Abstract. The COVID-19 outbreak had an impact not only on health but also on new lifestyle changes (economic and environmental), particularly changes in mode choice behavior. Government applied various restrictions such as limited gathering, mandatory face masks to prevent the transmission of pandemic’s spread. Restrictions changes personal decisions about which mode of transportation to use. This study highlighted changes in perspective towards mode choice. People prefer walking, cars, and motorbikes during the pandemic as they feel safer and cost-effective. Numerous studies related to activity satisfaction found daily activities, mode choice, and well-being form process and evaluation of an individual's satisfaction. This study focuses the relationship between public transportation (sustainable transport, safe, green, and efficient) to activity satisfaction levels caused by COVID-19 outbreak. Agglomeration Surakarta, Indonesia, has become the location for this study. The data was taken through of 402 respondents. The level of activity satisfaction is indicated using a Likert Scale. Bivariate analysis is applied to determine the most influencing factors of trips decreased sharply [6]. The large reduction in the use of public transport explained by reason the pandemic situation. Public transport is a key driver of sustainability in the transport sector as well as a tool to address the sustainability impacts of auto-dependence private vehicle [7].

In the past decade, studies have started analysing the relationship between travel and well-being. A day-to-day variability framework will capture a better picture of how people undertake various activities and the duration of the activities in turn reducing bias in explaining transport related social exclusion/inclusion [8]. It can even be argued that people plan and undertake activities to satisfy their needs and maintain or enhance well-being.

This study conceptually outlines and examines how travel mode choice, and activity satisfaction are interrelated and exploring satisfaction of out-of-home working and studying activities by a specific mode of transport. Public transportation has a variety impacts, specific on environmental, economic, and social issues of sustainable transportation and its application to decision making [9].

Several studies indicate that using public transportation correlates with more negative satisfaction than using private transport [10], but there are no...
specific studies that elaborate on people's activity satisfaction toward using ride-sourcing or public transport in more specific activity type. Another hypothesis that the different types of travel modes can have different effects to activity satisfaction, and private travel modes is hypothesized to positively correlate with activity satisfaction.

In this study we focus on type of activity: out-of-home working and studying, socialising activities and travel. It be argued that out-of-home working and studying activities or socialising activities using private car which can be considered as satisfying/enjoyable and realising certain personal goals are planned and undertaken to satisfy certain needs [11] or safety from viruses. Selecting an enjoyable travel mode can influence both activity satisfaction and eudaimonia well-being [12].

This research is structured as follows: Section 1 presents an introduction explaining the background COVID-19 pandemic has changed every aspect of life, work, satisfaction, and mode choice decision in Agglomeration Surakarta cities covered within this study. Section 2 gives an overview of existing studies on activity satisfaction, with a focus on the correlation of travel mode choice, mode choice based different activity and socio-demographic with activity satisfaction. Section 3 presents the conclusions of the results of this study and the proposed policy implementation, study limitations, and proposals for the next research.

2 Method

2.1 Agglomeration Surakarta data set

The study area is Agglomeration Surakarta, Jawa Tengah, Indonesia, consists of five regencies/cities including the City of Surakarta, Boyolali Regency, Sukoharjo Regency, Karanganyar Regency, and Sragen Regency. The areas contain of 2,855.16 km² and population of 4.4 million [13]. The area of the study based on the population and area it can be said that Agglomeration Surakarta is one of the megapolitan cities in Indonesia.

The area of Surakarta City is relatively limited, and public interest is high to live in the city resulted in the city can no longer accommodate population activities. Surakarta city as centre of activity that arose in the centre or better known with the Central Business District [14]. Each city around Central Business District in different function and role can support end equip one to another [15].

The data involved in this paper is a diary data set in the study area for adults (over 17 years of age) in a sample of family households. The activity diary recorded details of all activities and trips made by respondents in the four-day period, including the activity diary, time use, activity duration, travel mode used, street address, individual’s activity satisfaction, and other information about the individual present when performing each activity. The survey was made easier by dividing people's activity time into 96 time slices, each of which was equal to 15 minutes, as suggested by Dharmowijoyo et al. [16]. From March 2021 until Mei 2023, the government implement policies pemberlakuan pembatasan kegiatan masyarakat (PPKM), in Java and Bali Island cities.

2.2 Materials

2.2.1 Previous studies on activity satisfaction

Since the 2000s, situation has changed: measuring subjective well-being by individuals is being used more and more across multiple disciplines. Subjective well-being is a cognitive evaluation of how good one’s life is doing over a period of time [17]. Subjective well-being can be affected by (satisfaction with) daily activities. Daily activities help people to actualise their potentials and achieve personal growth and progress to their goals. Activities and travels are materialised actions of human in their efforts of satisfying their needs and desires shaped by their constraints in a complex manner within the constraints of time and space [18].

Evaluation of an activity episode is affected by the emotions experienced during that episode [19] whether positive or negative feelings during the activity. Out-of-home activities and leisure/social activities seem to result in higher levels of activity satisfaction compared to activities at home or more mandatory activities [20].

2.2.2 Mode choice

Numerous studies have shown that trip duration and choice of travel mode have a significant impact on how satisfied people are with the trip [21], but there are no studies about correlation of travel mode with activity satisfaction. Most studies analysing travel satisfaction focused on elements that explaining variations in how satisfied people are with their trips [22] while satisfaction with daily activity refers to how satisfied people are with daily activity patterns has not been studied.

Cognitive evaluation not only affect travel mode choice in a direct way; they can also affect the mode choice indirectly through longer-term choices that help to shape and are shaped by travel choices.

2.2.3 Socio-demographic variables

A group of socio-demographic variables was included to characterize the individuals in our sample and to identify their objective life circumstances: gender; age; household income; household members; leisure time; and religious activities time. We also assessed well-being status by questioning individuals about satisfied of activity.

2.3 Data analysis

To measure how satisfied respondents were with their activity we applied scale SAS. Satisfaction with activity scale (SAS) contains seven items analysing the experienced emotions during activity, ranging from
negative to positive with varying levels of activation (i.e., satisfied–dissatisfied).

Descriptive statistics are used to summarize data in an organized manner by describing the relationship between variables in a sample or population. Changes in activity and travel behavior can be explained by changes in activity and travel percentage using dataset in Bandung Metropolitan Area 2013 and 2017, in developing country.

The statistical of our observations was assessed using an of linear regression to identify the significantly correlation attribute to activity satisfaction during COVID-19 outbreak. Linear regression is a process of modelling a linear correlation between two variables. With linear regression a best fit or trend line is found that models a series of data.

3 Result

3.1 Sample description

The data was collected through a survey conducted from March to July 2021. A total of 402 respondents’ data diaries were received. The profile of the samples used in this study is shown in Table 1.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Percentage or mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male: 49.72%, Female: 50.28%</td>
</tr>
<tr>
<td>Age</td>
<td>Under 23 years: 29.10%, Between 23 - 45 years: 27.11%, Between 46 - 55 years: 27.36%, Above 55 years: 16.42%</td>
</tr>
<tr>
<td>Occupation</td>
<td>Non-Worker: 20.40%, Worker: 50.50%, Student: 29.10%</td>
</tr>
<tr>
<td>Income</td>
<td>Low income (IDR &lt; 3 million/month): 27.25%, Medium income (IDR 3-6 million/month): 29.41%, High income (IDR &gt; 6 million/month): 33.33%</td>
</tr>
</tbody>
</table>

Table 1 shows the descriptive statistics of the respondents in this study. Nearly 50.25% of the respondents are female. Meanwhile, 29.10% of respondents are under 23 years old (productive age).

3.2 Time allocation

Using Bandung metropolitan area (BMA) dataset for 2013 and 2017, and agglomeration Surakarta City (ASC) 2022 shows that in-home activities was also increase from 71.71% to 76.01% to 80.20%.

The activities out-of-home reduced from 22.91% to 18.48% to 16.10% as shown in Fig. 1. The data revealed that people had an extreme response to fear, people may suspect to physically contact other have a higher risk for disease transmission. According to similar research that pandemic changed in activity behavior, the fear during MERS pandemic the in South Korea, effect people refrained from normal daily activities such as going out [23].

3.3 Mobility during COVID-19 in agglomeration Surakarta cities.

Five transport modes were found in the dataset, with the distribution presented in Fig. 2, and considering that the main objective of this study is to identify the key features that are crucial in choice of transport modes:

- Bus, taxi, and trains are merged into one specific class: public transport (1.83% of the data).
- Car and motorcycle are merged into one specific class: private vehicle (55.51 % for car and motorcycle with 19.77 % of the data).
- Walking and bicycle are merged into one specific class: non-motorised (22.43 % of the data).
- Ride online, taxi online are merged into one specific class: ride-sourcing (0.46 % of the data).

Fig. 1. Percentage of various travel mode in 2022.

This assumption is made mainly because the main objective of this work is to study how these transport modes are chosen and considering the low number of trips made by public transport and ride-sourcing. Since reducing the “risk of infections” is now a priority in mode choice decisions, the high risk of exposure to the virus in public transportation brings about a sharp reduction in its usage [24].

The demand of taxis and ridesharing services we called ride-sourcing, has profoundly diminished due to both reduced service operations and users’ concerns about being infected with the virus in shared vehicles. Nian et al. [25] investigated the impact of COVID-19 on taxi travel behavior in Chongqing, China. The results show that the number of ride-sourcing dropped sharply during the pandemic and in the Surakarta agglomeration condition had the same experience as shown in Fig. 2.
3.4 Activity satisfaction based on variable

3.4.1 Activity satisfaction level based on socio-demographic.

The highest level of activity satisfaction were male, students, high income, and in the productive age range (under 23 years old) as shown in Fig. 3. During the COVID-19 pandemic, several government regulations appeal that learning activities doing at home. This allowed students to benefit from virtual applications, learning media accessible platforms, and they were free from time-wasting activities such as time to be spent on the way to school appropriate research of Ettena [10].

![Variation of Activity Satisfaction based on Socio-demographic](image)

**Fig. 3.** Activity satisfaction level-based socio-demographic in 2022.

In previous research the groups of students without online platforms demonstrated dissatisfaction, because they frequently deal with repetitive and accumulated daily activities or routines [26]. The results of this study show that student activities are more satisfied because they are assisted by virtual applications, without the need to travel time to school, which wastes time, effort, and money. Bartik [27] also showed that students who studying in home increased their productivity by 10%.

Individuals with high income affect activity satisfaction because their primary, secondary, and tertiary needs are met and so their emotions are stable. They do not need to work hard to meet their basic needs but are more satisfied with activities, such as being useful for other (social activities) and self-actualization.

3.4.2 Activity satisfaction level in various activity type using transport mode

Public transportation usage has the lowest level of activity satisfaction as shown in Figure 4. In previous research, people are dissatisfied using public transport for reason cleanliness, comfort, safety, punctuality, transit stops, distance travelled, road and paths used in accordance with public transport regulations [28] and results in a lower level of satisfaction when compared to non-motorized users [21].

Non-motorized users can be affected by weather conditions, the presence of slopes, personal health levels, and quality of walking/cycling infrastructure (e.g., wide sidewalks and safe (zebra) crossing for pedestrians; separated cycle lanes and cycling parking for cyclists) [28].

![Various Mode Transport in Travel](image)

**Fig. 4.** Activity satisfaction level of various mode transport in travel in 2022.

Considering the health aspect, travelling by public transport during COVID-19 makes people more worried and afraid to use private modes of transport. In previous studies, people who use public transport are most unsatisfied about their travel [22].

Salomon [29], Ory and Mokhtarian [30] show that people like leisure/socializing trips more than commuting trips. Fig. 5 show people who use high-frequency car for out-of-home mandatory (working, studying) activities are more satisfied. While compared activities such as socializing as shown in Fig. 6 (listening to music, enjoying the scenery, and talking to co-travellers using high-frequency car more improve the positive utility of satisfaction, some of the activities performed during travel, such as relaxing, reading a book or listening to music, might be attempts to abate boredom [22].

![Various Mode Transport in Out-of-home Working and Studying](image)

**Fig. 5.** Activity Satisfaction level of various mode transport in out-of-home working and studying activity in 2022.

Public transport users are considered dissatisfied with their trips compared to various modes of travel. Activity satisfaction with different destination produces different results because they have different characters. Commuter trips and work activities are mostly mandatory and invariable character, so they have a different level of activity satisfaction with travel than activities for socializing.
4 Conclusion

In general, the COVID-19 pandemic is a serious situation. The way that COVID-19’s effects are described is crucial and always evolving, the activity out of home low and low usage of public transport facilities. Cost and convenience were important factors in modal choice decisions in developing countries before the COVID-19 pandemic, but they have since been superseded by the variable lowering the risk of pandemic infection.

The results of the highest mode choice of community in Surakarta agglomeration cities are using private vehicles, cycling (conventional or electric), and even walking. The high risk of exposure to the virus in public transportation brings about a sharp reduction in its usage. The highest activity satisfaction was found when using private vehicles for socializing, working, and studying. This mandatory activity can increase in more the user of cars and congestion.

Accordingly, raising awareness about regarding people's behavior regarding the current pandemic, government policy must concentrate on designing appropriate spatial and transportation responses. Governments can also invest in preparedness for behavior changes that are likely to become habit-forming.

References


