experiencing some specific psychological symptoms when compared to car travel. The study mentioned above supports that positive psychological wellbeing effects should be considered in interventions seeking to promote active travel. Furthermore, Mulley et al. (2013) showed that there are important health benefits from active transport modes providing a positive association between active travel, recreational and total physical activity. Each additional hour spent in car travel per day was associated with 6% increase in the likelihood of obesity. On the other hand, each additional hour spent on walking travel per day was associated with a 4% decrease in the chance of obesity. Sahlqvist et al. (2012) found, that substantial physical activity can be accumulated through active travel, showing that adults who use active travel report significantly higher total physical activity and they are healthier and happier compared to those who do not. This also demonstrates that active travel is significantly associated with pre-determined factors such as the willingness of people to be physically active.

Additionally, any studies are focusing on children’s commuting to school and the effects on their body weight and physical condition. The study of Faulkner et al. (2009) showed that children who walk or cycle to school presented greater physical condition and healthier body weight ratio. Also, Schoeppe et al. (2015) investigated the associations of children’s active travel to school and non-school destinations. According to their findings, active travel to non-school destinations was positively related to children’s daily moderate-to-vigorous physical activity, in contrast to active travel to school. Furthermore, active
travel modes were not associated with children’s sedentary behavior levels.

Moreover, an interesting study was conducted for analyzing commuters’ punctuality and energy levels at work and school (Sahlqvist et al., 2012). Ten multilevel mixed-effect logistic regressions were used to determine the factors that impact the commuter’s feeling of being energized when they arrive at work or school and their punctuality. Results showed that weather conditions and mode of transport have a significant impact on an individual’s energy at work and punctuality. It is important to note that drivers have the lowest likelihoods of being energized and the highest likelihoods of arriving late for work. Meanwhile, cyclists have the highest likelihoods of feeling energized and being punctual. As a conclusion, this study suggests that satisfaction with travel mode is associated with higher likelihoods of feeling energized and being punctual.

Socio-economical and environmental factors affecting active transportation and physical activity

Built environment and street connectivity also affect active transportation and physical activity. Some studies showed that street connectivity is statistically significantly correlated with active transportation (Berrigan et al., 2010). More specifically, an explicitly geographic approach can strengthen the built environment and physical activity and active transportation. This shows that connectivity is a major factor for walkability. Connectivity can be enhanced by providing the necessary information to travelers, and this can be achieved by appropriate smartphone or wearable software applications. Also, green space and living in different travel-related urban zones can contribute to active transportation. Tomi E. et al. (2016) suggested that a good pedestrian and cycling infrastructure can play an important role in promoting active transportation regardless of educational background, leisure-time, and occupation physical activity. The benefits of pedestrianizing an area are very significant and were identified by a study from Soni and Soni (2016). The benefits were divided into five categories, which are transportation related, socially related, environmentally related, economically related and health-related. Some of the transportation-related benefits are mobility and accessibility improvement, reduction in car use, reduction in congestion and parking need, reduction in road accidents and in general, injury reduction. The socially related category includes social interactions and relations to security and safety. Air pollution and noise reduction are some of the environment-related benefits, while fuel and land savings are presented as economic-related benefits. According to the health-related benefits, unpolluted air intake in respiration, exercise, fat loss, and fitness, improvement in psychological health, metabolism and digestion are some of the beneficial factors. Another study that supports the fact that the built environment contributes positively to physical activity is the study by Carlin et al. (2017). The results showed that pedestrian and cyclist safety structure was positively correlated with physical activity, while lack of sidewalks and streetlights were negatively correlated with physical activity. Finally, Schwartz et al. (2009), examined associations of the built environment surrounding worksites and of work policies with walking behaviors. The results showed that when locating sites for work premises that are walkable and when also applying some policies at the same areas, then the employees become influenced to actively commute to their work more often. Also, Yu (2015) examined pedestrian injury severity indicating that individual characteristics, road environments and area characteristics around the crash location affect the pedestrian injury positively. Further, Zuniga-Teran et al. (2017) suggested a “Walkability Framework” to be used as a model to measure interactions between built environment and physical activity. The study integrates walkability categories with the two main purposes of walking, which are pleasure and transportation.

Another study that explores the benefits of active transportation is that of Olabarria et al. (2014), which evaluated the socio-demographic, mobility, road safety and environmental characteristics of the neighborhoods for walking and motorized trips. The results showed that motorization negatively affects walking, as walking rates fall when motorization rises. The suggestion is that motorization is a factor that should be considered when promoting safe, active travel. Ding et al. (2016), aimed at evaluating the economic burden effect on the physical activity levels all over the world. Using available data from countries representing 93% of the worlds’ population, the main parameters estimated were the direct health-care costs, the productivity losses, and the disability-adjusted life-years. The results demonstrated that physical inactivity leads to a significant economic burden and that promotion of regular physical activity should be prioritized to reduce non-communicable diseases.

Based on the above literature review a conceptual framework is developed analyzing the prospect of active transportation. The framework is presented in the next section, where independent, mediating and
moderating variables are identified with more focus on the potential of information and health status in the context of a smart city.

DEVELOPMENT OF A CONCEPTUAL FRAMEWORK ON ACTIVE TRANSPORTATION

By identifying the variables that promote and influence the commuter’s willingness for active transportation as well as the positive impact on the natural environment, on health status and the quality of life, a conceptual framework is developed and presented in this section. Variables were grouped into this conceptual framework based on the relationship between the independent variable “Information” and the dependent variable “Commuters’ Willingness for Active Transportation” as shown in Figure 1. Within this relationship, we have three sets of moderating variables that affect the decision for active transportation. The first set of moderating variables is the “Individual Characteristics” such as demographic characteristics (age, gender, weight, level of education) and socioeconomic characteristics (profession, car ownership, a family with children). The second set of moderating variables is health aspects that are caused by not being physically active, such as high blood pressure, cardiovascular complications and other diseases that are threatening the public health. The third set of variables is about “Culture and Mindset.” An opportunity exists here to change the mindset of people in order to add active transportation into their daily routine.

Furthermore, in the presented theoretical framework there are presented three mediating variables, namely wellbeing at work, obesity and municipality decision making for improving pedestrian conditions. Specifically, municipality decision making mediates between information and the pedestrian condition evaluation index; obesity mediates low active transportation and health problems; and finally, wellbeing at work mediates between commuters’ willingness for active transportation and job satisfaction/productivity.

Figure 1. Theoretical framework

As a result of the above theoretical framework (Figure 1) a number of research questions need to be further explored:

- "How does the necessary information about the pedestrian and cyclist network affect the willingness of the commuters for active transportation?"
- "Are commuters willing to be more active under certain conditions in the pedestrian infrastructure?"
- "How does culture influence the commuters’ willingness for active transportation?"
- "Are individual characteristics and willingness for active transportation correlated?"
- "How do health aspects influence commuters’ willingness?"
- "Does the commuters’ willingness for active transportation lead to increased wellbeing at work?"
• "How does active transportation influence productivity and job satisfaction?"
• "Does the willingness for active transportation reduce obesity?"

Further, a number of hypotheses need to be further tested for specific regions as follows:

1. H0: There is no correlation between the information about the pedestrian and cyclist infrastructure and the commuters’ willingness for active transportation.
   H1: With the appropriate information about the pedestrian and cyclist infrastructure, the willingness of commuters’ for active transportation will be increased.

2. H0: The conditions of the infrastructure are not related to the willingness for active transportation.
   H1: The conditions of the walkability infrastructure are related to the willingness for active transportation.

3. H0: There is no correlation between culture and willingness to active transportation.
   H1: There is a significant correlation between culture and willingness for active transportation.

4. H0: There is no correlation between individual characteristics and willingness for active transportation.
   H1: Individual characteristics are related to willingness for active transportation.

5. H0: Health issues are not correlated to willingness for active transportation.
   H1: Health issues are significantly correlated to commuters’ willingness for active transportation.

6. H0: There is no relationship between willingness for active transportation and wellbeing at work, productivity and job satisfaction.
   H1: Willingness for active transportation is significantly related to wellbeing at work, productivity and job satisfaction.

7. H0: Commuters’ willingness for active transportation and obesity are not correlated.
   H1: Commuters’ willingness for active transportation is significantly correlated to obesity.

CONCLUSIONS

This paper explored the variables that positively influence active transportation of modern commuters. As a result, a theoretical framework is developed that identifies independent, mediating, and moderating variables that influence commuter’s willingness for active mobility. Further, the relationships among the identified variables were drawn on an integrated conceptual model. This was achieved based on an extensive literature review on active transportation and the benefits on commuter’s health and wellbeing. Knowledge from the literature review was synthesized into a holistic model for active transportation. Based on the model, clear research questions to be explored were derived, and a number of formal hypotheses were developed. The next step is to carry out a survey study on the topic of commuter’s active transportation which will provide us with the necessary data in order to develop a multidimensional predictive model on active mobility for commuters.

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