SUSTAINABLE MOBILITY AT HIGH-TRAFFIC LOCATIONS – THE CASE OF GENERAL HOSPITAL NOVO MESTO

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This survey study was conducted as part of the SALOMON[1] project which aims to raise awareness about sustainable mobility and increase the share of trips made by sustainable forms of mobility when traveling to General Hospital Novo mesto in Slovenia. The aims of the survey study were: 1) to identify the current travel patterns and 2) to explore the critical factors (e.g., travel time, convenience, safety risks) influencing travel mode choice among hospital staff, patients, and visitors. An online survey was used to collect data from a total of 279 respondents (146 hospital staff and 133 patients/visitors). Examination of the frequencies for different travel modes shows that a big majority of the respondents, both among hospital staff and patients/visitors, use petrol/diesel cars when traveling to the hospital. On the other hand, sustainable travel options, especially public transport use and active modes such as cycling, are rarely used. The Importance-Performance Analysis (IPA) framework was used to identify the factors that are critical for travel mode choice among the respondents. Based on the variables measured in the survey, different factors, such as time use, convenience, and safety, were used in the IPA. Average scores for the selected factors concerning both importance and performance dimensions for public transport and active transport use were presented using IPA charts. Results showed that regarding public transport, the frequency of the services, followed by flexibility, time use, and delays were the most important factors to improve performance. For active transport, safe routes for walking and cycling, traffic accident risks, and time use appeared as the most important factors to improve performance for both groups. Road transport authorities, transport companies, and the hospital can influence these factors to some extent. Practical and policy implications for developing effective measures to increase sustainable transport mode use among the target groups are discussed.

1. INTRODUCTION

There is an increasing need to promote sustainable transport use in urban environments as frequent use of motor vehicles has several negative consequences, such as increases in air pollution, traffic congestion, traffic safety, and health risks. Since a big part of the adult population in European countries is working and work trips are predominantly made by private cars, it is especially important to start promoting sustainable transport in work settings (Guzman et al., 2020; Petrunoff et al., 2016). A shift from the use of private cars towards sustainable travel modes (cycling, walking, public transport) in

workplace settings could lead to significant decreases in traffic congestion and improvements in individuals' health (Petrunoff et al., 2016). The SALOMON project aims to develop a mobility plan that will help to increase the use of environmentally friendly transport options (e.g., cycling, walking, public transportation use) among employees, patients, and visitors of General Hospital Novo mesto (GHNM), which is the second largest regional hospital in Slovenia. Currently, most of the hospital visitors predominantly use motorized vehicles which leads to high pressure on the local urban infrastructure and generates societal costs, such as congestion, accidents, and environmental degradation. Hence, to reduce the carbon footprint and establish a sustainable, healthy, and accessible environment GHNM urgently needs tailored mobility solutions. To do that, first, it is essential to identify the current travel patterns and explore the critical factors that influence transport choices among those who travel to the hospital. Thus, to reach this goal a survey study was conducted within the SALOMON project. The present paper summarizes the findings from the survey study and discusses possible implications for the hospital, authorities, and transport companies.

Compared to private car use, both public transport (e.g., bus, metro, tram) and active transport (walking and cycling) have significantly fewer environmental challenges and provide economic and health benefits to individuals (Kvan and Hashim, 2016; Patterson et al., 2019; Rojas-Rueda et al., 2012). In terms of public transportation, having fast, frequent, and reliable public transport services were reported as the most important factors in attracting travelers to use public transportation more often (Aruwajoye, 2020; Beirao and Cabral, 2007; Chakrabarti, 2017; Guzman et al, 2020; Rye, 1999). Another important factor is the cost of the public transport tickets. Subsidies (e.g., reduced fees or free) to employees for public transportation use are shown to have a positive effect on increasing public transportation use, especially among users with lower income levels (e.g., De Witte et al., 2006; Guzman and Hessel, 2022). In addition to these external factors, psychological factors, such as attitudes towards public transportation and habits, are also critical for the use of public transportation. While positive attitudes towards public transportation are shown to be positively related to the use (e.g., Bamberg et al., 2003; Beirao and Cabral, 2007), having a strong car use habit has been shown as a negative predictor of both intentions to use public transportation and reported use (e.g., Simsekoglu et al., 2015).

When it comes to active transport, bad weather conditions, logistical constraints (e.g., transport of big items, activities before or after work), accident and safety risks, and lack of cycling facilities at the workplaces (e.g., secure bike shelter, showers) appear as the most common barriers (De Souza et al., 2014; Piatkowski et al., 2015; Rérat, 2019). On the other hand, forming positive attitudes, building a positive culture for cycling, especially for employees who have negative attitudes toward cycling and never contemplated it, and examples of other colleagues who cycle to work were shown as factors that can increase cycling to work (Gatersleben and

Appleton, 2007; Heinen et al., 2012). In terms of walking, problems with the connectivity of the streets, topography (e.g., steep uphill topography), sidewalk surface, and feeling unsafe and insecure while walking were reported as the most common barriers (e.g., Forsyth et al., 2008; Larranaga et al., 2019; Larranaga and Cybis, 2014; Sehatzadeh et al., 2011; Tian and Ewing, 2017). Therefore, it appears that to increase active transportation use in workplace settings it is especially important to improve the infrastructure and safety of the cycling/walking paths as well as improving the cycling facilities at the workplaces.

1.1. Present study

Previous studies indicate that there are both psychological (e.g., attitudes and social norms), economic (e.g., travel costs), and physical factors (e.g., built environment, cycling/walking infrastructure) that influence the travel mode choice among travelers. Theory of Planned Behavior (TPB) (Ajzen, 1991) is a commonly used model for explaining the role of psychological variables in travel mode choice among travelers. According to the TPB (Ajzen, 1991), our intentions (i.e., readiness to act in a certain way) are determined by attitudes (i.e., a person's overall evaluations of a behavior), subjective norm (i.e., a person's beliefs about whether significant others think he/she should engage in that behavior), and perceived behavioral control (i.e., to what extent we have control over the behavior). Previous studies applying the TPB to explain different travel behaviors show both direct and indirect significant effects of attitudes, subjective norm, and perceived behavioral control on travel mode choice (e.g., Bamberg et al., 2003; Donald et al., 2014; Lo et al., 2016). In line with the previous studies, the present study also used the TPB as the theoretical base when selecting the psychological variables that might influence travel mode choice among staff and patients/visitors of GHNM.

The aims of the study were: 1) to find out the current travel patterns among GHNM staff and patients/visitors 2) to examine attitudes, social norms, intentions, and perceived barriers related to public and active transport use 3) to explore the importance of different factors for travel mode choice by using the Importance-Performance Analysis (IPA) framework.

2. METHOD

2.1. Data collection

An online survey was used to collect data from hospital staff, and patients/visitors at GHNM during February-April 2023. Staff was reached through emails at work, while patients/visitors were met during their stay at the hospital. Since patients and visitors visited the hospital only occasionally and were fewer in number, they were merged into the same group. To reach a higher number of respondents, a small group, especially older respondents, was approached at the hospital and invited to respond to the survey with the help of some assistants. The data was collected according to the ethical guidelines. Participation in the survey was voluntary and all the respondents

were assured confidentiality and anonymity of their responses before starting the survey.

2.2. Sample characteristics

There was a total of 279 respondents including 146 hospital staff and 133 patients/visitors. Most of the respondents were female in both groups (81.5 % of the staff, and 71.4% of patients/visitors). Patients/visitors had a slightly higher average age (48.4) than the hospital staff (44.1). In both groups, almost half of the respondents had a university or higher level of education. Overall, both respondent groups have a similar demographic profile.

2.3. Questionnaire

The questionnaire consisted of several sections. The first section included questions measuring the use frequency of different travel modes (e.g., petrol/diesel car, bus, train, walking) among the respondents. Also, there were some questions to gather some background information, such as distance to the hospital, parking location, and working schedule (for the staff). The second section included a scale measuring some psychological variables, which were attitudes, subjective norms, descriptive norms, and intentions related to the use of sustainable travel modes. Respondents were asked to rate the items using a 5-point Likert-type scale (1= completely disagree, 5=completely agree). The third section included three scales to measure perceived barriers against using public transport (e.g., infrequent services) and active transport (e.g., lack of safe walking and cycling routes). For each scale, relevant factors were listed, and respondents were asked to indicate to what extent these factors hinder them from using the mentioned travel mode (1=not at all, 5=to a large extent). Finally, some questions measured demographic profile (e.g., age, gender, education) and vehicle and bike ownership of the respondents. Most parts of the questionnaire were responded to by all the respondents; however, a small number of questions or items targeted only hospital staff or patients/visitors.

2.4. The Importance-Performance Analysis / Methodological Framework

To study the possibilities of transition towards more sustainable transport solutions at the GHNM we used the Importance-Performance Analysis (IPA) (Martilla and James, 1977), which is an approach originally developed to study the efficiency of marketing programs and later applied in other contexts such as evaluation of training programs (Siniscalchi et al., 2008), and sustainable transport alternatives (Hanssen and Hasan, 2023). The applicability and reliability of the IPA method have been widely tested (see e.g., review by Magal et al., 2009).

In the IPA approach, first, the indicators to be measured are identified. Then, two questions or statements are given to each respondent for each indicator in the questionnaire. The first statement measures importance and the second measures performance. In the analysis, average ranking (scores) for the indicators concerning both importance and performance are compared.

Traditionally the average scores are plotted in a two-by-two table (the IPA matrix) with degree of importance on the X-axis and degree of performance on the Y-axis. This gives a positioning of all indicators in four quadrants indicating which attributes one should focus more on, and which are less important to develop further. An alternative IPA map is illustrated in Figure 1, where an ISO-rating line is introduced. The 45-degree upwards-sloping ISO-line represents a perfect balance between importance and performance and a zero-performance gap (e.g., Magal et al. 2009). The reasoning is that this line represents a situation where importance equals performance, and if there are any deviations from this situation it would indicate a need for change in strategy.

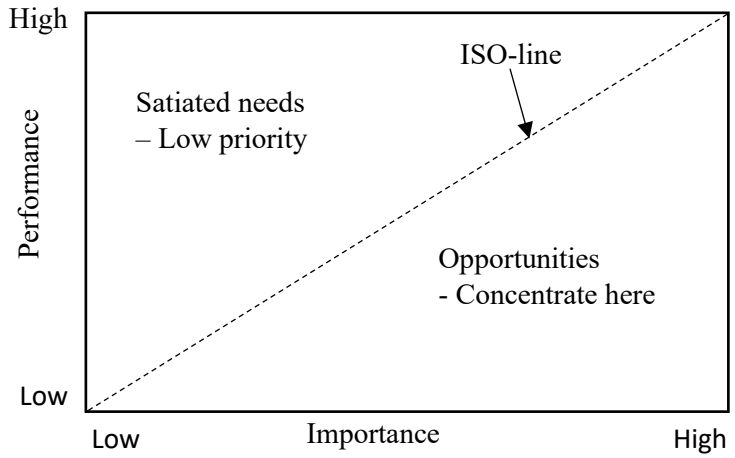

Figure 1. IPA map with ISO-line indicating balance between importance and performance.

3. RESULTS

This section summarizes the results from the survey data. First, some descriptive analyses were run to examine the frequencies of different travel mode use and the mean scores of the ratings of the items measuring the psychological variables and perceived barriers related to sustainable travel mode use for both respondent groups. Next, IPA was run by using attitudes to represent the importance of the factors and the perceived barriers to representing the performance of the factors.

3.1. Frequency of different travel mode use

Figure 2 shows the number of hospital staff using different travel modes to travel to/from the hospital in a typical week. The most frequently used travel mode for the hospital staff was a petrol/diesel car, followed by walking and carpooling. Most of the staff (74%) reported using a petrol diesel car 5 days or more in a week, almost 20% reported walking to the hospital and 13.1% reported using carpooling some days in a week. Thus, the frequencies of walking and carpooling were much less compared to car use. On the other

hand, only a few respondents reported using other travel modes, such as bus, train, and bike.

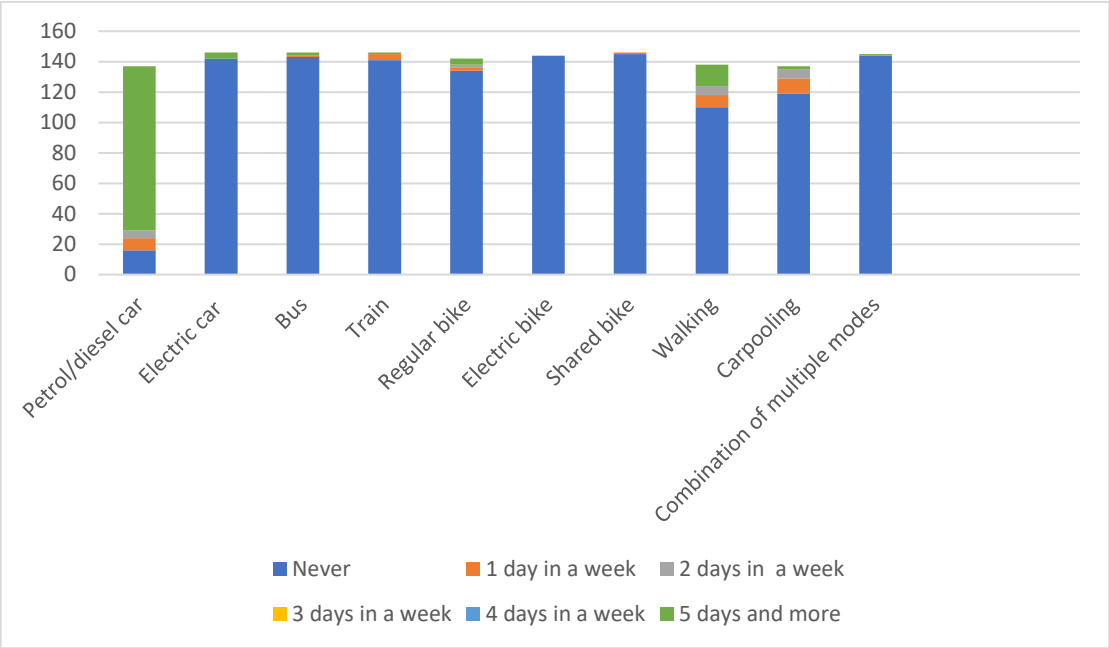

Figure 2. Travel mode use frequency for hospital staff.

Figure 3 shows the number of patients/visitors using different travel modes on hospital trips. It should be noted that the frequency of travel mode use for the patients and visitors was not measured on a weekly base as they do not come to the hospital as often as the staff. Like the hospital staff, most of the patients and visitors use a petrol/diesel car when they travel to the hospital. 65.4% reported using a petrol/diesel car always, while 20.3% reported often. Walking followed by patient transport (i.e., special cars for transporting patients) were the next most frequently used travel modes among the patients and visitors. The least frequently used travel modes were shared bikes followed by taxis and electric cars.

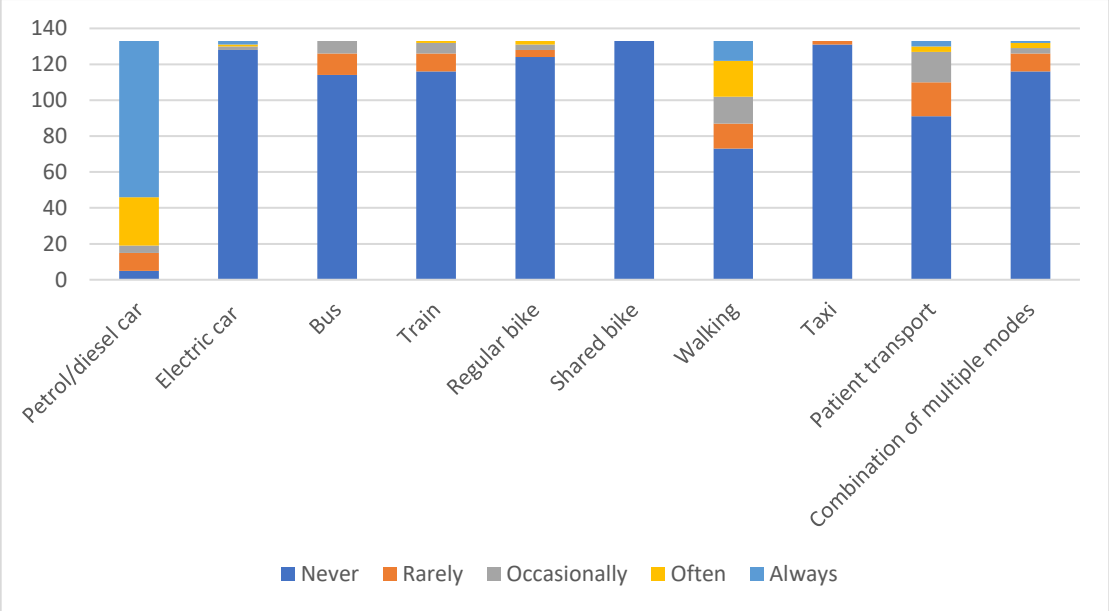

Figure 3. Travel mode use frequency for patients/visitors.

Although travel patterns for hospital staff and patients/visitors show big similarities, compared to the hospital staff, the proportion of patients/visitors using walking, bus, train, and combination of different travel modes was higher. This indicates that high car use on hospital trips is a bigger problem to focus especially among the hospital staff.

3.2. Attitudes, social norms, and intentions related to the use of sustainable travel modes

Table 1 shows the mean scores for the items measuring attitudes, social norms, and intentions related to the use of sustainable modes both for the hospital staff and patients/visitors. Items were measured using a 5-point scale (1=completely disagree, 5=completely disagree) so higher scores indicate more favorable attitudes. In terms of attitudes towards sustainable transport options, items related to the health benefits of active travel modes, followed by items related to the environmental benefits of sustainable transport options, and items related to the time-consuming aspect of public transportation were agreed most. On the other hand, the least agreed items were related to the adequacy of public transport connections and ease of cycling to the hospital. In addition, mean scores for the items measuring hospital staff's attitudes towards the hospital management's approach indicate that hospital staff do not think that sustainable mobility is a prioritized topic at the hospital. Regarding social norms, subjective norm (i.e., whether close others approve or support a certain behavior) was rated more favorably than the item measuring descriptive norm (i.e., what the others are doing) for the hospital staff. This indicates that although the hospital staff receive support from their family and close friends for using sustainable transport options, they do not see enough examples of colleagues using sustainable transport options at the hospital. Finally, item measuring intention was rated at a moderate level by

both groups indicating neither a weak nor strong intention to use sustainable modes of transport in the future.

Table 1. Mean scores for attitude, social norm, and intention items.

	Staff	Patients/ visitors
Attitudes towards sustainable transport [a]		
Public transport connections to the hospital are adequate	2,17	2,39
It is time-consuming to use public transport to/from the hospital	3,75	4,03
It is cost-effective to use public transport to/from the hospital	2,88	3,02
It is easy to cycle to the hospital from where I live	2,43	2,5
Using active travel modes is beneficial for my health	4,53	4,41
It is dangerous to cycle to/from the hospital due to accident risks	3,60	3,58
I can save money by using active travel modes to/from hospital	3,29	3,18
Increasing sustainable mobility can reduce environmental problems	4,03	3,96
To reduce congestion around the hospital car use should decrease	3,92	3,74
Intention		
I plan to use sustainable transport options more often in the future	2,77	2,92
Subjective Norm		
My close others support me in using sustainable transport options	3,1	3,36
Descriptive Norm		
Most colleagues at the hospital use sustainable transport options	1,77	NA
Attitudes towards management's approach		
Sustainable mobility is not a prioritized topic at the hospital	3,06	NA
The hospital has too few incentives to increase sustainable mobility	3,34	NA

[a] *The first 7 attitude items are used as a proxy for the importance dimension in the IPA framework.*

3.3. Perceived barriers against using sustainable travel modes

Table 2 shows the mean scores for the perceived barriers against public transport and active transport use. In addition, factor names for the barrier items that are associated with the performance dimension in IPA analysis are shown. Infrequent public transport services, followed by the lack of flexibility with travel times and the lack of possibility to combine with other activities, such as shopping and delivering children to school, appear as the strongest barriers against public transport use in both groups. For the hospital staff, working the night shift was also reported as one of the strongest barriers. On the other hand, traffic accident risks, followed by risk of harassment/unpleasant incidents and lack of comfort appear as the lowest barriers for both groups.

When it comes to walking and cycling, bad weather conditions (e.g., rain, snow), followed by long travel time, lack of cycling and walking routes, and working night shifts (only for staff) were among the highest rated barriers, whereas the risk of harassment/unpleasant incidents and lack of bike renting possibilities were among the lowest rated barriers for both groups. Not surprisingly, health problems and physical discomfort were reported as bigger barriers among the respondents including patients, who are more likely to have some physical limitations that make walking or cycling more difficult. Also, compared to patients/visitors, hospital staff rated the lack of safe walking

and cycling routes and lack of cycling facilities (e.g., secure bike shelters) as bigger barriers, which can be explained by the fact that they need to travel to the hospital more frequently and regularly.

Table 2. Mean scores for perceived barriers items.

		Staff	Patients/ visitors
Barriers to using Public Transport (PT)	**Performance Factor [a]**		
Long travel time	Time use	3,69	3,54
Long distance to the nearest PT point	Distance	3,25	3,14
Infrequent PT services	Frequency	4,27	4,11
Delays with the PT services	Delays	3,58	3,26
Lack of comfort	Comfort	2,47	2,51
Lack of flexibility with travel times	Flexibility	3,99	3,97
Lack of possibility to combine with other activities	Combine	3,76	3,73
Bad weather conditions	Weather	3,07	3,36
Expensive PT tickets	Cost	2,60	2,71
Risk of traffic accidents and injuries	Accident	2,21	2,20
Risks of harassment or unpleasant incidents	Harassment	2,26	2,20
Barriers to using active transport (AT)			
Long travel time	Time use	3,67	3,90
Physical discomfort	Comfort	3,33	3,64
Lack of cycling facilities (e.g., secure bike shelter)	Facilities	3,53	3,28
Lack of safe cycling and walking routes	Safe routes	3,82	3,59
Lack of possibility to combine with other activities	Combine	3,48	3,41
Bad weather conditions	Weather	3,93	4,07
Risk of traffic accidents and injuries	Accident	3,34	3,11
Risks of harassment or unpleasant incidents	Harassment	2,36	2,34
Health problems	Health	2,80	3,46
Lack of bike renting possibilities	Renting	2,73	2,56

[a] Barriers relates to real life experiences and these measures are used as proxies for the performance dimension in the IPA framework.

3.4. Important-Performance Analysis Results

Ideally, a survey would ask respondents to rate the importance (I) and performance (P) of each factor on a fine-graded scale. It was not possible to obtain such an approach in this survey since 1. We had to limit the extent of the survey due to time limits, especially for patients/visitors who had to respond to the survey at the hospital 2. Data were collected according to the TPB framework, which put restrictions on which variables to address. Thus, instead of making a direct measurement, we have measured importance (I) and performance (P) indirectly. As a proxy for importance, we used respondents' attitudes towards different aspects of sustainable transport. This dimension relates to general expectations and was limited to aggregated categories. For performance, we used respondents' perceived barriers which fits well since it is a measure based on real experiences.

Figure 4 visualizes evaluations of the importance and performance of public transport. As accounted for in the theoretical framework, the ISO line represents the perfect balance where important equals performance. A positioning along this line indicates that the factors that are most important for

changing behaviour towards more sustainable transport modes should have the highest performance. The alternative assessment by use of the traditional IPA framework with a two-by-two matrix could render somewhat different results. Our findings show that no factors would be positioned at the top left indicating both high importance and full satisfaction. Still, interpretations would not be substantially different since the focus would be on improving performance at the lower left quadrant.

The IPA map (Figure 4) shows that both groups agree to a great extent on both the Importance and Performance of the factors. The most important factors to improve performance are, increasing order, Frequency, Flexibility, Time use, and Delays. Interestingly, both groups agree on the ranking of the factors. However, staff are generally less satisfied than patients/visitors while at the same time rating them as lower importance.

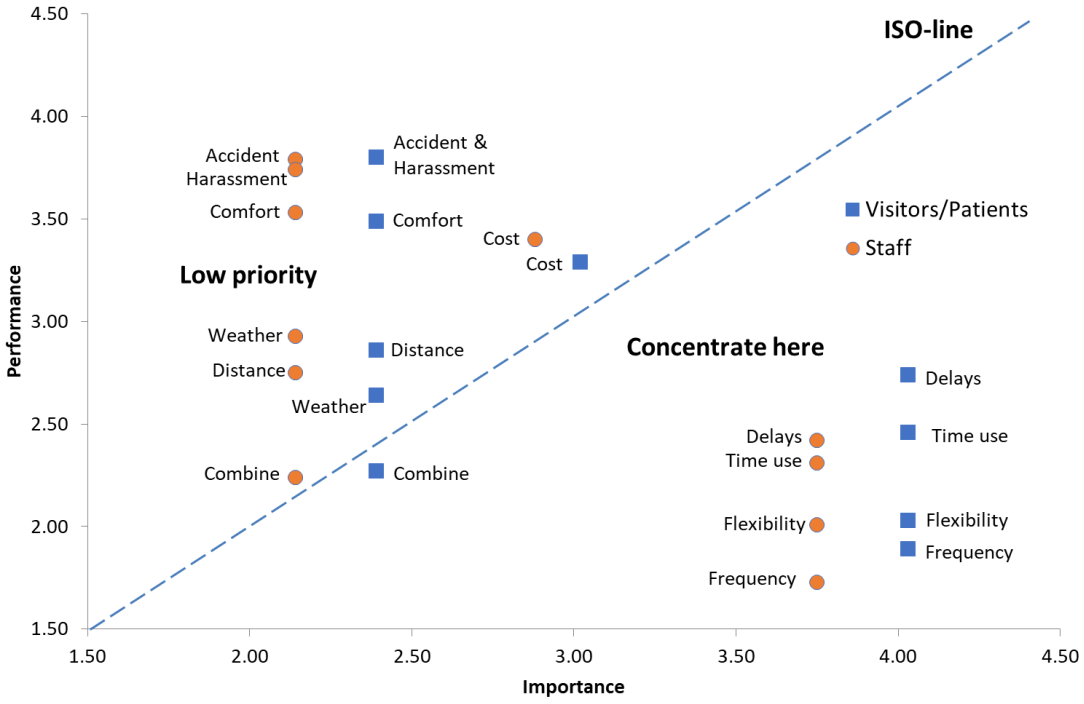

Figure 4. IPA chart with ISO-line for public transport (staff in boxes and visitors/patients in circles).

Figure 5 provides the IPA chart for active transport modes and for simplicity, the same legend is used in cases where the two groups have scores that are located close. Harassment is the only variable located in what would be classified as the upper left quadrant named “Keep up the good work”. Improvements should be concentrated on establishing safe routes for walking and cycling, reducing the probability of accidents and time use, and increasing focus on health benefits. Authorities are greatly represented as the main responsible for these factors. These elements are seemingly quite closely related where, for example, a measure of establishing dedicated lanes separated from road traffic would be safer, faster and encourage increased

use which would have positive health effects. On the opposite side of the figure, we see that the availability of bicycles for rent is very high and further improvements do not seem to be necessary, at least not for transport to the hospital in case. There is not much to do with the weather, but any protective sheltering to improve conditions here is highly valued.

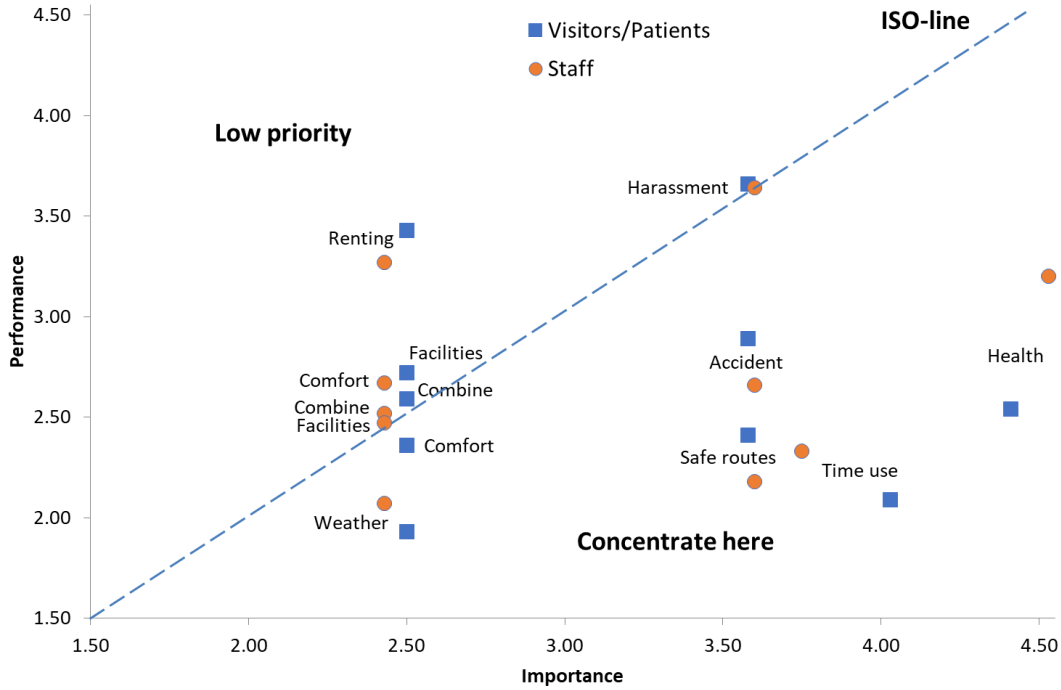

Figure 5. IPA chart with ISO-line for active transport (staff in boxes and visitors/patients in circles).

4. CONCLUSIONS AND FUTURE WORK

This study focused on examining the travel patterns and critical factors for increasing sustainable mobility among the hospital staff, patients, and visitors in the case of GHNM. The results of the survey confirm that when traveling to the hospital traditional fossil-fueled cars are the most predominantly used transport mode by all the respondents, whereas sustainable transport options, such as public transport and bikes, are rarely or occasionally used. These findings clearly indicate the need to take some actions to reduce car use on hospital trips which can help to reduce traffic congestion, environmental problems, and traffic accidents around the hospital, which is currently a high-traffic location.

In terms of psychological variables related to travel mode choice, both the hospital staff and patients/visitors reported positive attitudes regarding the health and environmental benefits of using sustainable transport options. However, they report less favorable attitudes regarding, especially the time-related (e.g., frequency of public transport services, delays), and safety aspects (e.g., traffic accident risks) of sustainable transport options. Also, the intention to use sustainable transport options was relatively weak. Thus,

findings indicate that although the respondents strongly believe in the environmental and health benefits of sustainable transport options, they find it difficult to use them due to some practical and safety reasons.

The remaining part of the study focused on examining the specific barriers that might hinder the respondents from using public transport and active transport. Additionally, the importance of the barriers for the respondent's actual preferences was examined using Importance-Performance Analysis (IPA) as the methodological approach, which allowed us to show which factors are most critical and which factors have less priority for increasing sustainable mobility. IPA results show that regarding public transport for both staff and patients/visitors groups, frequency of public transport services followed by flexibility, time use in travel, and delays were the most important factors to improve performance. Although both groups gave quite similar ratings for the barrier items, hospital staff perceive especially time-related barriers as stronger, which can be explained by their regular trips to the hospital and strict schedule at work. Thus, time used when traveling to the hospital appears as a very important factor for both groups, especially for the hospital staff. When it comes to active transport use, safe routes for walking and cycling followed by reducing the probability of accidents and time use appear as the most critical factors to improve for both groups.

Based on the IPA results, it is possible to discuss measures that can be initiated to increase the use of public and active transport modes in hospital trips. Table 3 shows possible measures and responsible actors who might take a role in the development of these measures to increase sustainable mobility in hospital trips. It should be noted that even though the transport companies have freedom in how they behave in the market, the responsibility cannot be fully put on them since they are operating within the public regulations for passenger transport. Consequently, they must meet requirements that are exogenous to them and fulfill the criteria of subsidy contracts to obtain funding. Hence, an improvement of these factors would need to be developed in cooperation between transport companies and the subsidizing body of the transport authorities.

It should also be noted that even if the IPA charts enable us to visualize which factors should be given priority, there are no considerations of costs. In most situations, there are budget restrictions for all involved actors in the market for transport. Hence, in line with the reasoning of marginal thinking in economic theory, measures for improvements must be taken where they make the most contribution for each additional unit of invested resources.

Although this study is based on a hospital case, the findings can be applied to other workplace contexts where there is a need for developing sustainable mobility plans.

Table 3. Possible measures to increase sustainable mobility in hospital trips.

Factor	Mode *	Main responsible	Possible measures
Accident	AT, PT	Authorities	Infrastructure improvements for the transport network (e.g., bus stops, signs, speed limits, winter maintenance)
Combining multiple modes	AT, PT	Transport company	Ticket regulations
Comfort	AT, PT	Transport company	Improving quality and standard of vehicles
Cost	PT	Authorities	Reducing ticket price, subsidies
Delays	PT	Transport company	Better route planning, dedicated bus lanes
Distance	PT	Transport company	Better route planning
Facilities	AT	Hospital	Installing safe bike parks, showers
Flexibility	PT	Transport company	Ticket regulations, increased cooperation with other transport modes
Frequency	PT	Transport company	Providing more frequent departures
Harassment	AT, PT	Authorities	Campaigns, law enforcement
Health	AT	Authorities	Campaigns, infrastructure
Renting	AT	Hospital	Bike stands
Safe routes	AT	Authorities	Investments in safe walking and cycling routes
Time use	AT, PT	Transport company	Better route planning, improving infrastructure
Weather	AT, PT	All	Shelters for bikes and bus stops

* AT represents Active Transport (walking and cycling) while PT represents Public Transport

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Notes

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