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Time-Use, Perceived Travel Time, and Involving
Other Person Other Person in Certain Activity
Effect on Social and Mental Health

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Socio-demography, travel parameter, diary time-use, perceived travel time, and involving other person other person in certain activity effect on social and mental health

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Abstract. Without movement, it is impossible for people to fulfil their needs and desires. Therefore, transportation is one of the most crucial sectors supporting human activity in daily life. People make daily decisions regarding travel, including how much to travel, what mode of transportation to use, whether motorized or non-motorized, and where and when to travel, in order to satisfy and complete their needs and desires. These decisions have a significant impact on their health, whether positive or negative. This study try to investigate the possibility of intermediate factors that can bridge the gap between travel-participation and health parameters. Some intermediate variables, including social intensity and affective experience, may serve as a bridge between activity-travel behavior and social and mental health issues.

Keywords: involving other person, travel behaviour, health..

1 Introduction

In order to better understand how individuals compose their daily activities and travel patterns, the interaction between constraints and individual needs within a time and space scale can reveal how individuals respond to changes in the environment, and how individuals can influence and change their behaviors in their daily activities and travel patterns. [1]–[3]. Every day, people make travel that may impact to their health, including how much to travel, what type of mode transportation to be used, and where and when to travel. Using motorized mode can allow an individuals to travel and reach certain locations in less time, for less money, and with more comfort than using non-motorized mode [3], [4]. However, when people use motorized modes, it has a more negative effect on their physical, mental, and social health, in addition to the environment, than when they use non-motorized modes [5]–[14]. How a person's day-to-day experiences may indicate whether they have social and mental health issues or not [15]–[17]. Most of social activities take longer time when spending with a group such as with family or friend, someone of the same gender, a close friend, or someone who lives far away [18]. There are numerous reasons to maintenance social activities that have positive effect on the physical [19]–[21], mental [22]–[24] and social health such as staying social can reduce your risk of developing depression [19], [25]–[29], to support cognitive function [29]–[32] and lower blood pressure [33], [34].

People who live in suburbanites tend to make discretionary visits to family members more often and are sometimes more involved in groups, whereas inner-city residents are usually more engaged to their neighbors and acquaintances. Patterns of discretionary travel to engage in social activities vary between suburban and urban visitors. It is reasonable to infer that the more frequent visits by inner-city residents to public areas such as cafés, malls, restaurants, etc., are made with friends and acquaintances. In the central city, people go to public areas more often on their own time to do their social activities. When residing in remote places, friends are frequently contacted by discretionary trips consisting of pre-invited visits to each other's homes. Relationships between social involvement and health vary by type of activity and rural-urban context. Those living in rural counties are less socially involved than those living in urban counties [35]–[41]. People would have opportunities to engage in more/less activities with more/less dispersed location and time depending on the conditions and variability of other resources, such as the availability and service level of the infrastructure and public transportation network, the option of potential activity locations within reachable distances, access to various travel modes, and amount of money to spend [42]–[46]. Allocating more time in some of social activities that have an important correlate of physical, mental, and social health [4], [47]–[51]. In travel behavior research, however, very little is known about the duration, frequency, number of participants, and with whom people engage or participate in social activities that have an impact on mental and social health. Spending more time for commuting line, such as traffic congestion, the main causes of a number problems, such as longer travel times for drivers and passengers, greater fuel consumption and greenhouse gas emissions, higher rates of motor collisions,

and several environmental difficulties. Exposure to congestion has also been linked to an increase in driver stress and a decrease in commuting satisfaction, as well as a decrease in an individual's reported subjective wellbeing and a slowing of metropolitan economic growth [9]–[14], [52]–[54].

From the explanation above, it can show as clearly the correlation between activity travel participation with *activity-daily experience* will help to design transport and urban planning policies and interventions that improve people's health behavior, then also have possibility to become intermediated factor between activity travel behaviour effects to the health. The conditions and variability of other resources, such as availability and service level of the infrastructure and public transport network, the selection of possible activity locations within reachable distances, access to various travel modes, and amount of money to spend, would provide individuals with opportunities to engage in more/less activities with more/less dispersed location and time. Some researchers have concluded that built environment elements, such as density, diversity, design, destination accessibility, and distance to transit, are associated with travel behavior that tends to play a marginal role in affecting travel patterns and also main factor to support the relationship between the built environment and health behaviors' by individual's daily experience [16]. When people judge their satisfaction with their travel, they may confound it with their satisfaction with the corresponding activities. Activity-diary experience refers to what people feeling when joining some activities weather, they have positive (happy, interested, and content) or negative (frustrated, sad, and bored) feeling during the activity, and what effect to physical, mental and social health. Usually, if an individual, feels less positive experience on a special activity, they may undertake another activity for improving their well-being. The correlation between activity travel behaviour with social intensity and activity-diary experience will help to design transport and urban planning policies and interventions that improve people's health behavior, then also have possibility to become intermediated factor that have effect to the health.

2 Time-space Prism

The theory is a crucial tool of the scientific study of things, especially when it comes to how people act, which includes how they travel. Even though different scientific fields may have different rules about how theories are used in research and data analysis, theory is an important part of both work that is theory-driven and work that is based on facts. Hagerstrand came up with the idea of "time-space prism" in the early 1970s to describe the spatial and temporal constraints that affect how people choose the activity and where place to travel. Day to day individuals undertaking some of activities as requirement for trading time for space to across some locations at their budget times to fulfill their need and desired. The notion of time-space prism or time geography is primarily focused on the interrelationships between activities in time and space and the constraints imposed by these interrelationships. [55]–[62] presented in Figure 1.

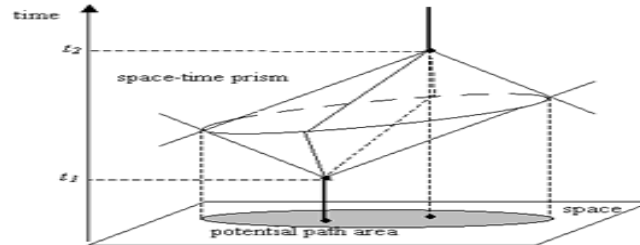


Fig 1. ([61], [63], [64])

Hägerstrand (1970) have hypothesized that the behaviors of individuals' could be represented in both time and space by confined in the three types of constraints: capability, coupling, and authority constraints. The limit of the individuals undertaking activities through their physical capabilities and/or available resources namely **capability constraints**. Individuals have to arrange the maintenance activities such as eating and sleeping; these require time and place. Also, individuals travel with motorised mode (private vehicles) type can generally travel faster than individuals who with non-motorised mode such as walk or rely on public transportation. **Coupling constraints** define when, where, and how individuals must arrange the activities jointly in time and space. The selection of activities or "bundles" like work, where multiple individuals' time-space paths join, necessarily constraints the remaining available time-space prism such as work, meetings, and classes. **Authority constraints** include laws, organizations, locations, or other domains in which activity bundles are organized and/or access is limited. For example, a shopping mall or gated society can make it difficult and illegal to enter at authorized times, while a public street cannot.

3 The day-to-day variability in individuals' activity-travel pattern

An individual's time-space prism [63]; Lenntorp,1976) is an essential concept for understanding the decision- making processes that underlie individual's activity-travel patterns. Based on this theory, an individual's personal and social identity form specific projects which interact with his/her capability, coupling and authority constraints within space and time scale to shape the individual's activity-travel pattern [55], [61], [65], [66]. The Individuals' time-space prism and path tends to be irregular from day-to-day due to different day to-day needs and constraints. The specific needs and constraints of individuals to form their daily activity-travel participations, in space and time in order to complete their need and desired will created by the interaction of individuals' characteristics in multiple dimensions [16], [67]–[69] that different every-day. The basic reason for engaged in an activity may presumed to be the fulfilment of human needs and the desire to complete duties associated with a specific condition. The opportunities for engaged depend on the availability of specialized facilities and the resources of time, money, effort, etc.

that an individual can contribute; travel may play an important role in enabling an individual to reach a specialized facility suitable for a specific form of activity participation [45], [70]–[75].

The act of performing an activity in turn satisfies needs and fulfills roles, hence influencing the immediate action priorities. Participation in an activity also modifies the resources available for succeeding activities by depleting or augmenting, for example, the available of of money (e.g., labour) or the amount of physical energy (e.g. by eating). Some activities (such as eating, sleeping, and commuting) are regularly undertaken almost day to day, whereas others, such as shopping, personal business, and social entertainment, are not necessarily performed daily [16], [17], [70], [76]–[78]. Individual's activity-travel patterns often include the interactions with other household members. This shows how basic the decisions about activity participation and priorities are made, and it puts each activity in a pattern of trips and at-home episodes [79], [80]. In addition, an individual's engagement with their society, such as membership in a certain organization and/or a particular school and neighborhood, will influence the construction of a series of activities and travels in interaction with the individual's other qualities. [16].

4. Health as capability constrain

The literature mentioned that health is well-defined as a state of complete physical, mental and social well-being and not simply the absence of disease or infirmity [16], [17], [45], [72], [81], [82]. From the figure 2. The study [72] mentioned that there three health parameters mainly physical, mental and social health, which contains eight subscales mainly physical functioning (PF), limitations on role functioning because of physical health (RP), bodily pain (BP), general health (GH), mental health (MH), limitations on role functioning because of emotional problems (RE), social functioning (SF), and vitality (VT). All this factor can effect tp activity travel participation, that way [45] mentioned that health also as capability constrains.

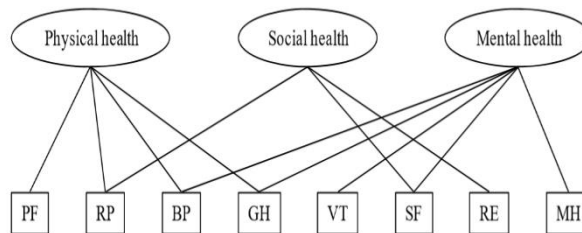


Fig 2 Health-related QOL with three-factor structure

There is a complex relationship between the activity-travel behavior of individuals and their health. The individual who has greater social and mental health has a tendency to have a higher percentage of motorized mode use, while the individual

who has better physical health tends to have the opposite pattern of behavior [45]. Allocating more time on leisure and social connections produce social inclusion and mental and physical health [19], [21], [83]. Social and mental health problem may limit individuals' participation to participated in certain activities that effect to individuals' well-being level [16], [72], [82]. In contrast, how the way individuals experience during a day will indication whether someone is on social and mental health problems or not[16][84].

The encouragement of walking and cycling as mode of transportation, complemented by public public transport or any other "active" mode, is referred to as active transportation, and it presents a potential solution that not only addresses problems of urban traffic congestion, environmental pollution, and climate change, but also provides major health advantages [85]. Despite related risks of exposure to traffic and to a lesser extent air pollution [86], active transportation may overcome car dependence and increase physical activity levels [87]. Using motorized mode can help an individual to travel a location in less time, low cost, and with greater comfort than using non-motorized mode. However, using motorized mode for travel day-to-day has detrimental effects on physical, mental, and social health, as well as the environment, compared to non-motorized mode [5]–[8], [10], [12], [13]. On the other hand, the choice of mode of transportation has been linked to a variety of health risks and benefits, which vary depending on the mode of transportation that is used[88]. There is a strong correlation between activity participation and self-reported health problems, but some effects are offset by the time tradeoffs between activities and travel. A person's physical health issue, such as a handicap or disease, might serve as a limitation on his or her ability to travel, therefore affecting activity travel participation [16]. [89] Mentioned that for self-reported mental health, both in-home and out-of-home mentally high intense activities seem to be positively correlated with self-reported mental health conditions. Understanding how diverse mechanisms underpin these various activities will enable us to provide additional opportunities to engage in them and/or to manage trips associated with them. In addition, correlations between these activities and health parameters indicate that participation in social-recreational activities tends to be favorably associated with improved social health conditions [17], [45], [72], [82], [90]. Meanwhile, performing grocery shopping as a primary activity and socializing as a secondary purpose promotes person to participate more physical activities, which improves their physical health [15], [45]. The individual with better physical health tended to use less motorized modes; nevertheless, none of the activity behavior variables improved the individual's physical health condition. This indicates that while an individual's physical health positively correlates with their daily activity involvement, the relationship between persons and various health conditions in relation to behaviors and the mode of transportation chosen is complex [16], [17], [45], [65]. The information on individuals' day-to-day activity participation, together with their panel travel behavior data will better enable us to design a policy that not only improves transport network conditions, but also enhances traveler's physical, mental and social health.

5. Transport and health

Space-time prisms model the ability of individuals to travel and participate in activities at different locations in an environment [57], [58], [91] was introduced by Hagerstrand (1970) in the early 1970s to describe the spatio-temporal constraints in which people make activity and travel decisions [15], [55], [80]. Moreover, time-space constraints play an important role in shaping people's activity-travel patterns [16], [17], [55] and adapt to changes, creating the opportunity for individuals to influence and change their behaviors' accordingly [16], [71], [89], [92], [93] day-to-day. Understanding how individuals composed their activity-travel behavior due to their personal and social characteristic within multi-dimensional and multi-hierarchical time and space perspective and its correlation with health factors may be able to suggest a certain policy that can confirm improvement of individuals' health particularly social and mental health [16], [24], [29], [50], [84], [88], [94]–[96]. Previous literature explained that not to be easy to find the correlation between individuals' activity-travel behavior, built environment conditions effect to the health, there is some intermediated factors may bridge the relations [5], [7], [100], [101], [41], [53], [69], [72], [96]–[99]. Planning and setting-built environment conditions is only facilitating individuals to do suggested activities for improving their well-being or health into a particular level. Health promotion activities included exercise, social activities, and family communication. For each type of activity, frequency, time period (weekday or weekend, time of a day), activity duration, activity companions, and access mode to activity site as well as dairy experience during activities participation will influence mental and social health [15], [18], [30], [31], [47], [72], [102]–[105] unfortunately there is lack study about this matter that may relate with positive and negative feelings, which may affect to the mental and social health. In this study a relation will be established between individual health condition and their time-use and activity participation through intermediate variable which are social intensity and affective experience. Furthermore, social intensity and affective experience will be studied from in-home and out-of-home mandatory, discretionary, maintenance and leisure activities.

6. Result and Discussion

6.1 Socio-Demography and travel characteristic

The survey data was taken between August and October 2019 in Malang City Area, Indonesia. The main survey involved 410 individuals from 98 households, covering inputs on their socio-demographic, travel characteristics, time use and activity diary, and perceived travel time. For the respondent's profile is shown Table 1 and study area shown in Figure 3. Respondents were firstly interviewed directly and informed of the procedure by surveyors, before the survey schedule after the screening process, 377 respondents aged 7 years old and above were retained for further analysis.

Table 1. Profile of the samples used in the study

Variables	Percentage or mean
<i>Socio-demographic</i>	
Males	51.20%
Females	48.80%
Workers	66.60%
Non-workers	6.10%
Students	27.30%
Age Below 22 years	27.60%
Age 23 - 45 years	51.50%
Age 46 - 55 years	13.80%
Senior citizens (> 55 years old)	7.20%
<i>Household characteristics</i>	
Part of low-Income household	77.70%
Part of Middle-Income household	15.90%
Part of High-Income household	6.40%
Number of household members	4.18
Number of dependent children per household	0.68
Number of private vehicles per household	2.40
<i>Travel variables on weekdays (Monday – Friday)</i>	
Percentages of daily travel time using non-motorised mode	22.72
Percentages of daily travel time using motorised mode	40.21
Percentages of daily travel time using public transport	20.99
Percentages of daily travel time using MBRS	4.17
Percentages of daily travel time using CBRS	11.91
Daily number of trips and number of trip chains	2.19 and 1.08
<i>Percentages of time use involving other persons within a specific activity on weekdays</i>	
Within in-home mandatory activity	1.03
Within out-of-home mandatory activity	2.19
Within in-home maintenance activity	4.63
Within out-of-home other maintenance activity	1.25
Within in-home leisure activity	17.58
Within out-of-home leisure activity	9.83
Within in-home online	5.88
Within out-of-home online	9.06
Within sport	0.38
Within travel	4.41
<i>Percentages of time-use involving other household members within a specific activity on weekdays</i>	
Within in-home mandatory activity	0.80
Within out-of-home mandatory activity	0.17
Within in-home maintenance activity	2.94
Within out-of-home other maintenance activity	0.70
Within in-home leisure activity	4.39
Within out-of-home leisure activity	1.57
Within in-home online	0.68
Within out-of-home online	0.16
Within sport	0.02
Within travel	0.73
<i>Percentages of time-use involving relatives within a specific activity on weekdays</i>	
Within in-home mandatory activity	0.08
Within out-of-home mandatory activity	0.14
Within in-home maintenance activity	0.84

Variables	Percentage or mean
Within out-of-home other maintenance activity	0.16
Within in-home leisure activity	3.73
Within out-of-home leisure activity	0.93
Within in-home online	0.59
Within out-of-home online	0.52
Within sport	0.00
Within travel	0.74
<i>Percentages of time-use involving friends within a specific activity on weekdays</i>	
In-home mandatory activity	0.10
Within in-home mandatory activity	1.76
Within out-of-home mandatory activity	0.67
Within in-home maintenance activity	0.35
Within out-of-home other maintenance activity	4.95
Within in-home leisure activity	5.90
Within out-of-home leisure activity	2.91
Within in-home online	6.48
Within out-of-home online	0.40
Within sport	2.36
<i>Percentages of time-use involving online friends within a specific activity on weekdays</i>	
Within in-home mandatory activity	0.07
Within out-of-home mandatory activity	0.13
Within in-home maintenance activity	0.18
Within out-of-home other maintenance activity	0.04
Within in-home leisure activity	4.51
Within out-of-home leisure activity	1.44
Within in-home online	1.71
Within out-of-home online	1.90
Within sport	0.00
Within travel	0.57
<i>Percentage of time-use involving a specific social network within all activities on weekdays</i>	
Household members	12.17
Relatives	7.72
Friends	26.00
Online friends	10.54
<i>Percentages of time-use involving other people within all activities (Monday-Friday)</i>	14.104

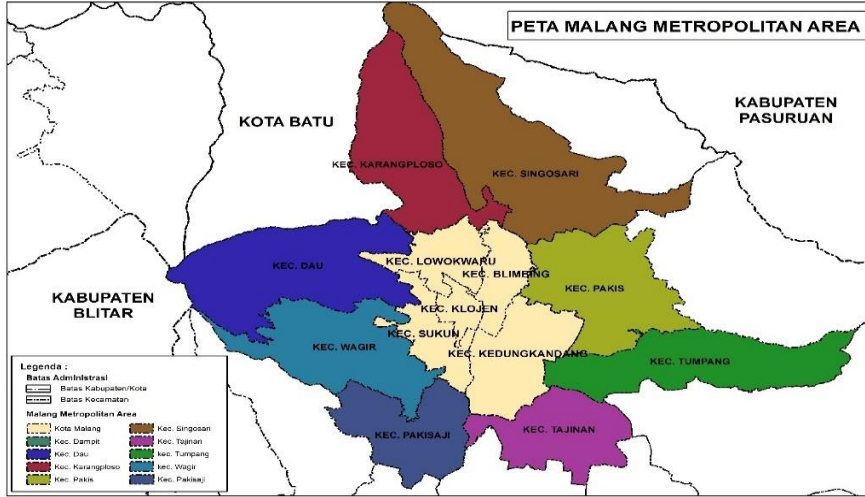


Fig 3. Malang city (modified from Land use planning of Malang City, 2010)

6.2. Conceptual Model

Multilevel modelling technique that is used to analyze structural relationships. This technique is the combination of factor analysis and multiple regression analysis, and it is used to analyze the structural relationship between measured variables and latent constructs. The method used in this paper capture explicitly the joint relationship among Socio-demographic (Sd_i), Travel Parameter ($Travel_{it}$), Time Use Activity Diary ($Time-Act_{it}$), Perceived travel time in certain public amnesties (Pt_i), and Percentages of time-use involving household members/relatives/friends/online friends within different activities (Inv_{it}). The proposed model can be seen in Figure 4, while the mathematical models are presented below:

$$SH = (\alpha_1 + \mu_1) + \beta_1 Sd_i + \beta_2 Travel_{it} + \beta_3 Time - Act_{it} + \beta_4 Pt_{it} + \beta_5 Inv_{it} + \epsilon \quad (1)$$

$$MH = (\alpha_2 + \mu_2) + \beta_6 Sd_i + \beta_7 Travel_{it} + \beta_8 Time - Act_{it} + \beta_9 Pt_{it} + \beta_{10} Inv_{it} + \epsilon \quad (2)$$

Linear and non-linear mixed effect models or an *NLME* package in R software, was used to apply the proposed model in this study. The *nlme*-package contains functions for estimation of multilevel or hierarchical regression models is a statistical method of exploring the relationships between, and testing hypotheses about, a dependent variable and some independent variables. Every regression equation was measured and estimate to retrieve the regression result, under condition that only variables with p-value < 0.1 were included into the calculation. The coefficients of parameters (β) in the hierarchical multilevel modelling considered nesting observations in endogenous activity-travel patterns and

exogenous variables made by individual i on day t , with/without participation of another/other people on a daily basis. Meanwhile for the uncorrelated individual specific error term μ has a mean value of zero and variance of σ_{μ} , while ε is the uncorrelated combined time and individual error components with a mean value of zero and variance of σ_{ε} , and for intercept (α) often labelled the constant is the expected mean value of Y when all $X = 0$. The individual specific error term captured the unobserved heterogeneity amongst individuals which was not explained by their day-to-day variations in activity-travel pattern variables. The only fixed is the overall mean. The parameter setting $\text{random} = \sim 1|\text{day}$ fits random variation between days. The interaction between variables units that are nested within days, are by default treated as random

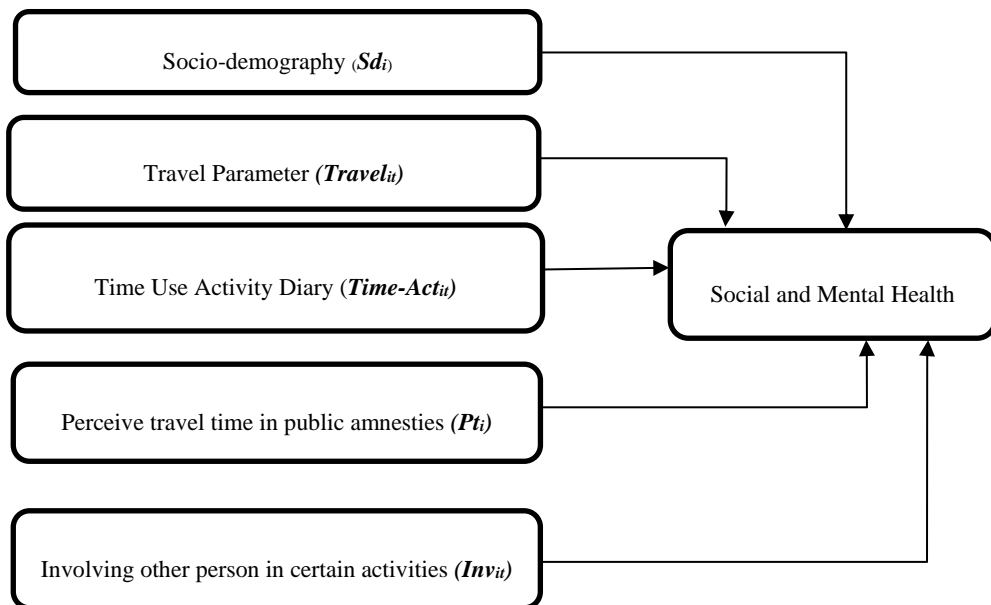


Fig 4. Proposed Model

6.3. Model estimation results

The Table 2 showed interactions between several observed variables, including socio-demography (Sd_i) aspects, travel parameters ($Travel_{it}$), time use-activity diary ($Time-Act_{it}$), Percentages of time-use involving other person within different activities (Inv_{it}), Percentages of perceived travel time to certain public amnestied (Pt_i) and Percentages of time-use involving household members/relatives/friends/online friends within different activities (Inv_{it}) on a person's social and mental health, as expected from the proposed model in Figure 4.

TABLE 2 Model estimation result for social and mental health condition (using standardised coefficients)

Variable	Social Health		Mental Health	
	Value	t-value	Value	t-value
<i>Socio-demography</i>				
(Intercept)	0,5711	2,1768	-0,3594	-1,3219
Male	-	-	-	-
Female	Ref		Ref	
Young Age	-	-	-	-
Aged 23-45 years old	-	-	-	-
Age 46-55 years old	-	-	-	-
Age above years old	Ref		Ref	
Low Income	-0,0287	-2,7042	-0,0287	-0,2564
Middle Income	-	-	-0,0146	-0,1939
High Income	Ref		Ref	
Worker	-	-	-	-
Student	0,0397	2,7840	0,0480	0,3264
Non-worker	Ref		Ref	
Number of dependent children within household	-	-	0,0042	0,0670
Number of household members	-0,0146	-4,4249	-0,0211	-0,1143
Number of trips	-0,0586	-1,9401	-	-
Number of trip chains	-	-	-	-
Number of private vehicles	0,0113	3,5382	-	-
<i>Travel parameter</i>				
Percentage of travel time using non-motorized mode	0,0002	2,3576	-	-
Percentage of travel time using private vehicles	-	-	-	-
Percentage of travel time using public transport	-	-	-	-
Percentage of travel time using CBRS	-	-	-	-
Percentage of travel time using MBRS	Ref		Ref	
Total daily ravel time	-	-	-	-
<i>Time-use for a specific activity</i>				
In-home mandatory	-	-	0,0000	0,0003
Out-of-home mandatory	-	-	0,0001	0,0008

In-home leisure	-	-	0,0004	0,0018
Out-of-home leisure	-	-	0,0001	0,0013
In-home socialising	-	-	0,0000	0,0007
Out-of-home socialising and recreations	0,0003	4,7966	0,0004	0,0031
In-home maintenance	0,0001	3,6454	0,0002	0,0016
Grocery shopping	-0,0001	-2,2741	-	-
Out-of-home other maintenance	-	-	-	-
Sport	-	-	-	-
In-home online	-0,0004	-6,7127	-0,0001	-0,0009
Out-of-home online	-	-	-	-
<i>Percentages of time-use involving other people within a specific activity</i>				
Within in-home mandatory	-	-	-	-
Within out-of-home mandatory	-	-	-	-
Within in-home maintenance	-	-	-	-
Within out-of-home maintenance	0,0453	2,5691	0,0574	0,4492
Within in-home leisure	-	-	-	-
Within out-of-home leisure	-	-	-	-
Within in-home online	-	-	-	-
Within out-of-home online	-	-	-	-
Within sport	-	-	-	-
Within travel	-0,0507	-1,7521	-	-
Within all activities	-	-	-	-
<i>Percentages of time-use involving other household members within a specific activity</i>				
Within in-home mandatory	-	-	-	-
Within out-of-home mandatory	-	-	-	-
Within in-home maintenance	-	-	-	-
Within out-of-home maintenance	-0,0282	-1,9918	-0,0459	-0,4545
Within in-home leisure	-	-	-	-
Within out-of-home leisure	-	-	-	-
Within in-home online	-	-	-	-
Within out-of-home online	-	-	-	-
Within sport	-	-	-	-
Within travel	0,0367	2,0753	-	-
<i>Percentages of time-use involving relatives within a specific activity</i>				

Within in-home mandatory	-0,0198	-2,0421	-	-
Within out-of-home mandatory	0,0093	1,7037	-	-
Within in-home maintenance	-	-	-	-
Within out-of-home maintenance	-	-	-	-
Within in home leisure	-	-	-	-
Within out-of-home leisure	-	-	-	-
Within in-home online	-	-	-	-
Within out-of-home online	-	-	-	-
Within sport	-	-	-	-
Within travel	-	-	-	-
<i>Percentages of time-use involving friends in a specific activity</i>				
Within in-home mandatory	-	-	-	-
Within out-of-home mandatory	-	-	-	-
Within in-home maintenance	-	-	-	-
Within out-of-home maintenance	-	-	-	-
Within in-home leisure	-0,0073	-1,9544	-	-
Within out-of-home leisure	-	-	-	-
Within in-home online	-	-	-	-
Within out-of-home online	-	-	-	-
Within travel	0,0331	1,6658	-	-
<i>Percentages of time-use involving online friends within a specific activity</i>				
Within in-home mandatory	-	-	-	-
Within out-of-home mandatory	-	-	-	-
Within in-home maintenance	-	-	-	-
Within out-of-home maintenance	-	-	0,0303	0,6451
Within in home leisure	-0,0218	-2,2070	-	-
Within out-of-home leisure	-	-	-	-
Within in-home online	-	-	-	-
Within out-of-home online	-	-	-	-
Within travel	-	-	-	-
<i>Percentages of time-use involving other people within all activities</i>				
Joint activities with household members	-	-	-	-
Joint activities with relatives	-	-	-	-
Joint activities with friends	0,0119	2,0413	-	-

Joint activities with online friends	-	-	-	-
<i>Percentages of perceived time to visit some of public amnesties</i>				
Perceived travel time to Bank			-0,0279	-0,0989
Perceived travel time to CBD	-0,0034	-4,1654	-0,0009	-0,0116
Perceived travel time to office government	0,0239	7,4410	0,0126	0,0441
Perceived travel time to Groccery			-0,0056	-0,0492
Perceived travel time to Health consultant	0,0163	3,3395	0,0799	0,1127
Perceived travel time to Junior and sebiar High school	0,0126	7,6073	0,0087	0,0426
Perceived travel time to Hospital	0,0010	1,9757	0,0024	0,0203
Perceived travel time to Market	0,0079	3,9671	0,0042	0,0400
Perceived travel time to Park	-0,0669	-11,7066	-0,0154	-0,0503
Perceived travel time to Pimery school	-0,0174	-4,3219	-	-
Perceived travel time to Public transport	-	-	-	-
Perceived travel time to Shopping centre	-0,0149	-3,2740	-0,0395	-0,0789
Mean	-0,5815		-0,2224	
Std	0,5488		0,4871	
μ	0,8498293		0,8806853	
ε	2,83748E-05		2,99488E-05	
AIC	4931,9450		5066,401	
BIC	5475,029		5609,486	
Log likelihood	-2367,972		-2435,201	

Based on estimated result have shown in Table 2, can see as clearly the interaction between socio-demographics, travel characteristic, activity time duration, Perceived travel time to certain public amnesties and Involving other person in certain activities, as they have an impact on social and mental health.

In terms of *socio-demographic variables* the correlation between gender and activity travel participation is a major component in determining the mode of transportation people used. In the social and mental health index, males are found no significant correlation in social and mental health index than female. In general, women have less access because they have to travel longer distances and spend more of their money on transportation. This makes it harder for them to get to places where they can work, which cuts them off from some of the opportunities the city has to offer. And, as the theory pointed out, women's access isn't just affected by how much time and money they have, but also by their preferences for security, coverage, and comfort [106], [107], that effect to their mental health as well. There are also incidents of memory biases in terms of seeing or hearing somewhat

extremely disagreeable that might limit women from taking public transport [108]–[110]. Another study mentioned that many women than men, are more likely to have shorter commute distances, to chain trips, to have more non-work-related trips, to travel at off peak hours, and to choose more flexible mode of transportation as they realize them-self as unsafe [111], [112], then bring them to have much time to spend with family in home or neighbour, indirectly women have a better social health index than man. For people coming from low income, have negative social and mental health index compare with people coming from high income, due to less of resources (private vehicles and money) make people coming from low income have limited access[112], [113]. Number of household members indicating have a less social and mental health whereas student have a positive correlation with social and mental health index, due to student have commitment time to go to school everyday and spend their half day to meet and sharing the activity with other people in school. The next variables mainly *travel parameters variable*; it can be seen as clearly that for male using non-motorised mode have a better social health index than Car Based Ride-Service (CBRS) due to during the travel activity man can meet many people a that make them have a better social health index and also less of the budget. For male using private vehicles, public transport, motorised mode and Motorbyke Based Ride-Service (MBRS) have found no any correlation to social and mental health index. The variable *Time-use for a specific activity*, it can show that for male allocating more time for out-of-home socialing and recreations and in-home maintenance may indicating have a better social and mental health index whereas spending more time for in-home online activity may indicating have no better social and mental health index. Moreover, the variable *time-use involving other people within a specific activity* within household members and other household members (relatives, friends, and online friends) in certain activities, then the model confirms that social and physical health is directly affected by type of activity classification is undertaken with others person and with whom, this is result same as previous study [114]. The several scholars mentioned that when the people can spending more time in social activities if the activity involved others people that have same age or passion, then it can increasing of well-being and have effect to social health, because when people spending time with person that have close relationships with them such as with family, relatives and friends then it is can increasing their well-being and physical health [50], [115], [116]. The way people spending their activity dairy and dairy experience can showing that person on mental and social health or not [16]. *Percentages of time-use involving other people within a specific activity* within out-of-home maintenance activity may describe individuals have a better social and mental health index, 0,0453 and 0,00574, respectively. Allocating more time within travel time, may describe individual have less social index -0,0507, but have no correlation with mental health index. For the *percentages of time-use involving other household members within a specific activity* have no better social and mental health index, -0,0282 and -0,0459, respectively, for within out-of-home maintenance activity. Moreover, for allocating more time within travel time may indicating individuals have a better social health index, 0,0367. Moreover for *Percentages of time-use involving relatives within a specific activity* have no better social health index for within in-

home whereas have a better social health index out-of-home mandatory activity, -0,0198 and 0.093, respectively. For the variable *Percentages of time-use involving friends in a specific activity* have less social health index, 0.0073 within in-home leisure whereas have a better social index 0.0331 within travel activity. The variable *Percentages of time-use involving online friends within a specific activity* have no better social health index, -0,02i8 within in home leisure whereas have a better mental health index 0,0303 within out-of-home maintenance. The *Percentages of time-use involving other people within all activities* allocating more time joint activities with friends may indicating have a better social health index, 0,0119. The last variable mainly *Percentages of perceived time to visit some of public amnesties* spending more time to perceived travel time to Central Bussness Distric (BSD), to Park, shopping centre, may indicating have no better social and mental health index. Moreover, allocating more time for perceived travel time to office government, health consultant, junior and senior high school, hospital and market may showing have a better social and mental health index. Addition, allocating more time for perceived travel time to public transport may indicating have no any significant in social and mental health index.

7. Conclusion

The survey's data took place in the fall of 2019 in The Malang City Area, Indonesia. The existence of public transportation in Malang City becomes an essential factor to support its inhabitant. The most used public transportation in Malang City is Angkutan Kota (Angkot). There are many Angkot routes available for connecting three main terminals. The complicated problem of Angkot route search encourages the necessity of media that can provide information and recommendations to the society. Using multilevel modelling analysis statistic to analyze the interaction between variables, can revealed that people on social or mental health condition. Males have a better social health than female due to man as leader on family have multiple characteristics as father, husband, employer in company and members of the neighbor that make his activity travel pattern more complex due to increasing number of trips everyday then females. Mostly, people coming from low income and middle income living near workplace and due to limited of resources make them using public transport or carpool and non-motorised mode to travel every day to reduce budget, that is bring them meet many people during the travel compare if using private vehicles.

8. References

- [1] F. N. Nkeki and M. O. Asikhia, "Geographically weighted logistic regression approach to explore the spatial variability in travel behaviour and built environment interactions: Accounting simultaneously for demographic and socioeconomic characteristics," *Appl. Geogr.*, vol. 108, no. May, pp. 47–63, 2019, doi: 10.1016/j.apgeog.2019.05.008.

- [2] D. Wang and S. He, *Mobility, sociability and well-being of urban living*. 2015.
- [3] N. Vasudevan, N. Gore, R. Zope, S. Arkatkar, and G. Joshi, "Determining mode shift elasticity based on household income and travel cost," *Res. Transp. Econ.*, no. November, p. 100771, 2019, doi: 10.1016/j.retrec.2019.100771.
- [4] J. Zhu and Y. Fan, "Daily travel behavior and emotional well-being: Effects of trip mode, duration, purpose, and companionship," *Transp. Res. Part A Policy Pract.*, vol. 118, no. February 2017, pp. 360–373, 2018, doi: 10.1016/j.tra.2018.09.019.
- [5] A. Samimi, A. (Kouros) Mohammadian, and S. Madanizadeh, "Effects of transportation and built environment on general health and obesity," *Transp. Res. Part D Transp. Environ.*, vol. 14, no. 1, pp. 67–71, 2009, doi: 10.1016/j.trd.2008.10.002.
- [6] D. C. Parra *et al.*, "Household motor vehicle use and weight status among Colombian adults: Are we driving our way towards obesity?," *Prev. Med. (Baltim.)*, vol. 49, no. 2–3, pp. 179–183, 2009, doi: 10.1016/j.ypmed.2009.07.010.
- [7] A. C. Bell, K. Ge, and B. M. Popkin, "The road to obesity or the path to prevention: Motorized transportation and obesity in China," *Obes. Res.*, vol. 10, no. 4, pp. 277–283, 2002, doi: 10.1038/oby.2002.38.
- [8] E. Berglund, P. Lytsy, and R. Westerling, "Active traveling and its associations with self-rated health, BMI and physical activity: A comparative study in the adult Swedish population," *Int. J. Environ. Res. Public Health*, vol. 13, no. 5, 2016, doi: 10.3390/ijerph13050455.
- [9] C. D. Higgins, M. N. Sweet, and P. S. Kanaroglou, "All minutes are not equal: travel time and the effects of congestion on commute satisfaction in Canadian cities," *Transportation (Amst.)*, vol. 45, no. 5, pp. 1249–1268, 2018, doi: 10.1007/s11116-017-9766-2.
- [10] R. E. Wener and G. W. Evans, "Comparing stress of car and train commuters," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 14, no. 2, pp. 111–116, 2011, doi: 10.1016/j.trf.2010.11.008.
- [11] M. Hilbrecht, B. Smale, and S. E. Mock, "Highway to health? Commute time and well-being among Canadian adults," *World Leis. J.*, vol. 56, no. 2, pp. 151–163, 2014, doi: 10.1080/16078055.2014.903723.
- [12] M. Sweet, "Traffic Congestion's Economic Impacts: Evidence from US Metropolitan Regions," *Urban Stud.*, vol. 51, no. 10, pp. 2088–2110, 2014, doi: 10.1177/0042098013505883.
- [13] W. J. Requia, C. D. Higgins, M. D. Adams, M. Mohamed, and P. Koutrakis, "The health impacts of weekday traffic: A health risk assessment of PM2.5 emissions during congested periods," *Environ. Int.*, vol. 111, no. October 2017, pp. 164–176, 2018, doi: 10.1016/j.envint.2017.11.025.
- [14] J. De Vos, "Satisfaction-induced travel behaviour," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 63, pp. 12–21, 2019, doi: 10.1016/j.trf.2019.03.001.
- [15] D. B. E. Dharmowijoyo, Y. O. Susilo, and A. Karlström, "On complexity

- and variability of individuals' discretionary activities," *Transportation (Amst.)*, vol. 45, no. 1, pp. 177–204, 2018, doi: 10.1007/s11116-016-9731-5.
- [16] D. B. E. Dharmowijoyo and T. B. Joewono, "Mobility and Health: The Interaction of Activity-Travel Patterns, Overall Well-Being, Transport-Related Social Exclusion on Health Parameters," *Energy Effic. Mobil. Syst.*, pp. 53–83, 2020, doi: 10.1007/978-981-15-0102-9_4.
- [17] Y. O. Susilo and C. Liu, "Examining the relationships between individual's time use and activity participations with their health indicators," *Eur. Transp. Res. Rev.*, vol. 9, no. 2, 2017, doi: 10.1007/s12544-017-0243-y.
- [18] P. Van den Berg, T. Arentze, and H. Timmermans, "A latent class accelerated hazard model of social activity duration," *Transp. Res. Part A Policy Pract.*, vol. 46, no. 1, pp. 12–21, 2012, doi: 10.1016/j.tra.2011.09.015.
- [19] C. J. Greaves and L. Farbus, "Effects of creative and social activity on the health and well-being of socially isolated older people: Outcomes from a multi-method observational study," *J. R. Soc. Promot. Health*, vol. 126, no. 3, pp. 134–142, 2006, doi: 10.1177/1466424006064303.
- [20] A. Brochado, F. Oliveira-Brochado, and P. Brito, "Effects of personal, social and environmental factors on physical activity behavior among adults," *Rev. Port. Saúde Pública*, vol. 28, no. 1, pp. 7–17, 2010.
- [21] L. Ramírez *et al.*, *Handbook of Leisure, Physical Activity, Sports, Recreation and Quality of Life*. 2018.
- [22] T. He, C. Huang, M. Li, Y. Zhou, and S. Li, "Social Participation of the Elderly in China: The Roles of Conventional Media, Digital Access and Social Media Engagement," *Telemat. Informatics*, vol. 48, no. January, p. 101347, 2020, doi: 10.1016/j.tele.2020.101347.
- [23] R. M. Gyasi, D. R. Phillips, and K. Abass, "Social support networks and psychological wellbeing in community-dwelling older Ghanaian cohorts," *Int. Psychogeriatrics*, vol. 31, no. 7, pp. 1047–1057, 2019, doi: 10.1017/S1041610218001539.
- [24] H. K. Park, S. Y. Chun, Y. Choi, S. Y. Lee, S. J. Kim, and E. C. Park, "Effects of social activity on health-related quality of life according to age and gender: An observational study," *Health Qual. Life Outcomes*, vol. 13, no. 1, pp. 1–9, 2015, doi: 10.1186/s12955-015-0331-4.
- [25] M. F. Steger and T. B. Kashdan, "Depression and Everyday Social Activity, Belonging, and Well-Being," *J. Couns. Psychol.*, vol. 56, no. 2, pp. 289–300, 2009, doi: 10.1037/a0015416.
- [26] D. Deka, "The effect of mobility loss and car ownership on the feeling of depression, happiness, and loneliness," *J. Transp. Heal.*, vol. 4, pp. 99–107, 2017, doi: 10.1016/j.jth.2016.11.005.
- [27] B. Schüz *et al.*, "Leisure Time Activities and Mental Health in Informal Dementia Caregivers," *Appl. Psychol. Heal. Well-Being*, vol. 7, no. 2, pp. 230–248, 2015, doi: 10.1111/aphw.12046.
- [28] D. Figueiredo and M. Neves, "Falls Efficacy Scale-International: Exploring psychometric properties with adult day care users," *Arch. Gerontol.*

- Geriatr.*, vol. 79, no. September, pp. 145–150, 2018, doi: 10.1016/j.archger.2018.09.001.
- [29] K. Tomioka, N. Kurumatani, and H. Hosoi, “Positive and negative influences of social participation on physical and mental health among community-dwelling elderly aged 65-70 years: a cross-sectional study in Japan,” *BMC Geriatr.*, vol. 17, no. 1, pp. 1–13, 2017, doi: 10.1186/s12877-017-0502-8.
- [30] M. E. Kelly *et al.*, “The impact of social activities, social networks, social support and social relationships on the cognitive functioning of healthy older adults: A systematic review,” *Syst. Rev.*, vol. 6, no. 1, 2017, doi: 10.1186/s13643-017-0632-2.
- [31] K. Tomioka, N. Kurumatani, and K. Saeki, “The differential effects of type and frequency of social participation on IADL declines of older people,” *PLoS One*, vol. 13, no. 11, pp. 1–17, 2018, doi: 10.1371/journal.pone.0207426.
- [32] C. Fu, Z. Li, and Z. Mao, “Association between social activities and cognitive function among the elderly in china: A cross-sectional study,” *Int. J. Environ. Res. Public Health*, vol. 15, no. 2, 2018, doi: 10.3390/ijerph15020231.
- [33] and D. M. Y. A. M. Kevin Range, “基因的改变 NIH Public Access,” *Bone*, vol. 23, no. 1, pp. 1–7, 2012, doi: 10.1038/jid.2014.371.
- [34] Y. C. Yang, C. Boen, and K. Mullan Harris, “Social relationships and hypertension in late life: Evidence from a nationally representative longitudinal study of older adults,” *J. Aging Health*, vol. 27, no. 3, pp. 403–431, 2015, doi: 10.1177/0898264314551172.
- [35] E. M. Vogelsang, “Older adult social participation and its relationship with health: Rural-urban differences,” *Heal. Place*, vol. 42, no. October, pp. 111–119, 2016, doi: 10.1016/j.healthplace.2016.09.010.
- [36] L. Dahlberg and K. J. McKee, “Social exclusion and well-being among older adults in rural and urban areas,” *Arch. Gerontol. Geriatr.*, vol. 79, no. August, pp. 176–184, 2018, doi: 10.1016/j.archger.2018.08.007.
- [37] T. Abe, J. Seol, M. Kim, and T. Okura, “The relationship of car driving and bicycle riding on physical activity and social participation in Japanese rural areas,” *J. Transp. Heal.*, vol. 10, no. June, pp. 315–321, 2018, doi: 10.1016/j.jth.2018.05.002.
- [38] P. Næss, “Residential location, transport rationales and daily-life travel behaviour: The case of hangzhou metropolitan area, China,” *Prog. Plann.*, vol. 79, no. 1, pp. 1–50, 2013, doi: 10.1016/j.progress.2012.05.001.
- [39] P. Næss, S. Peters, H. Stefansdottir, and A. Strand, “Causality, not just correlation: Residential location, transport rationales and travel behavior across metropolitan contexts,” *J. Transp. Geogr.*, vol. 69, no. April, pp. 181–195, 2018, doi: 10.1016/j.jtrangeo.2018.04.003.
- [40] U. Studies, “Accessibility, Activity Participation and Location of Activities: Exploring the Links between Residential Location and Travel Behaviour,” *Urban Stud.*, vol. 43, no. 3, pp. 627–652, 2006.
- [41] K. Mouratidis, D. Ettema, and P. Næss, “Urban form, travel behavior, and

- travel satisfaction,” *Transp. Res. Part A Policy Pract.*, vol. 129, no. October 2018, pp. 306–320, 2019, doi: 10.1016/j.tra.2019.09.002.
- [42] A. Nathan *et al.*, “The Role of the Built Environment on Health Across the Life Course: A Call for CollaborACTION,” *Am. J. Heal. Promot.*, vol. 32, no. 6, pp. 1460–1468, 2018, doi: 10.1177/0890117118779463a.
- [43] Y. Yang, X. Wu, P. Zhou, Z. Gou, and Y. Lu, “Towards a cycling-friendly city: An updated review of the associations between built environment and cycling behaviors (2007–2017),” *J. Transp. Heal.*, vol. 14, no. July, 2019, doi: 10.1016/j.jth.2019.100613.
- [44] P. Chen and J. Zhou, “Effects of the built environment on automobile-involved pedestrian crash frequency and risk,” *J. Transp. Heal.*, vol. 3, no. 4, pp. 448–456, 2016, doi: 10.1016/j.jth.2016.06.008.
- [45] D. B. E. Dharmowijoyo, Y. O. Susilo, A. Karlström, and L. S. Adiredja, “Collecting a multi-dimensional three-weeks household time-use and activity diary in the Bandung Metropolitan Area, Indonesia,” *Transp. Res. Part A Policy Pract.*, vol. 80, pp. 231–246, 2015, doi: 10.1016/j.tra.2015.08.001.
- [46] R. Lovelace and J. Parkin, “Estimating the Determinants of Cycling: From Area to Road Network Levels,” *J. Transp. Heal.*, vol. 9, pp. S4–S5, 2018, doi: 10.1016/j.jth.2018.05.054.
- [47] F. Takeda, H. Noguchi, T. Monma, and N. Tamiya, “How possibly do leisure and social activities impact mental health of middle-Aged adults in Japan?: An evidence from a national longitudinal survey,” *PLoS One*, vol. 10, no. 10, pp. 1–10, 2015, doi: 10.1371/journal.pone.0139777.
- [48] L. F. Berkman, T. Glass, I. Brissette, and T. E. Seeman, “Social Science & Medicine From social integration to health : Durkheim in the new,” vol. 51, no. 1, 2000, doi: 10.1016/S0277-Get.
- [49] K. B. Adams, S. Leibbrandt, and H. Moon, “A critical review of the literature on social and leisure activity and wellbeing in later life,” *Ageing Soc.*, vol. 31, no. 4, pp. 683–712, 2011, doi: 10.1017/S0144686X10001091.
- [50] A. Milner, L. Krnjacki, P. Butterworth, and A. D. LaMontagne, “The role of social support in protecting mental health when employed and unemployed: A longitudinal fixed-effects analysis using 12 annual waves of the HILDA cohort,” *Soc. Sci. Med.*, vol. 153, pp. 20–26, 2016, doi: 10.1016/j.socscimed.2016.01.050.
- [51] H. Gilmour, “Social participation and the health and well-being of Canadian seniors,” *Heal. Reports*, vol. 23, no. 4, pp. 3–12, 2012.
- [52] Q. Tang and X. Hu, *Triggering behavior changes with information and incentives: An active traffic and demand management-oriented review*, 1st ed., vol. 3. Elsevier Inc., 2019.
- [53] W. J. Requia, C. D. Higgins, M. D. Adams, M. Mohamed, and P. Koutrakis, “The health impacts of weekday traffic: A health risk assessment of PM2.5 emissions during congested periods,” *Environ. Int.*, vol. 111, no. November 2017, pp. 164–176, 2018, doi: 10.1016/j.envint.2017.11.025.
- [54] M. Sweet and P. Kanaroglou, “Gender differences: The role of travel and time use in subjective well-being,” *Transp. Res. Part F Traffic Psychol.*

- Behav.*, vol. 40, pp. 23–34, 2016, doi: 10.1016/j.trf.2016.03.006.
- [55] R. M. Pendyala, T. Yamamoto, and R. Kitamura, “On the formulation of time-space prisms to model constraints on personal activity-travel engagement,” *Transportation (Amst.)*, vol. 29, no. 1, pp. 73–94, 2002, doi: 10.1023/A:1012905110686.
- [56] A. Justen, F. J. Martínez, and C. E. Cortés, “The use of space-time constraints for the selection of discretionary activity locations,” *J. Transp. Geogr.*, vol. 33, pp. 146–152, 2013, doi: 10.1016/j.jtrangeo.2013.10.009.
- [57] H. J. Miller, “Modelling accessibility using space-time prism concepts within geographical information systems,” *Int. J. Geogr. Inf. Syst.*, vol. 5, no. 3, pp. 287–301, 1991, doi: 10.1080/02693799108927856.
- [58] H. J. Miller, “Time Geography and Space-Time Prism,” *Int. Encycl. Geogr.*, pp. 1–19, 2017, doi: 10.1002/9781118786352.wbieg0431.
- [59] K. Lucas, J. Bates, J. Moore, and J. A. Carrasco, “Modelling the relationship between travel behaviours and social disadvantage,” *Transp. Res. Part A Policy Pract.*, vol. 85, pp. 157–173, 2016, doi: 10.1016/j.tra.2016.01.008.
- [60] T. Neutens, F. Witlox, N. Van De Weghe, and P. De Maeyer, “Human interaction spaces under uncertainty,” *Transp. Res. Rec.*, no. 2021, pp. 28–35, 2007, doi: 10.3141/2021-04.
- [61] T. Neutens, T. Schwanen, and F. Witlox, “The prism of everyday life: Towards a new research agenda for time geography,” *Transp. Rev.*, vol. 31, no. 1, pp. 25–47, 2011, doi: 10.1080/01441647.2010.484153.
- [62] T. Neutens, F. Witlox, N. Van De Weghe, and P. H. De Maeyer, “Space-time opportunities for multiple agents: A constraint-based approach,” *Int. J. Geogr. Inf. Sci.*, vol. 21, no. 10, pp. 1061–1076, 2007, doi: 10.1080/13658810601169873.
- [63] T. Hägerstrand, “WHAT ABOUT PEOPLE IN REGIONAL SCIENCE ? by Torsten H / igerstrand *,” *Pap. Reg. Sci.*, vol. 66, pp. 1–6, 1970, doi: 10.1111/j.1435-5597.1970.tb01464.x.
- [64] I. Cullen and V. Godson, “Urban networks: The structure of activity patterns,” *Prog. Plann.*, vol. 4, no. PART 1, pp. 1–96, 1975, doi: 10.1016/0305-9006(75)90006-9.
- [65] D. B. E. Dharmowijoyo, Y. O. Susilo, and A. Karlström, “Relationships among discretionary activity duration, its travel time spent and activity space indices in the Jakarta Metropolitan Area, Indonesia,” *J. Transp. Geogr.*, vol. 54, pp. 148–160, 2016, doi: 10.1016/j.jtrangeo.2016.05.012.
- [66] T. Schwanen, M. P. Kwan, and F. Ren, “How fixed is fixed? Gendered rigidity of space-time constraints and geographies of everyday activities,” *Geoforum*, vol. 39, no. 6, pp. 2109–2121, 2008, doi: 10.1016/j.geoforum.2008.09.002.
- [67] Q. Liang, J. Weng, W. Zhou, S. B. Santamaria, J. Ma, and J. Rong, “Individual Travel Behavior Modeling of Public Transport Passenger Based on Graph Construction,” *J. Adv. Transp.*, vol. 2018, 2018, doi: 10.1155/2018/3859830.
- [68] K. Lucas, I. Phillips, C. Mulley, and L. Ma, “Is transport poverty socially or environmentally driven? Comparing the travel behaviours of two low-

- income populations living in central and peripheral locations in the same city,” *Transp. Res. Part A Policy Pract.*, vol. 116, no. August, pp. 622–634, 2018, doi: 10.1016/j.tra.2018.07.007.
- [69] M. Li, M. Zou, and H. Li, *Urban Travel Behavior Study Based on Data Fusion Model*. Elsevier Inc., 2019.
- [70] L. A. Merlin, “Accessibility, travel behavior, and urban form change,” *ProQuest Diss. Theses*, p. 174, 2014, [Online]. Available: <http://search.proquest.com.ezaccess.library.uitm.edu.my/docview/1548706931?accountid=42518>.
- [71] V. Van Acker, C. Mulley, and L. Ho, “Impact of childhood experiences on public transport travel behaviour,” *Transp. Res. Part A Policy Pract.*, vol. 130, no. October, pp. 783–798, 2019, doi: 10.1016/j.tra.2019.10.008.
- [72] J. Zhang, “Urban Forms and Health. Promotion: An Evaluation Based On Urban Forms And Health Health-Related Qol Indicators,” *Proceeding 13th World Conf. Transp. Res.*, pp. 1–20, 2013.
- [73] T. H. Newsome, W. A. Walcott, and P. D. Smith, “Urban activity spaces: Illustrations and application of a conceptual model for integrating the time and space dimensions,” *Transportation (Amst.)*, vol. 25, no. 2–4, pp. 357–377, 1998, doi: 10.1023/A:1005082827030.
- [74] S. Darcy and P. F. Burke, “On the road again: The barriers and benefits of automobility for people with disability,” *Transp. Res. Part A Policy Pract.*, vol. 107, no. October 2017, pp. 229–245, 2018, doi: 10.1016/j.tra.2017.11.002.
- [75] B. B. Brown, C. M. Werner, C. P. Tribby, H. J. Miller, and K. R. Smith, “Transit use, physical activity, and body mass index changes: Objective measures associated with complete street light-rail construction,” *Am. J. Public Health*, vol. 105, no. 7, pp. 1468–1474, 2015, doi: 10.2105/AJPH.2015.302561.
- [76] D. B. E. Dharmowijoyo, *7. The complexity and variability of individuals’ activity-travel patterns in Indonesia*. 2016.
- [77] K. Mouratidis, “Built environment and leisure satisfaction: The role of commute time, social interaction, and active travel,” *J. Transp. Geogr.*, vol. 80, no. August, p. 102491, 2019, doi: 10.1016/j.jtrangeo.2019.102491.
- [78] Y. Liu, Y. Zhang, S. T. Jin, and Y. Liu, “Spatial pattern of leisure activities among residents in Beijing, China: Exploring the impacts of urban environment,” *Sustain. Cities Soc.*, vol. 52, no. August 2019, p. 101806, 2020, doi: 10.1016/j.scs.2019.101806.
- [79] J. P. Gliebe and F. S. Koppelman, “Modeling household activity-travel interactions as parallel constrained choices,” *Transportation (Amst.)*, vol. 32, no. 5, pp. 449–471, 2005, doi: 10.1007/s11116-005-5328-0.
- [80] K. Fransen, S. Farber, G. Deruyter, and P. De Maeyer, “A spatio-temporal accessibility measure for modelling activity participation in discretionary activities,” *Travel Behav. Soc.*, vol. 10, no. September 2017, pp. 10–20, 2018, doi: 10.1016/j.tbs.2017.09.002.
- [81] J. Zhang, “Life-Oriented Behavioral Research for Urban Policy,” *Life-Oriented Behav. Res. Urban Policy*, pp. 1–83, 2017, doi: 10.1007/978-4-

- 431-56472-0.
- [82] Y. Suzukamo, S. Fukuhara, J. Green, M. Kosinski, B. Gandek, and J. E. Ware, "Validation testing of a three-component model of Short Form-36 scores," *J. Clin. Epidemiol.*, vol. 64, no. 3, pp. 301–308, 2011, doi: 10.1016/j.jclinepi.2010.04.017.
- [83] P. J. Chang, L. Wray, and Y. Lin, "Social relationships, leisure activity, and health in older adults," *Heal. Psychol.*, vol. 33, no. 6, pp. 516–523, 2014, doi: 10.1037/hea0000051.
- [84] F. J. Carod-Artal, "Social determinants of mental health," *Glob. Ment. Heal. Prev. Promot.*, pp. 33–46, 2017, doi: 10.1007/978-3-319-59123-0_4.
- [85] J. J. de Hartog, H. Boogaard, H. Nijland, and G. Hoek, "Do the health benefits of cycling outweigh the risks?," *Environ. Health Perspect.*, vol. 118, no. 8, pp. 1109–1116, 2010, doi: 10.1289/ehp.0901747.
- [86] A. De Nazelle *et al.*, "Improving health through policies that promote active travel: A review of evidence to support integrated health impact assessment," *Environ. Int.*, vol. 37, no. 4, pp. 766–777, 2011, doi: 10.1016/j.envint.2011.02.003.
- [87] A. C. Lindsay, M. L. Greaney, S. F. Wallington, T. Mesa, and C. F. Salas, "A review of early influences on physical activity and sedentary behaviors of preschool-age children in high-income countries," *J. Spec. Pediatr. Nurs.*, vol. 22, no. 3, 2017, doi: 10.1111/jspn.12182.
- [88] I. Avila-Palencia *et al.*, "The effects of transport mode use on self-perceived health, mental health, and social contact measures: A cross-sectional and longitudinal study," *Environ. Int.*, vol. 120, no. June, pp. 199–206, 2018, doi: 10.1016/j.envint.2018.08.002.
- [89] Y. O. Susilo, C. Liu, and M. Börjesson, "The changes of activity-travel participation across gender, life-cycle, and generations in Sweden over 30 years," *Transportation (Amst.)*, vol. 46, no. 3, pp. 793–818, 2019, doi: 10.1007/s11116-018-9868-5.
- [90] M. Fisher and F. Baum, "The social determinants of mental health: Implications for research and health promotion," *Aust. N. Z. J. Psychiatry*, vol. 44, no. 12, pp. 1057–1063, 2010, doi: 10.3109/00048674.2010.509311.
- [91] J. Bowman and M. Ben-Akiva, "The Daily Activity Schedule Approach to Travel Demand Analysis," 2015.
- [92] S. Cairns, C. Harmer, J. Hopkin, and S. Skippon, "Sociological perspectives on travel and mobilities: A review," *Transp. Res. Part A Policy Pract.*, vol. 63, no. May, pp. 107–117, 2014, doi: 10.1016/j.tra.2014.01.010.
- [93] T. Gärling and S. Fujii, "Travel behavior modification: Theories, methods, and programs," *Expand. Sph. Travel Behav. Res.*, no. March, pp. 97–128, 2009.
- [94] D. Umberson and J. Karas Montez, "Social Relationships and Health: A Flashpoint for Health Policy," *J. Health Soc. Behav.*, vol. 51, no. 1_suppl, pp. S54–S66, 2010, doi: 10.1177/0022146510383501.
- [95] T. Fasihi Harandi, M. Mohammad Taghinasab, and T. Dehghan Nayeri, "The correlation of social support with mental health: A meta-analysis," *Electron. Physician*, vol. 9, no. 9, pp. 5212–5222, 2017, doi:

- 10.19082/5212.
- [96] J. Garrard, "Active transport: Adults : An overview of recent evidence ," no. December, pp. 1–21, 2009, [Online]. Available: http://www.chpcp.org/resources/Active_Transport_Adults_FINAL.pdf.
- [97] B. van Wee and D. Ettema, "Travel behaviour and health: A conceptual model and research agenda," *J. Transp. Heal.*, vol. 3, no. 3, pp. 240–248, 2016, doi: 10.1016/j.jth.2016.07.003.
- [98] J. Zhang, *Life-Oriented Behavioral Research for Urban Policy*. 2017.
- [99] A. Bornioli, G. Parkhurst, and P. L. Morgan, "Affective experiences of built environments and the promotion of urban walking," *Transp. Res. Part A Policy Pract.*, vol. 123, no. January, pp. 200–215, 2019, doi: 10.1016/j.tra.2018.12.006.
- [100] C. Bartels, T. Kolbe-Alexander, R. Behrens, S. Hendricks, and E. V. Lambert, "Can the use of Bus Rapid Transit lead to a healthier lifestyle in urban South Africa? The SUN Study," *J. Transp. Heal.*, vol. 3, no. 2, pp. 200–210, 2016, doi: 10.1016/j.jth.2016.04.003.
- [101] M. R. O. Beiler, G. Miller, and M. Brown, "Transportation and recreational infrastructure development: Transport and land use measures for public health comparisons," *J. Urban Plan. Dev.*, vol. 144, no. 4, pp. 1–19, 2018, doi: 10.1061/(ASCE)UP.1943-5444.0000468.
- [102] J. Hwang, S. Park, and S. Kim, "Effects of participation in social activities on cognitive function among middle-aged and older adults in Korea," *Int. J. Environ. Res. Public Health*, vol. 15, no. 10, 2018, doi: 10.3390/ijerph15102315.
- [103] N. J. Newton, J. Pladevall-Guyer, R. Gonzalez, and J. Smith, "Activity Engagement and Activity-Related Experiences: The Role of Personality," *Journals Gerontol. - Ser. B Psychol. Sci. Soc. Sci.*, vol. 73, no. 8, pp. 1480–1490, 2018, doi: 10.1093/geronb/gbw098.
- [104] R. Arroyo, T. Ruiz, D. Casquero, and L. Mars, "Trip Characteristics Analysis of the Effects of a Travel Behavior Change Program," *Transp. Res. Rec.*, vol. 2672, no. 47, pp. 146–158, 2018, doi: 10.1177/0361198118773184.
- [105] S. Kaplan, D. K. Wrzesinska, and C. G. Prato, "Psychosocial benefits and positive mood related to habitual bicycle use," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 64, pp. 342–352, 2019, doi: 10.1016/j.trf.2019.05.018.
- [106] M. C. Lecompte and B. S. Juan Pablo, "Transport systems and their impact on gender equity," *Transp. Res. Procedia*, vol. 25, pp. 4245–4257, 2017, doi: 10.1016/j.trpro.2017.05.230.
- [107] E. García-Jiménez *et al.*, "Methodology for gender analysis in transport: Factors with influence in women's inclusion as professionals and users of transport infrastructures," *Sustain.*, vol. 12, no. 9, pp. 1–32, 2020, doi: 10.3390/su12093656.
- [108] M. I. O. Sánchez and E. M. González, "Gender Differences in Commuting Behavior: Women's Greater Sensitivity," *Transp. Res. Procedia*, vol. 18, no. June, pp. 66–72, 2016, doi: 10.1016/j.trpro.2016.12.009.

- [109] V. Basarić, A. Vujičić, J. M. Simić, V. Bogdanović, and N. Saulić, “Gender and Age Differences in the Travel Behavior - A Novi Sad Case Study,” *Transp. Res. Procedia*, vol. 14, pp. 4324–4333, 2016, doi: 10.1016/j.trpro.2016.05.354.
- [110] A. Press and B. Environment, “Women ’ s Gender-Role and its Influence on Travel Behaviour,” vol. 10, no. 1, pp. 61–68, 2013.
- [111] W. Elias, J. Benjamin, and Y. Shiftan, “Gender differences in activity and travel behavior in the Arab world,” *Transp. Policy*, vol. 44, pp. 19–27, 2015, doi: 10.1016/j.tranpol.2015.07.001.
- [112] J. Scheiner and C. Holz-Rau, “Gendered travel mode choice: a focus on car deficient households,” *J. Transp. Geogr.*, vol. 24, pp. 250–261, 2012, doi: 10.1016/j.jtrangeo.2012.02.011.
- [113] H. T. A. Nguyen, M. Chikaraishi, A. Fujiwara, and J. Zhang, “Mediation effects of income on travel mode choice: Analysis of short-distance trips based on path analysis with multiple discrete outcomes,” *Transp. Res. Rec.*, vol. 2664, no. 1, pp. 23–30, 2017, doi: 10.3141/2664-03.
- [114] J. Syahputri, T. B. Joewono, and D. B. E. Dharmowijoyo, “Investigating the Role of Activity-Travel Participation on Daily Travel Satisfaction in Bandung Metropolitan Area,” vol. 193, no. Istdc 2019, pp. 91–95, 2020, doi: 10.2991/aer.k.200220.019.
- [115] T. Schwanen and D. Wang, “Well-Being, Context, and Everyday Activities in Space and Time,” *Ann. Assoc. Am. Geogr.*, vol. 104, no. 4, pp. 833–851, 2014, doi: 10.1080/00045608.2014.912549.
- [116] J. Kim, S. Rasouli, and H. J. P. Timmermans, “Social networks, social influence and activity-travel behaviour: a review of models and empirical evidence,” *Transp. Rev.*, vol. 38, no. 4, pp. 499–523, 2018, doi: 10.1080/01441647.2017.1351500.