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Assessment of the Impact of COVID-19 Crisis on Transportation Users – Analysis of Passengers Satisfaction and Frequency of Mobility Use Before and During the Pandemic: Budapest versus Amman

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I, Malak Majed Shatnawi, declare that the dissertation entitled
Assessment of the Impact of COVID-19 Crisis on Transportation Users – Analysis of Passengers Satisfaction and Frequency of Mobility Use Before and During the Pandemic: Budapest versus Amman; is my original work where the references given in the reference list are used. All sections, which are transcribed or rewritten from some publications, they are correctly referenced.

Date: 25 October 2022

To my family;
My beloved husband and children, to my dear mother, father, sisters and brothers who gave me the full support.
To my university;
Represented by the Dean Prof. Dr. Rajnai Zoltán, to my professors, colleagues and the administrative staff for their support and help.

Abstract

The pandemic of COVID-19 has had a substantial impact on a variety of industries, including the transportation and mobility sector; the purpose of this research is to examine the effects of COVID-19 on various modes of transportation for outdoor activities, as well as how transportation patterns and mobility options have changed and will continue to change as the situation evolves. Additionally, it investigates whether the applied restrictions and procedures limited the spread of the disease from the user's perspective and affected the mobility options and people's cognitive behavior towards travel. A survey questionnaire method has been chosen and implemented in two capitals, Budapest- Hungary, and Amman – Jordan, to assess the future impacts and risks of the pandemic on transportation sustainability; the first part of the survey characterizes the frequency of using the non-motorized and motorized modes of transportation such as walk, ride a bike, private car, taxi services, auto-sharing, and bus or metro/ train and tram, before and during COVID-19 pandemic for certain activities including commuting for work, education, leisure, social mobility, and shopping. The second section discusses the perceived risks of getting COVID-19 as a result of various means of transport modes; moreover, the survey measure and evaluate the impacts of mobility mitigation due to the transformation to e- (work, study, and services), additionally assesses the degree of satisfaction with Public Transport PT and how the participants rate the digital transformation that associated with the pandemic, to make the necessary assessments, the study utilized several variables based on the frequency of usage for each transport mode and mobility activity, the data and the hypotheses were processed and tested using SPSS v.26 and AMOS software. The findings revealed that the different demographical, spatial categories and characteristics significantly impacted the COVID-19 pandemic for each city. The collected data, the resulting analytical and statistical information, including the Exploratory Factor Analysis EFA, Confirmatory Factor Analysis CFA, and the Structural Equation Models SEM, emphasized what was stated in the hypotheses; it has been found that the impact of the pandemic on transport modes go beyond the traditional boundaries and the applied restrictions, although they are essential in the current stage, as the resulting models showed the extent of the strong correlation between the variables of the hypotheses, which will have the most significant role in determining the future influences. Such studies can benefit researchers and decision-makers responsible for developing mobility strategies, designing intervention mechanisms to manage the current pandemic, and planning for future risks.

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INTRODUCTION

A sustainable system is a symbol of a comprehensive, modern, developed, smart, and flexible system that can face any changes, manage and mitigate multi-critical issues and maintain stability; at the same time, sustainability is the ambition that we aspire to reach as an ideal and integrated system; however, this does not mean that a sustainability system is free of challenges, not at all, it means that such system has the flexibility to face and analysis the obstacles, manage, evaluate, mentor and control risks [1]. Sustainability is the ambition that we aspire to reach as an ideal and integrated system which implies the provision of more efficient services that maintain public health and welfare and a cost-effective system to reduce the negative environmental impacts, now and in the future to have the flexibility to face obstacles and challenges, in order to assess environmental sustainability performance two major aspects technology and energy must be taken into consideration [2], in addition to the known three dimensions of transportation sustainability, we do not deny that this is often a kind of dream; only it requires cooperation and coordination between all relevant sectors. Therefore, the supreme goal and the highest priority should be for human beings to have socio-economic and environmental sustainability because we are committed to making future generations' lives on this planet more sustainable. Nowadays, due to COVID-19, all countries are in the same tragedies' crucible, and coronavirus is considered highly contagious and has been linked to a high incidence of deaths also causing losses in jobs, trading, tourism, transportation sector, education sectors, and many others [3]. However, the degree of risks varies depending on several factors related to the comparative advantages of each country, the major concern is to reach a sustainable society capable of fighting any pandemic, facing the challenges, and ensuring continuity by establishing solid pillars wherever and whenever necessary, this can only be achieved when the foundation is free from deficits, and the infrastructure meets the criteria of health and safety with sustainability conditions.

One of the major issues now is that the COVID-19 pandemic is causing an inevitable disruption for sustainability in most vital sectors; one of these is the public transport sector which struggles to maintain the safety of passengers by all available means. This research, through a questionnaire survey, will investigate the impacts of the COVID-19 pandemic on mobility, the central part of the study will be to understand the passengers' cognition towards traveling during the COVID-19 by assessing the impacts of the pandemic, analyzing the sustainability of mobility and the frequency of transport usage before and during the pandemic. It is well known that the Sustainable Development Goals SDGs, that the United Nations established (the 2030 Agenda for Sustainable Development) [4] is a set of 17 goals, and as an attempt to achieve some of these goals, this research, through assessing the impacts of coronavirus on the transportation sector and the sustainability of mobility during the pandemic, can introduce a significant contribution to the eleventh goal of sustainability which is "Sustainable Cities and Communities." The first part of the survey will characterize the frequency of using non-motorized and motorized transport modes before and during COVID-19, also the impacts on certain activities such as work, education, free time, social mobility, and shopping. The second part deals with the perceived risks of catching COVID-19 due to using different transport modes; moreover, the survey measures the effectiveness of mobility mitigation and the impact of the digital transformation and rates the degree of satisfaction with Public transport PT. Researchers and decision-makers responsible for formulating mobility policies, designing

intervention mechanisms to control the current disease, and planning to fight any future pandemics might benefit significantly from the survey results and analytical and statistical information. Several main sections will be reviewed through the present study, starting with transportation sustainability and the theoretical research, the methodology of the research, data analysis and results, and finally, the discussion and conclusion.

The Research Investigation Problems

The coronavirus has affected all aspects of life, and during the pandemic, operators, investors, shareholders, planners, and decision-makers in the transportation sector faced many challenges. Most researchers who have studied pandemics have tried to take into account the development of the system while maintaining the sustainability of the transportation sector, but dealing with COVID-19 must be done with caution because until now, it is not known when the epidemic will end, and there are new waves that appear even with vaccination it's still severed. The main feature research is divided into five sections to evaluate the risks of the pandemic and assess the negative impact on the sustainability of the transportation sector. The current situation will be assessed through a survey questionnaire that has been distributed in the two capitals, Amman - Jordan and Budapest - Hungary; such a questionnaire would be the first alternative for mobility studies during the pandemic because such data, which is concerned about individuals and compare the frequency of movement and mobility through different modes of transportation and for various activities before and during the pandemic, is not available or documented by the authorities concerned with the transport sector in both countries to date.

Objectives of the Research

The research will focus on all available modes of transportation to assess the impact of COVID-19 on individual behavior and whether the pandemic affected the choice of the appropriate mode of transportation for various necessary or recreational activities, all of these will be from user perspectives in Amman and Budapest, based on several demographical and other characteristics.

The research aims toward achieving the following objectives:

1- To compare before and during COVID-19 regarding the frequency of use of each transport mode, also comparing before and during COVID-19 regarding the frequency of each mobility activity
2- To investigate the effectiveness of the procedures, restrictions, and laws applied to limit the spread of the disease in every mode of transportation.
3- To measure the degree of satisfaction with public transport regarding the vehicle itself and the services provided to facilitate movement.
4- To investigate if the intelligent applications for work and study will continue in the future, even after the end of the pandemic. And if so, is the use of intelligent applications e- (payments, delivery, and services) positively impacting the quality of life?

Methodology

The methodology consists of two parts;

1- The first part is related to the pilot study, original preliminary survey design, sampling, the final results of the pilot tests and how it shaped and finalized the questionnaire.
2- The second part includes the main study and research, the main objective, the final survey design, methodology and investigation plan, data collection characteristics, and variables for each hypothesis.

Finally, the statistical analysis procedures and implementation for the two cities, Amman and Budapest.

Hypotheses

The research hypotheses are presented below;

1- Hypothesis one, H1, will assess the transport modes and outdoor activities by measuring the frequencies of usage before and during the COVID-19 pandemic.
2- Hypothesis two, H2, will study the probability of catching the disease during the usage of each transport mode and the effectiveness of the restrictions and procedures applied to prevent the spread in each one.
3- Hypothesis three, H3, will rate the passengers' satisfaction of public transportation PT modes and services.
4- Hypothesis four, H4, will rate the digital transformation e- (learning, work, shopping and services) even after the end of the pandemic and whether the use of smart applications will have a positive impact on the quality of life; all from the participants' point of view.

The Dissertation Structures

The thesis will follow the following structure:

1- Literature review and the theoretical part;

In this section, the following subjects are to be thoroughly reviewed from previous research discussed and analyzed to relate it to the main purpose of the thesis:

- The transportation sustainability performance will be reviewed, discussed, and analyzed as a background for the theoretical part, which will focus on transportation and mobility frequency before and in the presence of COVID-19 to understand the trend of the transportation sector, including needed research to reach a sustainable level ready to face challenges.
- Investigate how the applied restrictions and procedures during the COVID-19 pandemic affected transport modes, outdoor activities, and public transportation users' satisfaction.
- The acceleration in digital transformation for study, work, and services during the COVID-19 pandemic whether will continue to increase even after the end of the pandemic.
- The above main paragraphs are classified into items and formulated in a survey questionnaire to four main hypotheses and four sub-hypotheses that will be presented within the structure of the thesis.

2- Procedure and method used

The method will test the hypotheses through the necessary statistical analysis for Budapest and Amman by evaluating the data collection characteristics of each sample;

- Analysis of the data normality, homogeneity, multicollinearity, reliability, and validity.
- Analysis for Exploratory factor (EFA) and Confirmatory Factor Analysis (CFA).
- Descriptive statistics analysis and demographical characteristics results.

3- Result Analysis

Analyze the hypothesis and sub-hypothesis outcomes, the trend of the analysis, the structure of the questionnaire factors analysis, address the model depending on each sample results for each city, and make the necessary hypothesis comparison and findings.

4- Discussion and Conclusion

Discuss the main significant features of the research, the significances and acceptance degree of the hypotheses, and scientific research contribution for both cities, the future recommendation, suggestions, and further research studies.

1. THEORETICAL RESEARCH

1.1 Transportation Sustainability System

The theoretical part will discuss previous studies and research, track what has been achieved so far, investigate and verify the theories to enrich the study, and build on what is necessary.

A definition of sustainable development provided by an ASCE/UNESCO working group on developing sustainability asserts that sustainable development is genuinely about balancing several pillars (environmental, economic, and social) over dynamic time and spatial horizons. Accordingly, research in sustainable urban infrastructure reflects the need to design and manage engineering systems in light of environmental and socio-economic considerations; therefore, the main goal for planners is to find suitable long-term means and processes for analysing and improving [5], [6]. Public transport systems can be sustainable if the negative impacts on the environment and society are eliminated, which will help to achieve sustainability in other aspects of human life, there are many indicators to assess, but sustainability indicators for transportation [7], is suitable to achieve the goal, the method used concentrated on developing eleven indicators to determine environmental, social, and economic impacts; the eleven quantified indicators were classified into sustainability indices (environmental, social, and economic), impacts and performance, each scenario are evaluated based on a composite sustainability index and by encompassing the index to four sustainability categories [8]. Although there have been many studies about indicators and their application, few studies have used sustainability indicators to compare systems and apply this concept. [9], [10], [11], [12] all of them considered that sustainability in terms of dimensions that can be quantified.

Sustainability means more efficient and effective services, including using Renewable Energy RE that maintains social safety and reduces pollution in all its forms [13], nevertheless, specific measures should be taken into consideration to increase the efficiency of RE because it is well known that it has an interrupted nature, and its variation is unpredictable and depends on weather conditions and seasonal changes. Technology, clean energy, and smart applications have significant impacts on mobility sustainability not only through operational processes but also through the manufacturing of vehicles and the construction of the infrastructure [14]. Developing socio-economic and environmentally sustainable transportation is a vital element that can be reduced by controlling pollution, emissions, and waste by encouraging smart and green transportation. Transport is a vital sector for the economy and an important component of daily life; in the past decade, the countries heavily invested in expanding the road network, which constitutes the backbone of the national transport system, improving urban transport, and enhancing the logistics industry and international connections. In parallel, the transport sector has seen a gradual or completely process of liberalization, opening the market to private operators and private investors [15]. Governments can achieve sustainability if they maintain the *"three-dimensional model" of sustainable development which was introduced in the Rio Summit's declaration as one of two main pillars: (1) equity between and within generations; and (2) the equal status of social, economic, and environmental goals* [7].

However, sustainable transportation balances two important subjects; "the need to travel with the need to improve quality of life." Every significant step forward was made by incorporating sustainability into surface transportation planning. *A sustainable transportation system is defined as "one in which (a) current social and economic transportation needs are met in an environmentally conscious manner while (b) future generations' ability to meet their own needs is not jeopardized.* The American Association of State Highway and Transportation Officials (AASHTO) listed a set of goals for sustainable transportation, including improved accessibility, mobility, and safety, reduced pollution, and ecosystem impacts.

A comprehensive definition of sustainable transportation that includes most of the social, economic, and environmental concerns has been provided by the European Council of Ministers of Transport. [9]*"a sustainable transportation system as one that 1) allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations, 2) is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy, 3) limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable resources, limits consumption of renewable resources to the sustainable yield level, reuses and recycles its components, and minimizes the use of land and the production of noise".*

1.1.1 Sustainability Smart Mobility System and Indicator Performance

For transportation system sustainability, many researchers proposed a set of indicators for assessing transportation systems; a study that investigated sustainability initiatives in North America, Europe, and Oceania recommended twenty-eight indicators which reflect thirteen goals and four sustainability categories [11], others investigated the sustainability categories for assessing urban sustainability and developed a tool as an add-on module in integrated transportation and land-use model for assessing urban sustainability [8]. The indicators were based on large-scale simulation models to reflect aspects of the environment, society, and economy, divided into three groups based on their long-term viability. The weights for the specific criteria were determined by transportation planning professionals, and their proportional costs to society evaluated the weights of the indicators; as a result, the tool may help select acceptable performance criteria for sustainable transportation. Recent summarizes studies have considered sustainability in terms of dimensions with different objectives and pillars, including social, environmental, and economic dimensions [16] it is a fact that public transport systems can be sustainable based on the type of impact on the environment and society, it can also be a means of helping to achieve sustainability in other aspects of human life [17].

The term "sustainable development" was first introduced in 1980 by the International Union for Conservation of Nature IUCN. Since then, sustainable development has become a vital matter in everyday life and is used by all institutions and companies. Studies of the history and evolution of the concept of sustainable development reveal the absence of a consensus related to the definition of this semantically problematic concept [18], on economic and social development. Sustainable development, though a very restrictive term and open to criticism, physically shape the interplay between these issues and shows that the three dimensions (economic, social, and environmental)

actually overlap [19]. Transportation leads to a series of parameters that influence all vital factors including, socioeconomic and environmental impacts [20], across these pillars, sustainability can be challenging, and authorities can do sustainability evaluation and examine important sustainable transportation ideas [21], a five-step procedure with overlaps between pillars at each level makes an important structure, the five components start with a grasp of the idea of sustainability and finish with the implementation of performance metrics. Considerable sustainable development issues must contain simple, understandable, and measurable elements and use the three sustainable dimensions, which are commonly referred to as the "Triple Line," as a concept for assessing the performance [22], [23], [24], it is known that the application and definition of sustainability go beyond technical progression and social concepts [25]. Because analyzing and planning for the transportation systems relies on indicators to understand the trends and the impacts, four pillars were suggested [26] various stainability frameworks have been developed based on different communities, and many institutions have embraced sustainable transportation definitions taking into account environmental, social, economic, and other issues needed to create a technique for measuring urban sustainability as an integrated model [27], [28], and employed the three basic-domain systems to measure sustainable transportation and sustainability indices. Using factors based on six groups, the sustainability assessment factors were clustered into the performance framework, indicating that the indicators for assessing sustainable transportation for them are under a transportation system that takes into account social and the dimensions of sustainability [29], some defined and used interdependent systems in order to calculate the parameters (the transportation system, the activity system, and the environmental system) [30]. Finally, according to the center for alternative development initiatives (considering sustainable development from the Philippine perspective), "sustainable development is a multidimensional concept, involving no less than seven dimensions" Notably, the study recommended that society be considered a separate dimension. Sustainable development is a multidimensional concept involving seven dimensions [31]. Customers continually demand higher standards of service and have higher expectations, which in turn can produce higher profits. However, the public transport system will not be successful unless it satisfies passengers., as it is essential to increase the use of public transport at a regional level, it is essential to stop reducing the number of public transport service routes to decrease travel times, cover more comprehensive, areas and improve service quality to ensure customer satisfaction [32]. Challenges regarding transportation infrastructure planning are connected with development, including current issues such as the debate on how to achieve "transport sustainability" [33], [34], or "sustainable mobility" [35]. The word "sustainable development" first appeared in the environmental field in the 1980s, when it was referred to as Environmentally Sustainable Development ESD. It was approached using a triangular framework representing three economic, social, and environmental sustainability dimensions. Today, the term "sustainable transport" is a generally accepted principle in transport planning processes [33], [34], [36]. It is assumed that traditional procedures, such as cost-benefit analyses, would not be sufficient to assess sustainability [37], [38], [39], [40]. Moreover, separate economic or environmental approaches in isolation are considered less efficient than integrated assessments covering the whole range of sustainability impacts. An evaluation encompassing the three main sustainability criteria (efficiency, cohesion, and environment) is required in assessment methodologies, in the first stages of network development, transport policy needs to be more "efficiency-oriented," but as infrastructure. Like many other developing countries, it has experienced

rapid population growth. Furthermore, the nation is experiencing increased pressure on natural resources, widening income disparities, and growing poverty. Countrywide, access to freshwater represents the most pressing challenge, both in terms of quantity and quality [41].

An attractive modern study also quantified the sustainability indicators and combined them to form studies dealing with intelligent transportation and smart mobility. The proposed evaluation intelligent mobility model consists of four indicators to measure and assess the sustainability of the system these are; Efficiency, Technology integration, Traffic congestion, and Accessibility rate; if they do not work as they should, a major delay will be caused, spreading all over the day as continues rush hours, a smart system should be applied to solve this by providing accurate data and convenient information and suggesting a suitable gaudiness and all along the road until arriving at the destination [42]. The systems should include a combination of ICT and AI that help people navigate other smart public transport services; when it works effectively and efficiently, they will be like a backbone [43]. It should be noted that all of this must be under the umbrella of the environment; the lousy environment is the most significant impact that is a result of the combination of poor infrastructure and poor vehicle performance with lousy quality of service; on the other hand, smart infrastructure development will lead to public transport sustainability. The smartness environment system should include smart services, smart ticketing, smartphone application, taking advantage of artificial intelligence and IoT for better reliability, accessibility, safety, and security system for the benefit of passengers, pedestrians, and all segments of routes users [44].

1.1.2 Risk Management in the Mobility Sector

One of the problems facing the sectors that need urgent economic concerns is achieving the appropriate degree of safety and security while staying within the available resources, despite the growth of complexity inside such sectors which require a certain degree of protection the budgets have not risen. The safety and security levels must become more efficient and employ risk management effectively to give an optimal cost-effective solution [45], risk management has been considered a significant vital item in recent years, particularly in connection to the security of information and communications systems; it is essential to define the scope of reviews and the potentially catastrophic consequences of attacks before moving on to risk assessment [46]. To face the current challenges new steps and tasks can be added to the different sectors and systems, including risk assessment and analysis [14], i.e. identifying the assets, resources and stakeholders is the first step in risk assessment, followed by identifying the threats, vulnerabilities, implications on security goals, and the possibility of security failures. Risk evaluation entails estimating risks and the acceptance levels that representing an example of assault tactics connected to information security, particularly the analysis of web-based security threats [47]. Intrusions and unauthorized use pose distinct security concerns. With the proliferation of wireless and mobile networks and wireless-enabled computers and other devices such as tablets, mobile phones with Wi-Fi interfaces, and various operating systems and applications with advanced capabilities, these risk management issues are becoming increasingly important [48].

Risk mitigation is the process of changing a project's schedule, budget, scope, or quality that will decrease uncertainty without having a substantial influence on objectives; consequently, risks must be precisely identified to conduct a good vulnerability analysis. The Probability Impact Ratio PI Ratio, or quantitative value of risk is calculated using the formula PI Ratio of a risk = (Likelihood

of risk) x (Impact of risk), the likelihood of a risk occurrence might range from (zero to one hundred) percent and if the risk occurs, the impact is classified using impact analysis. The reduction approach must strike a balance between safety, security, and risks levels through:

• Define an acceptable risk threshold ("risk appetite");

• Determine the resources required to attain the acceptable risk level.

The risk treatment process generally involves minimizing, removing, or transferring risks based on the initial phase's analyses, an essential set of information security standards developed by the International Organization for Standardization ISO, 27000, and the International Electrotechnical Commission, the IEC [49]. As the transport sector is continuously affected by changes over time, it requires a design with efficient technical and economic considerations. Transportation risk management was brought to the surface during the COVID-19 pandemic, and in this research, the aims are to make the mobility sector more secure in terms of protection against pandemics by making the appropriate health measurements; the main challenge is to monitor human behavior through implementing developed methodologies. The restricted rules and regulations to achieve the necessary risk assessment process should not depend on an ideal design system and technologies; it is only seeking available information and data from different realistic resources and assistance from transportation researchers and planners; the risk assessment process must be identified, analyzed, and evaluated, and each step in the assessment process must be supported by concepts that are specified and designed as guidelines and defines the approach to the risk management, followed by communication and consultation in each phase [50].

1.2 Covid-19 Pandemic

1.2.1 The Impacts of COVID-19

A primary survey that investigated the COVID-19 pandemic was conducted in ten cities all over the world; it consisted of two parts; the first part is an analysis of the frequency of different modes of usage for each mobility activity, including works, education, social and shopping mobility as well as free time and leisure travel, while the second part assessment the risks of catching COVID-19 from different transport modes from the users perspective [51]. Another survey concentrated on the experts in the field of mobility and transportation, which was conducted online for experts in sixty countries [52]. The questionnaire assesses transportation and mobility usage, the interrupted modes, facilities, and activities during COVID-19, and the lockdown. Critical comments and recommendations came out of the research; for example, the experts expected that people would avoid crowded public transport modes and certain places (avoiding supermarkets and malls) to the benefit of other options such as private cars and small local businesses, most likely was because of physical safety and some psychological and mental issues, this may affect transport behaviors in the future, so enhancing the trust and passenger levels of safety and comfort during and after the pandemic is significant to maintain sustainability. On the other hand, they suggested that online education will not last, but generally, the majority believe society will grow more splintered due to smart technologies, AI, and digital transformation; expert opinions are vital at this stage of the current pandemic, although surprises are to be expected they can describe the whole picture of the

situation, even there is some uncertainty, they can evaluate transport system performance compared with before. Mostly they agreed that the world economy is a vital and critical case, and immediate plans should be implemented to control the side effects of PT as soon as possible, whether there is a "cure" or not [52].

1.2.2 Risks of the COVID-19 on Mobility

The pandemic has a negative impact on the levels of services, health, and safety, that directly reflected in the infrastructure [53], human losses and costs are incalculable; even the topographical and spatial characteristics were affected by the pandemic; for example, women and girls were found to be highly affected by the pandemic in Asia districts due to many reasons associated with the pandemic, causing a shortage and lack of modes of transportation and limited the movements [54], in addition to other emergency reasons such as the transformation to digital education and the need to facilitate these new and unfamiliar tasks for the family members [55]. Females were allowed to reduce the hours of work compared with men. On the other hand, older people reduced mobility and tried to avoid as many as possible crowded areas, including public transport services; some Asia countries, such as Japan, rebuilt new online platforms in an attempt to have some sustainable recovery, improve connectivity, and accelerate the digital transformation by improving e-services and shopping and paving for intelligent infrastructure to use renewable energy RE and energy efficiency tools that will allow for better mobility performance and most of the beneficiaries of the new and smart access during the pandemic will be women, older people, and children [53]. Since mobility plays a major role in the spread of COVID-19 disease most countries applied districted restrictions for commuters within transport modes [56]. To control the spread as much as possible, passenger satisfaction from Public Transport PT was a complicated issue; some groups only choose to use public transport, especially for long-distance trips, while others have entirely shifted to other motorized or non-motorized modes. In many cities, hygiene, cleanliness, temperature checking, safe social distancing, masks, and gloves were mandatory, or at least masks were compulsory [57], for this and more passengers try to shift to modes that are less congested or avoid traveling during peak hours as much as they can. In some developed countries, innovative technology, AI, and mobile applications for checking were used; Beijing allows access just through appointment to prevent crowding, Singaporeans used a Bluetooth signal between devices to prevent close distancing and to avoid connecting with infected people, and some countries urged people to download in mobiles and smart devices and application that contain demographic data not just for transport access but also in any public places and buildings [58].

However, shifting to online work and education will solve many problems to avoid physical contact and reduce congestion, reducing emissions and pollution in cities. As previously mentioned, many attempts to study the current situation in the presence of COVID-19 were investigated to search for the optimal means of application for the benefit of the transportation sector. For these reasons, many studies were directed to assess the current situation and try to make a simulation similar to reality by studying the modes and activities before and during the pandemic. Several observations, qualitative and quantitate studies found that to make a comparison between before and during the

COVID-19 pandemic, one of the suitable scenarios is to measure the frequency of use [59]. It seems that passengers for short-distance trips shifted to non-motorized modes such as walking and cycling, and many others have changed their modes of transport from public to private vehicles during COVID-19. Since the priority for any study or procedure to be followed is the safety of users, the goal was to ensure the passengers' safety with minimum risk and suffering; however, it cannot be said that the transport sector, throughout the ages, has been free of challenges and risks [60] in fact, that system has wide flexibility and can be evaluated and assessed for any risk with a comprehensive performance to reach optimal solutions [61], because the method of evaluating risks differs according to the mode of transportation, many researchers have conducted interesting studies to assess the various transportation risk management; for example, but not limited to; some studies had assessed air transport combined with risk management [62], some others had assessed the rail transport combined with risk management [63], [64], [65] [66]. Several studies take into consideration assessing only roads transport [67], [68], while using joint methods that can be applied to assess roads transport and highways altogether can be significant [69]. The most basic definition of risk is the probability of a specific adverse outcome resulting from being exposed to danger. The three critical parts of risk management have to be defined: the risk's likelihood and sensitivity to risk (both of which are linked to resilience).when an unfavorable situation happens, for example, infrastructure and vulnerability an analogous people, infrastructure, and various tangible assets with a uniform specified distribution influenced by a negative incident [70], [71]. Furthermore, the bio-resilience of transportation infrastructure is becoming increasingly important, it should consider many hazards, such as epidemic illnesses, natural disasters, and terrorist attacks. At the moment, the coronavirus illness affects public transport and necessitates a substantial and fast response. COVID-19 and other global illnesses have a massive influence on tourism, transportation, economics, and energy demand [72], [73], [74]. A lead link to the demographical characteristics can be used as an assessment for scientific investigations [75], currently it is only used for studying infectious diseases and their dynamics, when the disease becomes more endemic due to migration between cities, a transport-related infection influences affect the number of infections and the length of the pandemic [76]. Studies, on the other hand, demonstrate that an efficient transportation system is linked to enhanced sanitary conditions and ventilation in public transit and lowering the risk of an epidemic [77]. Meanwhile, congested cities with highly crowded transportation and infrastructure have ventilation problems, which increases the risk of illness; according to the findings of the study, the hazard increases primarily in the shared inside environment; however, some public spaces are much worse than public transport due to CO2 concentration, so it is a design and operation matter that is always connected with efficiency regardless of the place or period of exposure, if the priority is for costs rather than health, the inside atmosphere will be a huge problem. An exciting research result related to the number of COVID-19 cases confirmed in certain cities and the number of passengers through different transport modes was found that only traveling by train shows a significant link with the number of COVID-19 cases, but the other modes did not record any statistically significant relation [67], so, how to maintain passenger safety in public transport, whereas companies suffer financially. This is a balanced equation that should be achieved; it is the responsibility of the

companies, the stakeholders, and the transport sectors to assess the risk management tools and to conduct the essential cost-effective analysis, including environmental assessment, since energy consumption and fossil fuel are causing continues negative environmental impact, this assessment will make the mobility system more effective because public transit sector caused enormous socioeconomic and environmental problems that can be avoided [78], the pandemic threatens the transport sector because the fear of the possibility of catching the virus forced the users to shift toward private transport, which will worsen the situation from an energy consumption point of view. Previous studies in American, Canadian, Australian, European, and Asian cities show that private transportation modes consumed more than twenty times the amount of energy consumed by public transport modes [79]. According to the American Society for Industrial Safety ASIS, a hazard is "a situation in which critical and severe conditions that can cause physical, psychological, or mental harm," while risks are experiencing specific undesirable effects as a result of being exposed to the hazard and a threat, the danger can be classified into two aspects, the first one is an objective danger which is evaluated based on the level of harm and other characteristics, such as the number of road deaths recorded in a given area, or the number of crashes. The other is subjective, and it is evaluated based on a felt sense of risk in the situation (e.g., parents do not feel safe enough to allow their kids to walk alone to school) [80]. Safety issues contain both the hazards and risks with social, economic, and environmental problems, which must be managed to ensure the health and well-being of citizens; however, all disaster types will put the transportation systems at risk and influence the operation and performance. Risk management is a method that integrates the phases of risk assessment and risk treatment into a repeatable and formalized practice; its goal is to improve the quality of safety-related choices and reduce the negative repercussions for system users (e.g., transport system users) [81]. The epidemiology risks are the risk of a pandemic with a level of severity, simple risks are either irregular or rare instances risks that occurred in a limited region with complete control over infected cases, while catastrophic risks cause a slew of epidemics around the country, and this is the case with COVID-19 pandemic. For many reasons, COVID-19 causes a decrease in public transport usage; in Spain, the reopening of facilities was done thoroughly; nevertheless, transit usage recovered at a slower rate than other traffic as one might predict that given the desire to avoid congested settings and close-range interactions with strangers, at the same time, an increase in bikes sharing was noticed [82]. To explore the impacts of COVID-19, interviews were done with young adults in Melbourne and Victoria, Australia; the study indicates that there are considerable effects on all young people for short-distance travel, but for long-distance travel, consequences are dependent on how they are progressing through critical life stages because the pandemic had a negligible impact on some respondents, while it had a more significant impact on others due to the acceleration in life which coincided with the presence of COVID-19 crisis [83]. A travel survey questionnaire was used to perceive passenger satisfaction during several types of daily trips; based on a survey in New Delhi, critical variables that were found to be significant in commuters' trip satisfaction and have been taken into consideration include some demographic characteristics, such as gender, age, traffic congestion, security, comfort, etc. The trip-satisfaction data are perfectly represented by logistic regression models using tip-satisfaction modeling [84]. For travels other than

work, Indian commuters choose to utilize a cab service or an app-based cab service; Vehicle ownership has a significant negative effect on work trips but a positive coefficient for non-work trips. This might be because private excursions need some personal freedom, flexibility, and control by allowing individuals to travel anywhere and whenever they choose, the reduction in overall trip quality was a one-of-a-kind finding in this study [85].

1.2.3 Analysis Before and During the COVID-19

Research conducted in South Korea studied the modes of transportation with different variables, the outcomes show differences in usage in cars and buses during the pandemic, the methodology developed eight models with car and bus usage to evaluate the change due to COVID-19 and for variables such as times, land use types, and land prices. The model used takes the 'land price' as a variable because it indicates the neighborhood's financial level and economic, i.e., that financially satisfied people are more active in movements than other segments [86], [87]. Moreover, COVID-19 led to a more significant decrease in the frequency of trips during weekends since moving only for optional and non-mandatory travel such as inessential shopping; in addition to that, the existence of a modern delivery system urged the use of digital services during the pandemic and accelerated the growth in delivery services and e-shopping [88], [89], [90], [91]. Comprehensive companies that used more than one means of transportation to carry out their services achieved sustainability in transportation activities even with the pandemic [92].

To verify the structure of the survey and become familiar with the analysis, China was taken as a case study; a conceptual model was designed to find the impact of COVID-19 on transportation and logistics; the hypotheses were implemented and formulated by Structural Equation Modelling SEM, analysis comprising of Confirmatory Factor Analysis, CFA and path assessment [93], on the other hand, to identify the variables and implement statistical analysis, the following test applied; normality, validity, and reliability; multivariate statistical technique; structural relationship analysis; regression forecasting methods; path analysis; t-test and r-squared [94], [95], [96]. A study to assess the impact of COVID-19 on air and land freight is conducted, and it turns out that statistical analysis and tests showed statistically negative and accepted, while ocean fright is statistically insignificant and rejected; such studies could be dynamic to conduct the same studies in other countries to make a comparison between the countries [97]. Latent variables in such studies usually have two parameters classification, for the probability that the respondent belongs to class a specific class or category, and then the latent class analysis was conducted using a programming language [98]. To determine the number of latent classes involved in a study with an approach between 0 and 1 values representing the assumed probability [99], a Chi-Squared statistic was used to compare the performance; the research analyzed the physical contact and online communication before and during the pandemic for different segments and purposes of mobility and SWOT analysis for opportunities and threats of mobility.

Many challenges for transportation systems have been faced, including maximizing technology potential and addressing issues related to the COVID-19 epidemic. Mobility can be more sustainable, dependable, secure, and safe when applied development systems with ICT and AI

technologies will be required; not only will it assist in minimizing risks wherever possible and appropriate, but also it will increase the effectiveness and efficiency by controlling mobility, minimizing peaks of mobility during rush hours, and give homogeneous distribution for mobility throughout the day. As a result, investments must also be made in virtual infrastructures that allow dual communication with and without transportation to make the future safer and more intelligent [100], some of the pioneer studies that investigated COVID-19 with post-pre-studies in the transportation sector assessed the outdoor trips characteristics, commute and discretionary activities and their relation with transport modes; a mathematical model had been created for before and during COVID-19 transport passenger frequency of use. The chosen methodology was Multiple Discrete Choice Extreme Value MDCEV, which proposed models [101], [102], [103], then followed by other studies that adopted a similar methodology with some different paths [104], [105] forecasting models related to traveling changes activities and modes, and the importance of such models is that they could be applied in other countries in the absence of forced COVID-19 restrictions. Some studies for developing countries introduce an assessment during the COVID-19 pandemic [106] and some evaluate the transport mode selection for each outdoor activity by implementing two regression models) [107], [108], for pre and post-COVID-19, the dependent variable was related to the mode chosen and frequency for each activity; a significant relationship between some demographical and other characteristics has been measured; for example, during COVID-19, the distance and the purpose of the trip are significantly correlated with a certain degree with trip purpose either it is an essential or not [109] . Previously, income levels and chosen transport modes were firmly connected and significantly differed. During the pandemic, there is a significant shift towards walking, riding a bike, and private modes of transportation because it offers better performance. It is well known that public transport sustainability will be in a critical situation, and the frequency of usage will continue to reduce, so applying taught restrictions and the needed precautions with suitable levels of safety procedures and services that enable travelers to keep a safe distance from each other may gain the trust in PT [110].

Studying multiple scenarios of mode-shifting behavior can be investigated after the pandemic by studying regressions and the hierarchy process [111], the theory is that even though every passenger has some preference for choosing either the previous mode or switching to the new one, the implementation of a system whose priority is to provide safety and security will help restore confidence again [112], studies the changes in travel behavior and transport mode usage with traveler characteristics. A mathematical models were developed to quantify the effect of the demographic variable is hence a Multiple Discrete-Continuous MDC variable with two components: discrete mode choice and continuous mode-specific weekly trip frequencies, mode choices of travelers are influenced by three categories of factors: characteristics of users, characteristics of the journey and characteristics of the transport facility. To assess the most used modes for various trip purposes as logistic issues, the study [113], analyzed two logistic regression models before and during a pandemic. The dependent variable and medical trips had the most significant impact during pandemics. Long-distance journeys have declined in importance, but business trips and greengrocery have risen, indicating a growing preference for essential travel. On the contrary, they pointed out

that market and long-distance recreation trips have become less critical and considered non-essential travel. A chi-square test was performed in many kinds of research to assess the relation between commuting days and occupation type where the relationship between these variables was significant; the income level and private car usage have a significant relationship for the mid-high income group, and even mid- low-income people used private car during the pandemic, also it is observed that private car and walking are the most common modes being used. For shopping trips, grocery shopping trips are not statistically significant [114].

1.2.4 Assess the Changes in Travel during the Pandemic

Many countries introduce mandatory restrictions and procedures to limit coronavirus spread, especially in crowded sections such as the transportation sector. Such forced restrictions aimed to prevent and control the spread of the virus. The effectiveness of these restrictions and did they change the travel and movement patterns should study to identify passengers' activities before and during the pandemic for each mode of transportation separately. It appears that transit users having private vehicles shifted to use them regularly instead of public transport while those without private vehicles used public transport for essential and urgent trips only, i.e., the results of previous studies show the behavior of passengers varies according to the different segments of the society [115]. The lockdown differed from one country to another, but most important businesses, including grocery stores and pharmacies, were re-opened in the early stages, then services, restaurants, bars, and other facilities were allowed to open as long as they adhered to safety and health standards and requirements. A survey focused on Toronto city aimed to collect data about travelers' behavior and habits during two stages. The study's importance is that it classified the citizens according to their segments in the society, population based on specific characteristics or factors, travel mode, attitude, and outdoor activities. Change in transportation behavior during a pandemic should not be underestimated because it has a long-term effect, and assessing this change, many studies consider the activities and transport mode frequency usage as the primary indicators. There is a significant impact on travel activities and transport modes when comparing post and pre of COVID-19; the shift to the preference of private vehicles during the COVID-19 pandemic upon public modes is a big issue; it is difficult to predict the future growth in the number of vehicles because it is linked to the growth in population which is governed by many issues including the geopolitical factors [116], according to the survey's findings from India, one-third of respondents altered their means of transportation for work during the pandemic because the mobility pattern correlated with COVID-19 spread socioeconomic characteristics with negative effect was noticed, due to implementing mobility restrictions [117], [118]. Some studies investigate the non-motorized modes and how people preferred walking and cycling during the pandemic over other modes [119], [120], this brought the authorities to pay massive attention to infrastructure suitable for such modes. Forecasting models for mobility future prediction is not a regular direct process since safety and health are the primary concern regardless of other issues [121]. One of the essential studies that assess the relationship between the degree of catching the disease and the type of activity that the individual practice shows that most of the activities' frequency is reduced in the whole world during the first

stages of the pandemic. A study that investigated the restrictive measures implemented in ten countries around the world done by (Mobility and perceived risk associated with mobility in Australia, Brazil, China, Ghana, India, Iran, Italy, Norway, South Africa and United States) [51]. The survey that distributed during 2020 to assess the effect of COVID-19 on the transportation sector, from respondents' perspective, compared with before, as well as to assess the risks of catching the disease within each transport mode and the effectiveness of the applied measurements in each [122], for mobility behavior and mode choices, including bus, metro, private car, and ride-sharing or taxi for each journey, the study showed that mode choices are connected with areas and the distinguishing features for each, although the COVID-19 pandemic affected the whole world without the discrimination, the impact was not the same for the developed and developing countries, i.e., culture, attitude, economic level, population density, so on have a significant influence [123]. The study of Switzerland [124], used a tracking app and online surveys to study the changes in mobility due to the COVID-19 pandemic. The study sample showed a slight increase in car owners but an essential reduction in travel for all demographic groups, "The online survey classified the groups into the following samples:

• Motorized individual transport (car, motorbike, taxi, Uber)
• Public transport (bus, tram, ferry, metro, train)
• Non-motorized transport (walk, ride a bike).

The results showed that traveling using individual and non-motorized modes during the lockdown had increased compared with the previous period. Data that depend on daily usage was compared to yearly modal surveys and measurement data from the prior year; the survey collected data on the mode of transportation used for different trip purposes, journey frequency, distance from home to stop station or location, and essential questions related the reason for refraining from or using a particular mode of transportation, for instance why to select cars over public transport during a pandemic all were verified to understand the human behavior during the pandemic, the impact of avoiding public transport in favor of private automobiles was investigated using by using numerous factors; five factors included in the logistic regression models: trip time, cost, safety, crowd avoidance, and cleanliness, according to many studies that delay, safety, speed, comfort, convenience, and flexibility of trip are all significant factors in selecting a car over public transport [125], [126]. A comprehensive survey in Chicago looked for the variables that changed the mobility and travel patterns during the COVID-19 pandemic and investigated their long-term effects even after the end of the pandemic; the modeling revealed that 80% of auto commuters would continue to drive after the pandemic, implying that any policy enacted or plans and measures that will be taken now and in the future must be based on passengers' mode of transportation preference, and their behavior because the situation will worsen in the future if it is not addressed from the beginning. [127]. Encouraging walking, cycling, or any other non-motorized modes through short-distance trips for those whose nature of work cannot be done remotely and need to go back to work; this is a unique study conducted in the UK [128], the study reviewed the advantages of non-motorized modes and the long-term benefits on the personal and public levels.

A study conducted in Chicago shows that the number of those with no online working experience has dropped from 71% to 37% during the pandemic [127]. In Australia the first stages number of those with zero days of online working before the pandemic decreased from 71% to 39% [129], [130], while in In the Netherlands, around 54% of all workers become hybrid workers, the effect on mobility and the change in travel behavior could occur in the short and long term; conversely the effect of online work and shopping and deliveries on older people was not easy, especially if they live alone [131], to solve this, online applications need to be more straightforward, accessible, and available all the time; otherwise, this will put them in the sole solution, getting out. The hypothesis that concentrates on avoiding the use of public transport during pandemics has considered many factors, not only the physical and safety problems but also the psychological and mental issues this may affect transport behaviors in the future, so it is essential to enhance the trust and increase the levels of safety and comfort for passengers during and after the pandemic; this can maintain some sustainability [132], [133]. To evaluate the current situation and investigate the effect of such pandemics on mobility users, an assessment of the impacts of the pandemic on the transportation sector and travelers' behavior in different cities from different countries was conducted [134], [135], this comes with several recommendations that are found compatible with many other studies; for example, there are differences according to the circumstances of each country and the demographical characteristics of the individual in the society; also some of the findings showed that there are significant effects of the applied restrictions on the passenger behavior [136], [137], [138] [139], in addition, e-studying and e-working make people avoid non-essential travel activities [140]. An article that focused on the dynamics of daily travel in three-phase, in Istanbul, Turkey, for the period between January 2020 and April 2020, when the situation had turned into a global pandemic, mobility users were investigated during these early stages of COVID-19 in Istanbul [141], and through three phases of different procedures and regulations that were applied by the government that affected all commuting activities and modes of transportation, it was noted that there is an increase in using private cars and non-motorized modes.

1.2.5 The Impact of the Pandemic on Public Transport Sector

Countries are taking a different path when dealing with the pandemic; some countries, such as China, Spain, and Italy, applied lockdowns in some stages to control the disease, and others used what is called intelligent lockdowns, such as the Netherlands, Japan, and Turkey and asked the citizens not to move and stay home as much as they can, other crucial notes during the pandemic is the positive environmental impact due to the reduction in vehicle usage, due to online learning and working as well people decrees their shopping, free time and social trips to the minimum and concentrate on essential trips, this significant reduction was the dominant feature in many countries for example in Australian cities, car use decreased by 35% compared to the pre-COVID-19 period [142] in the Netherlands, the drop in car use by a passenger was almost 80% [139]. Other cities experienced a huge reduction of more than 80 % in Milan, Rome, Barcelona, Madrid, and Paris) and around 70 in Moscow, New York, London, Boston, and Lisbon) in car traffic in March 2020 [143]. In Istanbul, 29% and 53% of private car use were reduced during the “late March-late April”

period. As serious measurements, public transport moved by 50% before vaccination to ensure social distancing and forcing passengers to wear masks and use hygiene in public transport [142], [139]. As serious measurements, public transport moved by 50% before vaccination to ensure social distancing and force passengers to wear masks and use hygiene in public transport [138], [135], for instance, from March to May 2020; public transport experienced a decrease of 60% to 40% in Sweden [144]. In Budapest, Hungary, public transport during early 2020 decreased by 80% [145]. In Australia, public transport use trips fell from around 15% to 7% in the early days of the virus outbreak [142]. In Indian cities, 5% of passengers avoided public transport and shifted to private modes during the outbreak.

In European cities, when comparing the post- and pre-COVID-19 period, an overall drop of 90% in France and Italy, 70% in Germany, 85% in Spain, and 75% in the UK (with some variations across cities) [146], all reported a sharp decrease in public transport usage [147]. Threats in using public transport should make planners seriously think of solutions using modern technology to develop smartphone applications to use for choosing the suitable mode of transportation, suitable activity, or suitable areas during the day, also trying to shift toward more sustainable urban mobility by encouraging walking and cycling as much as it could be by implementing certain services with suitable infrastructure and facilities [148], [149]. The pandemic may enhance sustainability and improve the environment. for example, people such as in New York City without cycling backgrounds have turned to cycle to minimize the exposure period [150], Australia [142], and Bogota, Colombia [151], during the pandemic did the same for short trips.

1.2.6 The acceleration in Digital Transformation during the Pandemic

The absence of emergency plans or at least alternative plans that have sufficient flexibility to meet any challenges that may arise is one of the biggest problems that face the various sectors, not only the transport sector, survey conducted in Turkey [152]. To investigate the existence of clear guidelines and emergency plans for different transport modes and facilities, including aviation, maritime, rail transit, bus, taxis, express motor highways, and logistics facilities. The results indicate a certain lack of emergency plans and public health instructions; the participants were asked if they found a decrease in public transport usage to other modes, and more than 80% answered that they witnessed a shift to private cars, walking, and bicycles.

It is a fact that the transformation to online and remote meetings and e-learning will become more feasible, which can result in long-lasting reductions in transport demand. One of the lessons learned that should be taken into consideration after the pandemic is investments in sustainable infrastructure [153]. The most positive global impact of COVID-19 was accelerating the digital transformation for sectors and individuals since it has become a must and not an option. Smart infrastructure and transportation are considered one of the main objectives, and looking for studies and surveys that have comprehensive approaches and models to evaluate the cities and the transportation infrastructure capacity will be the first; any intelligent mobility model should consist of at least the following indicators; the measure of efficiency, traffic congestion, accessibility rate and technology integration with advanced applications, AI, cyber technology, space systems, data analysis, and autonomous technologies. The strengths of such a model come from its design and the selected parameters and indicators with suitable modifications to evaluate smart transportation [154].

Another smart study that concentrates on using smart cameras, visions, and sensors for recognition to identify people is essential in these circumstances, as well as enabling and emerging technologies, assessing the situation, and checking social distances and physical situations by using Deep Neutral Network DNY [155], and definitely with machine learning, which can identify and recognize the locations and the nearby pedestrian, passengers, traffic conditions, and the degree of risks in public places, even develop a mechanism to reduce and minimize both pedestrian and vehicle delays and maintain peak social distances at stops stations [156], by using Machine learning, IoT, and AI, which is very important in tracking at-risk humans to detect humans with specific symptoms and track infected persons in public places and congestion areas, as well as older people, to make sure that they are in self-protection areas [157], with all of this, it is important to protect and not breach the privacy of innocent and committed people from becoming victims not only from health attacks but also from cyber-attack and to ensure that data protection mechanisms, including data anonymization, randomization, and aggregation, should be utilized. For example, we can Activate the feature of sensitive information and personal identities in sensitive locations to exchange or anonymize, show or hide according to the person's desire through trusted mobile users to avoid the attackers [158]. There is a global focus on implementing digital acceleration by constructing smart cities with environmentally friendly situations. Intelligent Traffic System ITS, is a crucial aspect of digital transformation that encompasses numerous variables and leads to successful traffic with digitally linked cars, ITS is also supported by virtual radars, emergency, and dispatch solutions, toll and fare administration, parking management, and many other current tools and processes, this would assist in relieving traffic congestion, reducing carbon emissions and oil consumption, and improve road safety, among other things, the purpose of the proposed model was to make it easier to implement ineffective traffic management and intelligent traffic systems, in addition, to enhance transportation quality, generate cost-effective commuting, reduce carbon emissions, and provide a safe and dependable transportation environment. Based on vehicle variables such as speed, vehicle distance, road specifications, and the route map, the simulation explores the before and after consequences of incorporating the system into commuter trip planning, which relies entirely on data gathering and analysis to monitor, manage, and plan transportation; mobility autonomy is critical as we move closer to creating a smart city associated with commuters' willingness and acceptance [159].

1.2.7 Jordan’s Transportation System

Jordan has been subject to many waves of forced migration since 1948, mainly for political reasons due to wars and revolutions in several neighboring countries. Infrastructure has been affected by these unexpected increases in population; the major effects were on the water, energy, education, health, and transport sectors, leaving the country with high congestion and low pedestrian safety procedures. With COVID-19, it is now more important than ever to improve the mobility infrastructure to be prepared for any future pandemics. In Jordan, public transportation is unreliable, which causes less job access amongst vulnerable, such as women and youth, many women in Jordan have declined a job due to public transportation; this minor role that public transportation plays and the modest public transport services caused a great increase in car ownership, in taxis and ride-hailing fleets all of these led to serious social, environmental, and economic issues. However, despite the international assistance, Amman’s infrastructure did not keep up with the demographic and

spatial growth; recently, the Greater Amman Municipality GAM has operated the first phase of the BRT, the project consists of two routes with a total length of 25km, and 140 buses will eventually carry more than 315,000 passengers per day, in addition, GAM will conduct green infrastructure projects in the city with accessible paths for walking and pedestrians. The civil war in Syria, which began in 2011, is still having serious impacts on the region, while the situation in Iraq, dating back to 1990, can still be valued as unstable [160], [161]. Jordan imports 96% of its energy from other countries, [162], constituting a high percentage (8% - 20%) of its GDP; this has led to looking up for the development of alternative energy sources and enhancing energy efficiency in buildings and industrial processes. Jordan has one of the highest per capita vehicle ratios for traffic accidents involving fatalities globally, coinciding with low pedestrian safety procedures. Based on Jordan's Long Term National Transport Strategy, transport safety is considered a critical issue. Although the Jordan National Transport Strategy contains all transport modes, the most significant improvements are related to safety challenges which should be achieved mainly in the road sector [163]. The transportation sector consumption exceeded 50% of the total kingdom's energy consumption. Improving public transport toward sustainability will indeed reduce energy consumption, increase efficiency and reduce the deficit in the GBD, General Budget, improve the national economy, and decrease emissions; in addition, the financial resources saved by greening the transportation industry can be used to create new jobs and can reduce emissions (Envision Consulting Group Jordan, 2011) [164]. Even though the international community tried to help, the country's debt increased and the quality of life for Jordanians and Syrians lowered equally [165]. Furthermore, the crisis has increased the financial pressure placed on disadvantaged residents and overburdened institutions; the crisis has severely impacted the transport industry in the northern Governorates and throughout Jordan. This is exacerbated by a lack of funding for preventative and routine maintenance, which impacts the road's life cycle. The response plan concentrated on improving public transport, including taking the necessary steps to increase safety standards, as well as maintaining existing road networks and, rehabilitating and expanding regional roads with positive social economic, and guaranteeing the safe movement of people and products [166], [167].

A qualitative study assessment made by using" a macro-level secondary data review", in Jordan showed that the social, economic, and environmental risks are diverse even from a gender point of view; the women facing many barriers in the labor sector with unequal opportunities or support from the society in fact workers woman carry most of the responsibility of the family upon her shoulders forcing her some times to make sacrifices for the benefit of the family, other socio-economic challenges is a shortage in water which forced many to pay for drinking water and agriculture environment, and climate change also impacts a serious matter [168], [169]. Some studies introduce public mobility in the capital as a fleet of public transport that consists of public vehicles operated by either small firms, buses, minibuses (or coasters), jitneys (fixed-route taxis) [170], and recently on demand taxis through smart app and regular cabs [171], also, there is a large proportion of (yellow) taxis in Amman. A survey is conducted by randomly chosen passengers (employees, school students, university students, and workers, the survey questions targeted the evaluation of different travel demand elements in a pairwise comparison [172], in the examined case

study, it is noticed that the greater utilization of public transport did not depend on general service improvements, and an increase in public transport travel could be reached by improving transport quality elements, mainly travel safety, and increase in the bus lines travel frequency also the waiting times were criticized [173], [174].

To evaluate the supply quality of public transport in Amman, Jordan, and the transport quality criterion was reported to be of the highest importance [175]. Moreover, some other aspects can also be considered, such as the conflicting interests of stakeholders, their characteristics, and priorities related to public transport. However, results clearly show the possibility of applying an in-depth analysis supporting the public transport development decisions [176], [177], as well to detect the changes before and during COVID-19 [178].

1.2.8 Hungary's Transportation System

Hungary has a well-developed sustainable, and organized transportation system and continues to build a unique standing in the sector, among others in the area, with innovative and sustainable mobility solutions that are framed by (long-term) strategies and plan up to 2050 electric cars increased continually, and electric buses soon will be put into operation. At least 1,300 electric buses shall operate by 2030; the Hungarian companies produce around 200 e-buses yearly. Smart Mobility Plan SMP for Budapest is aware that the capital needs intelligent and sustainable transportation systems, which is the first step towards an intelligent city. Hungary's sustainable and smart mobility 2021 [179], Budapest has one of the highest public transport modal shares in Europe with 45%, according to the European Platform on Mobility Management (EPOMM, 2020), the information based on March 2020: it was road transport, automatically measured data collected by (Budapest Közút Zrt., BK), Budapest Roads Ltd.; the Hungarian Public Road Nonprofit Ltd, and by (Budapesti Közlekedési Központ Zrt., BKK); Budapest Centre for Transport Ltd., which is the largest public transport company in Budapest and one of the largest in Europe, while BKK. Provided Bike-Sharing System BSS, usage data, the results show the reduced share of public transport due to many reasons, such as online work and study and the trend to use private transport modes to reduce contact with others.

Hungary aims to reduce harmful GHG emissions by at least 40% by 2030, as a large amount of the harmed emissions, air pollution, and noise are strongly connected with the transport sector (operation, construction, maintenance, and rehabilitation) e-mobility will consider necessary not only for the environment but also for other economic benefits [180], Budapest, compared with other cities, has the optimal use of public transport, and the GPS is used frequently; in addition, BK, the public road management company of the city of Budapest, provided the needed traffic data and information in Buda and Pest sides [145], in addition to other information based on Google location data, (Google LLC, 2020) [181], BKK in Budapest, has physical counting locations to implement any household survey when needed [182]. From the initial stages of the COVID-19 pandemic, many actions have been taken to limit the spread of COVID-19 and minimize its impact, the first stages when declared an emergency state. And people stayed at home; then the government announced a three-stage plan before breaking the lockdown; stage 1 included only "essential goods and services;

in stage 2, more services opened but with challenging conditions and health and safety requirements (Government of Ontario, 2020), the last stage, all businesses re-open, and that when approaching a reasonable level of control [183]. In April–June 2021, statistics even the passenger's performance increased, but it can be seen that it is significantly lower than two years earlier by a third; it was 60% lower than in the same period of 2019. During the first quarter of 2020, car usage increased from 43% to 65%, while cycling traffic activities have remarkable increased [184].

1.2.9 Research Questions and Score Ranges

The main questions that aim to assess the impact of the COVID-19 pandemic on the transportation sector and upon which the study stands are summarized as follows:

1- The participants were asked; how often they used each transport mode before and during the pandemic for different outdoor activities [185], [186].
2- The participants were asked; to rate the probability of catching the disease from the use of each transport mode, to rate the effectiveness of the restrictions and procedures applied to limit the spread in each one, as well as when the epidemic is expected to end.
3- The participants were asked; to rate the degree of satisfaction with public transportation modes and services.
4- The participants were asked; about remotely (studying, working) and e- (payment and services) if it will continue in the future after the end of this pandemic, and whether the use of smart applications will have a positive impact on the quality of life.

1.2.10 Hypotheses

The primary objective of this study is to assess the impact of the COVID-19 on mobility and transportation modes according to the following hypotheses:

1- The First Hypothesis H1
The frequencies of usage of each transport mode for outdoor activities have significant differences before and during the pandemic [187], [188]:

1.1. The First Sub Hypothesis (H1.1)
The frequencies of usage of non-motorized transport modes (Walking/ Riding a bike) for outdoor activities have significant differences before and during the pandemic.

1.2. The Second Sub Hypothesis (H1.2)
The frequencies of usage of private transport modes (Motorbike/ Private car) for outdoor activities have significant differences before and during the pandemic.

1.3. The Third Sub Hypothesis (H1.3)
The frequencies of usage of taxi services (Taxi services/ Auto-sharing; with or without other passengers) for outdoor activities have significant differences before and during the pandemic.

1.4. The Fourth Sub Hypothesis (H1.4)
The frequencies of usage of public transportation PT for outdoor activities have significant differences before and during the pandemic.

2- The Second Hypothesis H2
The probability of catching the disease while using transport modes and the applied procedures and restrictions on transportation to limit coronavirus spread in each mode have significant effects on transport users [189], [190].

3- The Third Hypothesis H3

There are significant effects of passengers' satisfaction with public transportation modes and their services [191], [192], [193].

4- The Fourth Hypothesis H4
The trend towards digital transformation e-(learning, work, shopping, and services), even after the end of the pandemic, and the use of smart applications have significant effects and positive impacts on the quality of life [194], [195], [196], [197].

1.2.11 Significance of the Study

To date, COVID-19 is the main concern for all countries of the world; the disease has been contained to some degree, but it has not been eradicated so far, and transportation modes of all kinds are an active focal point for disease transmission locally and globally. It was necessary to study the impact of the pandemic from the point of view of users and their satisfaction in light of the applicable preventive measures and instructions, and to measure the impact on the sustainability of the transport sector, in addition to anticipating the future of the digital transformation from the users' perspective. The seriousness of the pandemic compared to others is that it is not confined to a certain region to be quarantined and contained as its predecessors. Unfortunately, the disease is developed itself so that vaccines do not constitute complete protection and that some people's disregard for safety measures, whether when using modes of transportation or in other places, can lead to disasters, and the only solution is not only to take the necessary precautions, but it is also to avoid crowded places as much as possible, especially those who have people of old age [198], [199].

2. METHODOLOGY

2.1 Main Objectives

Assess the impact of the COVID-19 pandemic on transport mode choice (Walk or Ride a bike, Motorbike /Private car, Taxi services /Auto sharing; with or without other passengers, and Bus /Metro /Tram /Train) for various necessary or recreational activities, all of these will be from user's perspectives in Amman and Budapest. During the Corona pandemic, procedures and restrictions were applied when using transportation modes, with the aim of containing the disease as much as possible; this will be rated for each transport mode by users in addition to the degree of satisfaction from the public transportation. Finally, investigate from the participants' point of view will the electronic transformation for study, work, and e- services and delivery will continue even after the end of the pandemic.

2.2 Survey Design

The initial design of the questionnaire was chosen by reviewing the theoretical frameworks related to previous research that studied the effects of the pandemic and its impact on the transport sector, and after consulting with my supervisors, it was decided to add two additional paragraphs to the original questionnaire, concern about the digital transformation and the use of e-(work, study, and services) even after the end of the pandemic and to rate the degree of satisfaction with public transportation. The main sections of the questionnaire study the frequency of usage of mobility modes and activities before and during the COVID-19 pandemic and assess from the participants' perspective the probability of catching the disease through the frequent use of transport modes as posted in the original questionnaire [51], [200], several studies have followed a similar trend and

analyzed the effects of the pandemic starting from the early stage of the disease; for example a study of Pakistan [201], [202], India [110], developing countries [106], and Istanbul [203], experts [204], and others [205], [206]. They all concentrated on analyzing the modes and activities to figure out the effects of COVID-19; generally, it is better to adopt studies that contain high-quality, effective, and trusted research.

The current study took into consideration many demographical and other characteristics, all of which have been linked to COVID-19, to investigate the impact of the pandemic in Amman and Budapest. The questionnaire consists of five main sections containing items from (Question Q1) to (Question Q 17) see Appendix I:

The first section (Q1 – Q4) contains demographical characteristics questions such as age, gender, education levels, car ownership, occupation, income, etc., besides other mobility features. The second section (Q 5 – Q9) contains items that concern assessing the impacts of COVID-19 on transportation and mobility from the users' perspective; the used mechanism is to measure the frequency of usage before and during the pandemic for all transport modes; for non-motorized modes such as (Walk or Ride a bike) and motorized modes such as (Motorbike /Private car, Taxi services /Auto sharing with or without other passengers, Bus, metro/train, and train) and for each activity such as (work/study, free time, social activities, essential shopping, and non-essential shopping) Figure 1 and 2 show for the hypothesis, H1 the structure design, activities vs. transport mode and the expected attitude and change in activities and modes respectively [207].

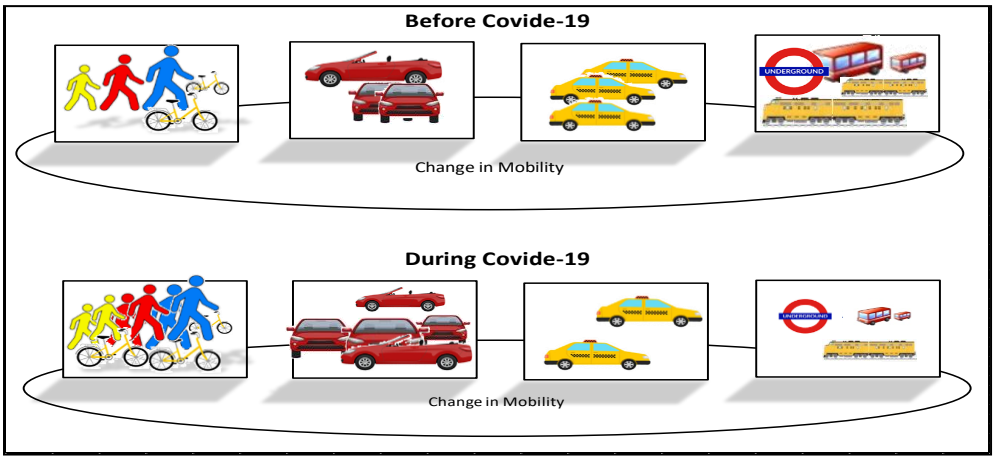


Figure 1: 1st Hypothesis; Activities vs. Transport Modes source, the author.

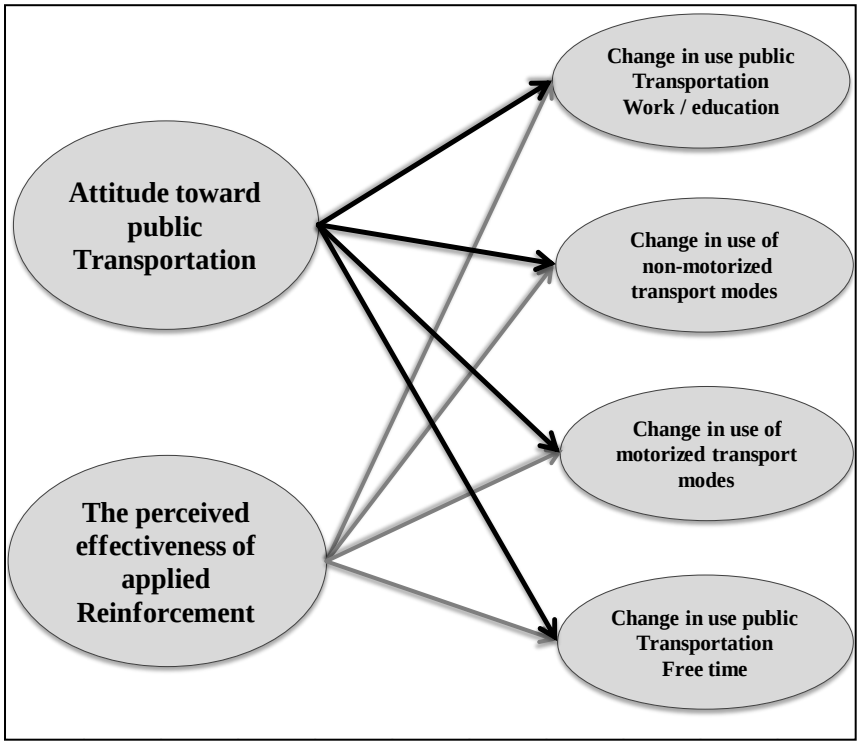


Figure 2: 1st Hypothesis; Change in Activities [207]

The third section (Q 10 - Q 11) is about the effectiveness of the applied restrictions and procedures to limit the spread of the pandemic and the probability of catching the disease from the users' perspective while using each mode of transportation, as seen in Figure 3.

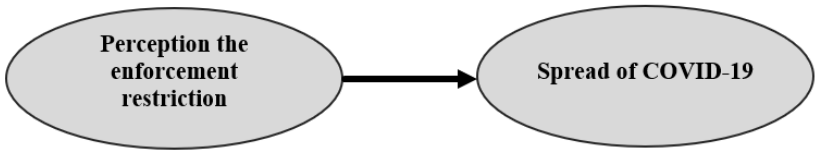


Figure 3: 2nd Hypothesis; Perceptions on the enforcement Instructions [207]

The fourth section (Q13a and Q13b) rates the degree of satisfaction with public transportation from the passenger's perspective.

The last section (Q14 - Q17) concerns about digital transformation and the use of e- (work, study, and services) after the end of the pandemic.

The participations were informed from the beginning that the data were confidential and their response would remain anonymous. The current study will assess and investigate [208], the priority mobility modes and activities choices during the pandemic from participants' perspectives.

Theoretically, it is assumed that either in Amman or Budapest, the pandemic had an impact on human behavior related to movement using various modes of transportation and for various activities; this and more will be assessed in the current study to investigate the priority modes of activities choices from participants' perspective. The plan is intended to generate two separate studies with the necessary comparison between the two cities. It does not make sense to conduct any merged assessment for Amman and Budapest, each model will assess the mean behavior for all categories, and the ideal would be an assessment for the groups of categorical variables like (gender, age, income, work, or study, etc.). The next chapters will explain in detail; the pilot study, the final questionnaire, the plan implementation and investigation methods, the data collection characteristics, the independent and dependent variables, the sample size, and all needed statistical analysis. Figure 4 shows the research methodology, as will be presented in the next chapters.

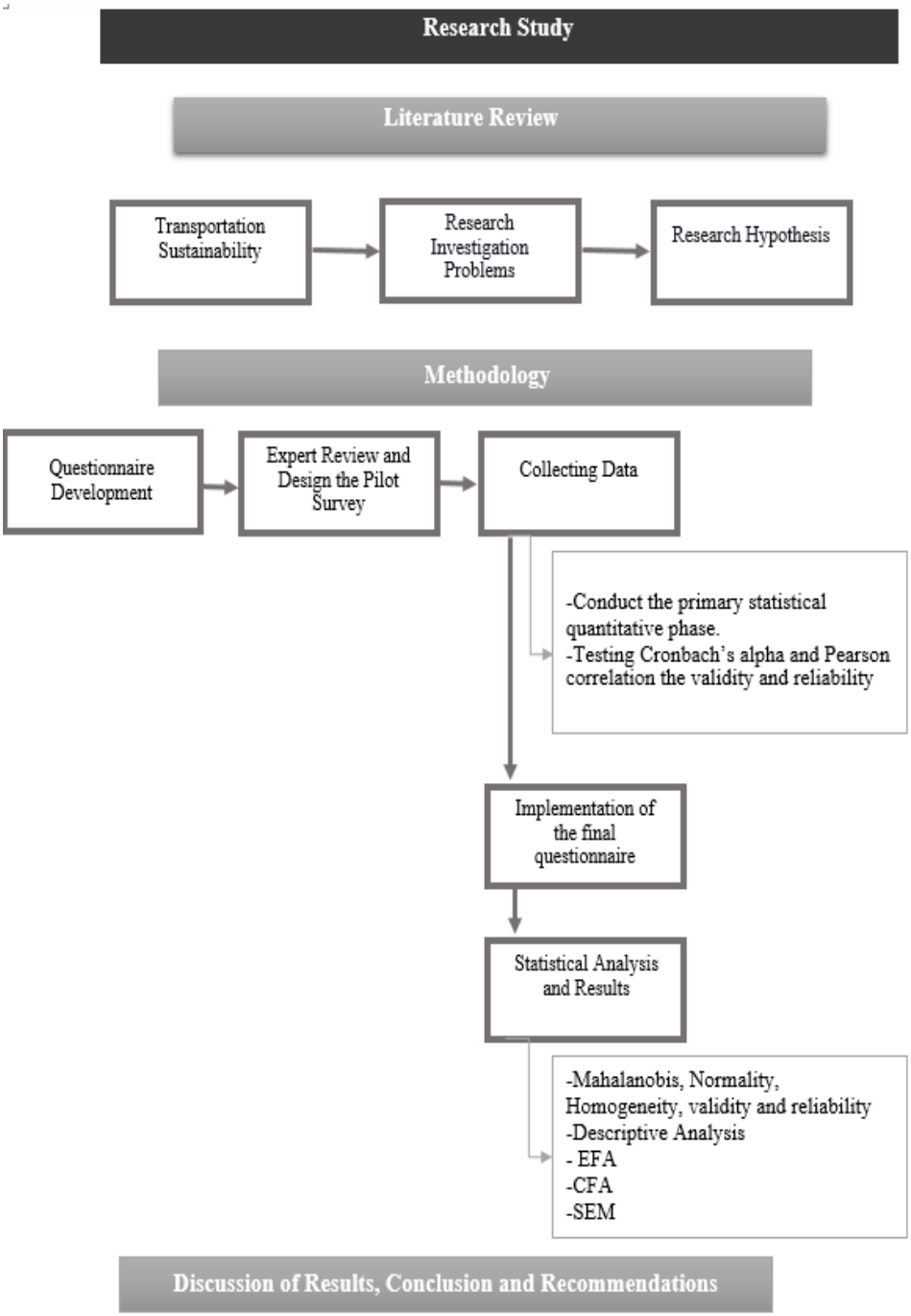


Figure 4: Research Methodology

2.3 The Pilot Studies

The original questionnaire survey was prepared and distributed as an international study that included ten countries during COVID-19 [51]. The current questionnaire contains the original one

and two extra paragraphs to rate the passengers' satisfaction and the acceleration in digital transformation for e-study, e- work, and e-services due to the current pandemic.
In this stage (41) respondents completed the questionnaire, the google form of the questionnaire opened from 20/10/2021 to 10/11/2021, and all received a comment from the participants; even the oral one was taken into consideration.

2.3.1 Pilot Objectives

The sample was distributed according to the criteria presented for the pilot stage to ensure that the respondents have a complete understanding and that the sentences have sufficient clearness and familiarity. From the outcomes and the feedback, the participants who fill out the questionnaire understand the main goal, which is how COVID-19 is associated with a change in modes of transportation and mobility activities needs for work, study, leisure, shopping, etc. and this is sufficient to distinguish; education, work, gender, age, and persons different, economic statuses (income and occupation). The experts from the same research field have tested the questionnaire, and their comments are taken into consideration and bring us some adjustments to the questionnaire. The following sections describe the procedures, and the results include some insights into the statistical procedures.

2.3.2 Sampling Plan and Analysis Methodology

The survey used the Google Forms questionnaire [209], [210], and the quota sampling strategy targets all strata of the society in both cities; the sample achieved the diversity of the population, and this sample considered a pre-test and good practice access to the major list of individuals with the whole probabilistic sampling and considered the potential of the diversity of the population with the influence of demographical variables under the study [211]. The result of Pearson Coefficient for validity and Cronbach's Alpha for reliability were helpful and worthy; by taking the questionnaire structure as one unit, the reliability Cronbach's Alpha = 0.845, in addition, the value for each hypothesis is represented as seen in Table 1, [212], [213], [214]. The survey for reliability and validity results led to revision for some questions, including (merging, editing, and modifications) this reduced the main items from 81 to 74 items and the main questions from 21 to 17; however, the nominated variables did not change.

	Cronbach's Alpha	**Cronbach's Alpha Based on Standardized Items**	**N of Items**
All Hypotheses (H1, H2, H3 & H4)	.805	.845	81
Hypothesis H1	.831	.840	36
Hypothesis H2	.725	.709	11
Hypothesis H3	.954	.952	22
Hypothesis H4	.521	.505	6

Table 1: Reliability Statistics

2.3.3 Main Study and Research

Initially, from the first stages, the questionnaire consulted with my supervisor, who was credited from the beginning with translating it into Hungarian, then the Google Form questionnaire within its final shape distributed in three languages English, which is the main language of the original version, Arabic and Hungarian, the finalized google form questionnaire opened from 15/11/2021 to 2 /01/2022 for individuals and the means of communicating with people was through all available electronic and social channels, all possible means were used, with the help of my university and colleagues, friends, and family members to urge people to respond by sending reminders from time to time.

2.4 Methodology and Plan of Implementation

The survey considers convenient in such research; we used a questionnaire with different scales such as frequency of usage form, multiple choice, Likert scale with seven options, and open-answer questions. The requirements for the comparison between before and during COVID-19 undergo several tests; the analysis started with verifying the parametric or non-parametric characteristics, , [215], [216], [217], and ending with checking variables significances and research models [218], [219],[220]. The checks for normality and homogeneity were carefully handled for each assumption separately [221].

2.4.1 The Independent and Dependent Variables

The demographical characteristics and other mobility variables include; gender, age, education levels, occupation, income, number of owned vehicles, the status of work/ study (whether he/ she is studying or working remotely), etc., the dependent variables identify the main goal of the research which is the frequency of transport mode use for different mobility activities in essence, how mobility manifests and the variables was in the form of a matrix [222], that contains both frequencies with activities before and during the pandemic, other variables to measure; the perceived effectiveness of regional applied restriction on the spread of COVID-19 on each transport mode, passenger satisfaction with public transportation, and additional variables to investigate from the participants' perspective whether the digital transformation in e- (study, work, and services) will continue to grow in the future even after the end of the pandemic. The variables are illustrated in Figure 5.

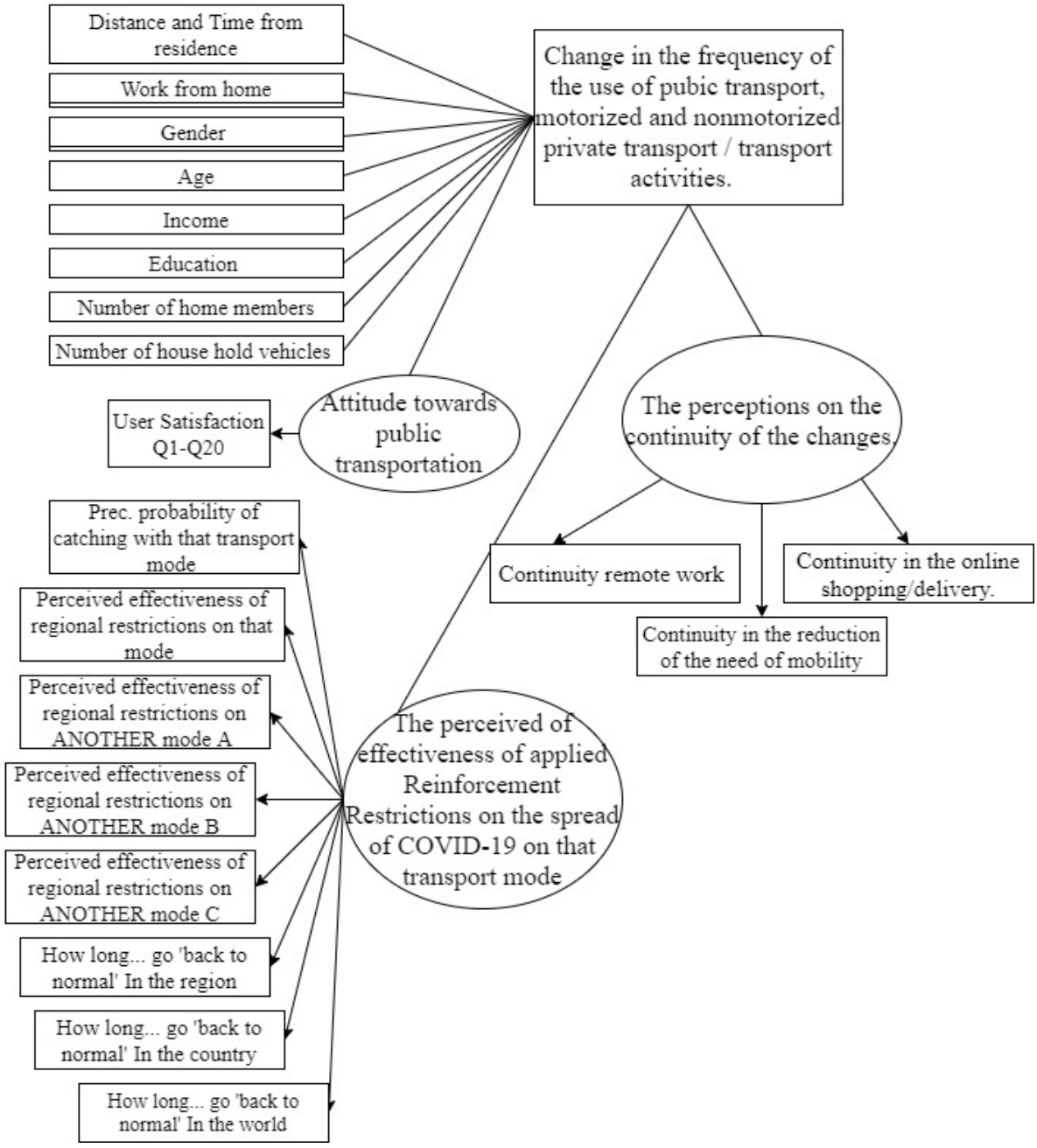


Figure 5: Research Variables [222]

2.4.2 Analysis and Descriptive Statistics

I. Major Descriptive and Analysis Plan

Related to the sections of the thesis, as mentioned previously, the main section studies the frequency of mobility before and during the COVID-19 pandemic see Appendix II.

The items of the section are well defined by the frequency of usage as a matrix question of several multiple-choice simultaneously in a grid format, multiple-choice closed questions, and open-choice questions. Initially, Cronbach Alpha calculated and Pearson Coefficient at a significant level (α=0.05), the mean, standard deviance, variance, skewness, and kurtosis [223], were generated to make the necessary comparison.

II. Levene's Test

This test shows the confidence intervals for post-hoc analysis to make the necessary comparison and to identify the most relevant variables that have significantly higher (or lower) variances [224], see Appendix III.

III. Analysis of Variance (ANOVA)

It is applied initially for uniform variance; after checking the normality of the data then, assessments of the data and variables in each group were calculated to check the skewed; in our case, the Kruskal-Wallis test [225], as non-parametric test [226], are suitable to be implemented.

IV. Exploratory Factor and Confirmatory Factor Analysis (EFA) and (CFA)

EFA is one of the approaches for identifying and explaining the relationship between variables by categorizing them based on specific linkages and discovering the underlying factors by computing the factor scores and then representing the items as groups [227], [228], while CFA is used to confirm the relationship between variables by test the hypotheses, then to ensure that the hypotheses' variables fit as model/ models [229], development of EFA and CFA methods and path analysis is Structural equation models SEM [230], which used to describe the connections between variables. It is important to mention in this stage that maybe we cannot assume groups are indeed totally independent because, under the influence of several variables, the users can move from one mode to another [231], [232], [233].

2.5 Data Collections Characteristics of the Sample

I. Characteristics of the collected sample

The targeted area and population considered all citizens in both capitals, Amman (Jordan) and Budapest (Hungary), where all the analysis will be implemented separately per city, i.e., two different tests for the variables to generate two models.

II. The sample demographical characteristics

Choosing the relevant demographical variables for the study, which are considered in the mobility behavior such as age, gender, car ownership, occupation, income, education levels, etc.

III. Other Information can be used to set the sample plan:

To achieve the study's objectives in both cities, Amman and Budapest, research for descriptive of the population and areas as illustrated in Tables 2 and 3 below [234], [235], [236], [237], were needed for a clear understanding to define additional variables that are relevant to the features of mobility and transportation; adding several influential factors for the data collection procedure will become complicated to be implemented, so the idea is to choose the most influential variables while still considering the practicality of using such variables for classification.

IV. Intervals and Distribution Channel

In both cities, online surveys through all possible channels and social media were used; in addition to that, in Jordan, the questionnaire was also filled by conducted face to face interviews with random selections in crowded places, such as malls and stop stations.

2.6 Plans of Budapest and Amman

City	
Budapest	Sample Size: 339
	Respondents Answers listed as excel sheets
	Respondents Answers listed as SPSS sheets
	Major information sources:
General Information	The Hungarian capital city has a peculiar dual self-government system. Hilly Buda, which comprises one-third of the city's area of 525 km² is located along the right bank of the Danube surrounded by low mountains. The population of Budapest is about 1 723 836 persons, 17% of the country's population. Population density is 3,346.2 persons/sq. km, [236], [238], [237], [239]. Women contribute more than half, 54% of the population. Public transport in Budapest is the responsibility of the Budapest Transport Company, or BKV by its Hungarian acronym. Almost 60% of the Budapest people use public transport to work, 29% drive a car and 11% walk. 42% of the people of Budapest use public transportation day by day and 73% at least once a week [240].
Needed Characteristics Data	Budapest consists of several districts, almost with differ geography around the river, it is not a rural region and the districts have their own specificities as an urban society the needed data grouping categories consist of the following: 1) personal and demographical characteristics such as age, income, gender, education, occupation, 2) non-demographical characteristics such as city of residence, remotely working/ studying, family members, number of vehicles in the household, percentage of transportation expenditure from the total family income, the distance (km) from residence to work/ study place and the time (in minutes) it takes from residence to work/ study place.

Table 2: Plan of Budapest

City	
Amman	Sample Size: 370
	Respondents Answers listed as excel sheets
	Respondents Answers listed as SPSS sheets
	Major information sources:
General information	Amman is a unique city that has faced many challenges throughout history; Amman is culturally diverse, and almost four million inhabitants from many different sociocultural backgrounds live together in the capital. Amman Governorate's population is approximately 4,430,700 residents [234], almost 42% of the Jordanian population. The Greater Amman Municipality population is 3,816,980. The rapid rise in the city's population has had a tremendous impact on mobility causing constant traffic jams, insufficient infrastructure, poor public transportation networks,

	and a lack of other mobility options, such as walking and biking [235]. Females feel compromised while taking public transportation and remain dissatisfied with what should be considered a basic right. This dissatisfaction also extends to the experiences of minorities in general (e.g., persons with disabilities, persons from forced displacement Backgrounds, etc.). Car ownership has greatly increased in Amman, while public transportation plays a minor part in the modal share, with taxis and ride-hailing representing a large portion of that percentage. The BRT construction started in 2008, was suspended in 2011, resumed in 2015, and will be fully operational in 2023. A survey from 2018 stated that only 13% of daily trips are done through public transportation, of which 8% use taxis and 5% buses [241]. Furthermore, public transport users represent "captive riders" with an average monthly income of less than 400 Jordanian Dinars (JOD), and many of them do not own a car (65% in the GAM area). The low rate of public transportation and walking is primarily due to bad infrastructure and lacking safety, lacking good accessibility, or affordable means of transportation; all of this is followed by an increase in private vehicles and, hence, emissions, air pollution, and traffic jams [242]. The Capital Governorate consists of (9) counties, (8) municipalities, and (22) regions within the Greater Amman Municipality GAM; its average elevation is around 750 m above sea level, the governorate's area: is (7579.2 km2) and the population density: (528.8) inhabitants per square kilometre [234].
Needed Characteristics Data	Amman consist of several districts, almost with differ geography, it is not a rural region and consider the main destination for work, commerce and higher education, by keeping focus on the same trend as Budapest the needed data grouping categories consist of the following: 1) personal and demographical characteristics such as age, income, gender, education, occupation, 2) non-demographical characteristics such as city of residence, remotely working/ studying, family members, number of vehicles in the household, percentage of transportation expenditure from the total family income, the distance (km) from residence to work/ study place and the time (in minutes) it takes from residence to work/ study place.

Table 3: Plan of Amman

3. DATA RESULTS AND ANALYSIS FOR AMMAN AND BUDAPEST

The analysis for the current survey will be represented in detail through this chapter; the needed data was assessed through statistical processes. Viewing the outcomes, which aimed to assess the impact of COVID-19 on users of land transport before and during the pandemic by examining the hypotheses of the study, testing the variables, assessing the survey items and paragraphs with statistical analysis, that was processed using Microsoft Excel, statistical program analysis SPSS v. 26 [243], and AMOS [244], all are utilized to discuss the needed statistical tests, by reviewing the hypotheses in detail and illustrate the statistical description for the items of the questionnaire.

3.1 Test of Mahalanobis and Cook's Distance, Outliner, Incomplete and Missing Data

Detecting the data in the excel sheets was the first step to look for incomplete and missing items; the possible multivariate outliers can be identified through Mahalanobis Distance MD, which is an effective distance that finds the distance between the point and a distribution Table 4 and 5 show the extreme outliers points for demographical variables [245], the lower the MD, the closer to the benchmarks point.

City: Amman	**Gender**				**Occupation**				**Age**			
Residuals Statistics[a]	Min	Max	Mean	Std. Deviation	Min	Max	Mean	Std. Deviation	Min	Max	Mean	Std. Deviation
Predicted Value	62.37	74.30	67.98	5.96	58.32	73.79	67.98	5.31	54.18	76.20	67.98	5.44
Std. Predicted Value	-0.94	1.06	0.00	1.00	-1.82	1.09	0.00	1.00	-2.54	1.51	0.00	1.00
Standard Error of Predicted Value	1.66	1.76	1.71	0.05	1.30	2.53	1.66	0.47	1.23	3.32	1.67	0.42
Adjusted Predicted Value	61.99	74.51	67.98	5.96	56.89	73.98	67.98	5.31	54.02	76.54	67.98	5.43
Residual	-37.30	105.70	0.00	23.24	-30.79	121.68	0.00	23.40	-37.20	111.14	0.00	23.37
Std. Residual	-1.60	4.54	0.00	1.00	-1.31	5.19	0.00	1.00	-1.59	4.75	0.00	1.00
Stud. Residual	-1.61	4.56	0.00	1.00	-1.32	5.22	0.00	1.00	-1.60	4.76	0.00	1.00
Deleted Residual	-37.51	106.31	0.00	23.37	-30.98	123.11	0.00	23.54	-37.54	111.45	0.00	23.49
Stud. Deleted Residual	-1.61	4.68	0.00	1.01	-1.32	5.42	0.00	1.01	-1.60	4.90	0.00	1.01
Mahal. Distance	**0.885**	**1.123**	**0.997**	**0.119**	**0.131**	**3.304**	**0.997**	**1.185**	**0.026**	**6.442**	**0.997**	**1.092**
Cook's Distance	0.00	0.06	0.00	0.01	0.00	0.16	0.00	0.01	0.00	0.07	0.00	0.01
Centered Leverage Value	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.00

a. Dependent Variable: total Q5to17

Table 4: Residuals Statistics for Amman Mahalanobis and Cook's Distance

City: Budapest	Gender				Occupation				Age			
Residuals Statistics[a]	Min	Max	Mean	Std. Deviatio	Min	Max	Mean	Std. Deviatio	Min	Max	Mean	Std. Deviatio
Predicted Value	219.07	227.68	223.31	4.31	218.64	225.38	223.31	2.03	203.11	239.57	223.31	8.26
Std. Predicted Value	-0.98	1.01	0.00	1.00	-2.30	1.02	0.00	1.00	-2.44	1.97	0.00	1.00
Standard Error of Predicted Value	2.17	2.20	2.18	0.02	1.59	3.92	2.09	0.71	1.53	3.96	2.03	0.59
Adjusted Predicted Value	218.54	228.16	223.31	4.31	217.34	225.73	223.31	2.05	202.88	240.63	223.33	8.27
Residual	-89.07	89.93	0.00	28.39	-92.01	87.62	0.00	28.64	-94.99	91.30	0.00	27.50
Std. Residual	-3.13	3.16	0.00	1.00	-3.21	3.06	0.00	1.00	-3.45	3.32	0.00	1.00
Stud. Residual	-3.14	3.17	0.00	1.00	-3.21	3.06	0.00	1.00	-3.46	3.32	0.00	1.00
Deleted Residual	-89.59	90.46	0.00	28.56	-92.39	88.15	0.00	28.81	-95.28	91.70	-0.02	27.68
Stud. Deleted Residual	-3.19	3.22	0.00	1.01	-3.26	3.10	0.00	1.01	-3.51	3.37	0.00	1.01
Mahal. Distance	**0.968**	**1.027**	**0.997**	**0.029**	**0.036**	**5.309**	**0.997**	**1.593**	**0.041**	**5.975**	**0.997**	**1.296**
Cook's Distance	0	0.029	0.003	0.005	0	0.059	0.003	0.006	0	0.052	0.003	0.007
Centered Leverage Value	0.003	0.003	0.003	0	0	0.016	0.003	0.005	0	0.018	0.003	0.004

a. Dependent Variable: total Q5to17

Table 5: Residuals Statistics for Budapest Mahalanobis and Cook's Distance

3.2 Test of Normality

Normality for each hypothesis before and during the COVID-19 pandemic is checked [246], through Kolmogorov-Smirnov test [247], at the level of significance ($\alpha \geq 0.05$), as well as the kurtosis and skew values, were checked to ensure that the acceptable ranges (-10, +10) and (-3, +3), respectively [248], [249].

3.2.1 Hypothesis H1

For Amman and Budapest, Tables 6 to 10 and 11 to 15, respectively, show that the distribution of the Kolmogorov-Smirnov test is statistically significant since most of the statistical significance values are below the level of significance (α=0.05); this indicates that the distribution for the first hypothesis is not normal for (gender, educational level, age, occupation, and income) for the items related to the frequent use of different modes of transportation as shown in Figures 6 and 7. As well, the tests confirm that the values of kurtosis and skewness are acceptable for all variables and located within the ranges (-10, +10) and (-3, +3), respectively.

Tests of Normality							
City: Amman	**Gender**	**Kolmogorov-Smirnova**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Total During COVID-19	Male	0.18	196.00	0.00	0.85	196.00	0.00
	Female	0.17	174.00	0.00	0.87	174.00	0.00
Total before COVID-19	Male	0.17	196.00	0.00	0.87	196.00	0.00
	Female	0.18	174.00	0.00	0.87	174.00	0.00

a. Lilliefors Significance Correction

Table 6: 1st Hypothesis Test of Normality for Gender

Tests of Normality							
City: Amman	**Educational Level**	**Kolmogorov-Smirnova**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Total During COVID-19	High School or Less	0.160	160.000	0.000	0.815	160.000	0.000
	Bachelor's Degree	0.207	156.000	0.000	0.807	156.000	0.000
	Master's Degree	0.183	28.000	0.017	0.901	28.000	0.012
	Ph.D.	0.170	12.000	.200*	0.924	12.000	0.322
	Other	0.261	14.000	0.010	0.856	14.000	0.027

Total During COVID-19	High School or Less	0.158	160.000	0.000	0.818	160.000	0.000
	Bachelor's Degree	0.199	156.000	0.000	0.823	156.000	0.000
	Master's Degree	0.179	28.000	0.021	0.890	28.000	0.007
	Ph.D.	0.177	12.000	.200*	0.908	12.000	0.200
	Other	0.226	14.000	0.051	0.862	14.000	0.033

Table 7: 1st Hypothesis Test of Normality for Educational Level

Tests of Normality							
City: Amman	**Age**	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Total During COVID-19	less than 18	.125	38	.138	.944	38	.057
	18 - 28	.199	103	.000	.815	103	.000
	29-39	.261	78	.000	.732	78	.000
	40-49	.220	69	.000	.852	69	.000
	50-59	.176	49	.001	.817	49	.000
	60-69	.213	31	.001	.737	31	.000
	more than 69	.260	2	.			
Total Before COVID-19	less than 18	.102	38	.200*	.945	38	.063
	18 - 28	.204	103	.000	.844	103	.000
	29-39	.247	78	.000	.755	78	.000

	40-49	.192	69	.000	.809	69	.000
	50-59	.181	49	.000	.836	49	.000
	60-69	.225	31	.000	.731	31	.000
	more than 69	.260	2	-	-	-	-

Table 8: 1st Hypothesis Test of Normality for Age

Tests of Normality							
City: Amman	**Occupation**	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Total COVID-19 During	Student	.135	74	.002	.874	74	.000
	Working	.220	196	.000	.750	196	.000
	Studying and Working together	.325	8	.013	.736	8	.006
	Retired	.175	24	.055	.873	24	.006
	Unemployed	.245	68	.000	.686	68	.000
Total Before COVID-19	Student	.164	74	.000	.877	74	.000
	Working	.207	196	.000	.756	196	.000
	Studying and Working together	.322	8	.014	.845	8	.084
	Retired	.210	24	.008	.885	24	.011
	Unemployed	.234	68	.000	.703	68	.000
a. Lilliefors Significance Correction							

Table 9: 1st Hypothesis Test of Normality for Occupation

Tests of Normality							
City: Amman	Income	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Total During COVID-19	< 500	.203	212	.000	.747	212	.000
	501 - 1000	.100	97	.018	.934	97	.000
	1001 - 1500	.204	33	.001	.859	33	.001
	1501 - 2000	.294	12	.005	.729	12	.002
	2001- 2500	.237	8	.200*	.898	8	.278
	>2500	.257	8	.128	.809	8	.036
Total Before COVID-19	< 500	.190	212	.000	.799	212	.000
	501 - 1000	.133	97	.000	.917	97	.000
	1001 - 1500	.222	33	.000	.801	33	.000
	1501 - 2000	.223	12	.103	.940	12	.500
	2001- 2500	.264	8	.106	.866	8	.136
	>2500	.299	8	.034	.758	8	.010

Table 10: 1st Hypothesis Test of Normality for Income

Tests of Normality							
City: Budapest	Gender	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
TOTAL Before COVID-19	male	.157	172	.000	.839	172	.000
	female	.109	167	.000	.909	167	.000
TOTAL During COVID-19	male	.166	172	.000	.819	172	.000
	female	.101	167	.000	.912	167	.000

Table 11: 1st Hypothesis Test of Normality for Gender

Tests of Normality							
City: Budapest	**Education Level**	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Total Before COVID-19	High School or Less	.273	22	.000	.720	22	.000
	Bachelor's Degree	.088	115	.028	.972	115	.017
	Master's Degree	.121	106	.001	.882	106	.000
	Ph.D.	.133	60	.010	.895	60	.000
	Other	.253	36	.000	.800	36	.000
TOTAL During COVID-19	High School or Less	.265	22	.000	.647	22	.000
	Bachelor's Degree	.101	115	.006	.937	115	.000
	Master's Degree	.115	106	.002	.903	106	.000
	Ph.D.	.163	60	.000	.824	60	.000
	Other	.313	36	.000	.665	36	.000
a. Lilliefors Significance Correction							

Table 12: 1st Hypothesis Test of Normality for Education Level

Tests of Normality							
City: Budapest	**Age**	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
TOTAL Before COVID-19	less than 18	.162	11	.200*	.968	11	.867
	18 - 28	.153	81	.000	.889	81	.000
	29-39	.153	129	.000	.833	129	.000
	40-49	.143	65	.002	.874	65	.000
	50-59	.123	43	.102	.891	43	.001
	60-69	.200	10	.200	.901	10	.226

TOTAL During COVID-19	less than 18	.118	11	.200*	.973	11	.914
	18 - 28	.140	81	.000	.908	81	.000
	29-39	.149	129	.000	.842	129	.000
	40-49	.140	65	.003	.863	65	.000
	50-59	.113	43	.200	.900	43	.001
	60-69	.228	10	.149	.900	10	.218
a. Lilliefors Significance Correction							

Table 13:1st Hypothesis Test of Normality for Age

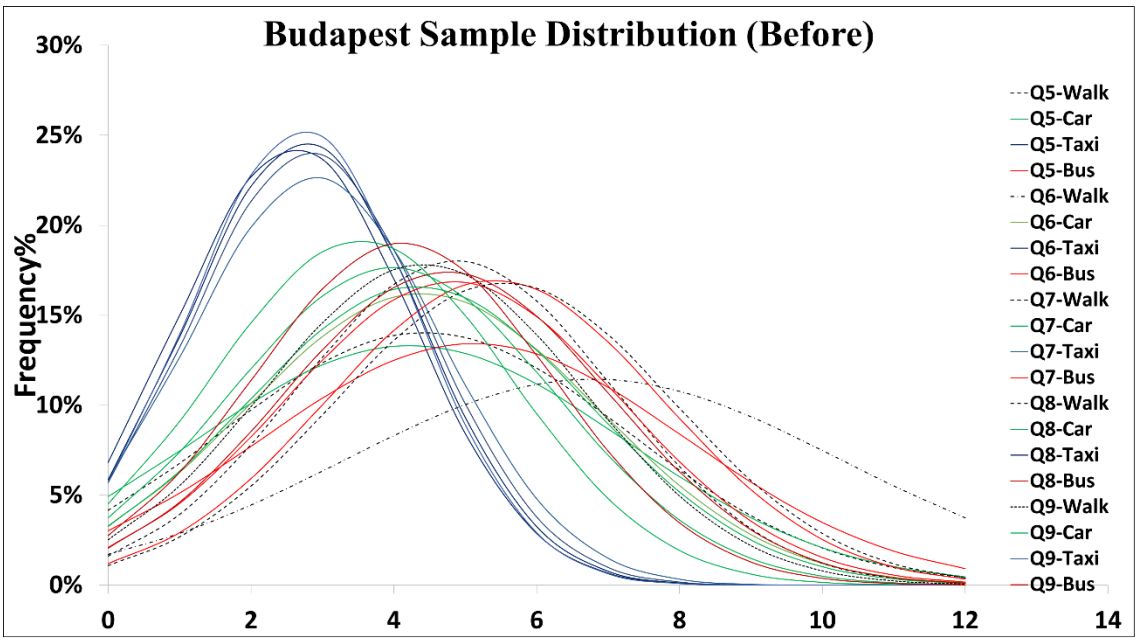
Tests of Normality [b,c,d]							
City: Budapest	**Occupation**	**Kolmogorov-Smirnov**[a]			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
TOTAL Before COVID-19	Student	.153	100	.000	.913	100	.000
	Working	.131	139	.000	.850	139	.000
	Studying and Working together	.235	61	.000	.756	61	.000
	Unemployed	.177	38	.004	.849	38	.000
TOTAL During COVID-19	Student	.126	100	.000	.912	100	.000
	Working	.121	139	.000	.847	139	.000
	Studying and Working together	.184	61	.000	.750	61	.000
	Unemployed	.241	38	.000	.803	38	.000

Table 14:1st Hypothesis Test of Normality for Occupation

Tests of Normality							
City: Budapest	**Income**	**Kolmogorov-Smirnov**[a]			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
TOTAL Before COVID-19	< 500	.129	47	.050	.921	47	.004
	501 - 1000	.117	112	.001	.868	112	.000

	1001 - 1500	.171	47	.001	.875	47	.000
	1501 - 2000	.160	45	.006	.759	45	.000
	2001- 2500	.185	31	.009	.776	31	.000
	>2500	.127	57	.023	.870	57	.000
TOTAL During COVID-19	< 500	.134	47	.034	.931	47	.008
	501 - 1000	.146	112	.000	.858	112	.000
	1001 - 1500	.173	47	.001	.901	47	.001
	1501 - 2000	.167	45	.003	.702	45	.000
	2001- 2500	.145	31	.096	.954	31	.201
	>2500	.169	57	.000	.868	57	.000
a. Lilliefors Significance Correction							

Table 15:1st Hypothesis Test of Normality for Income



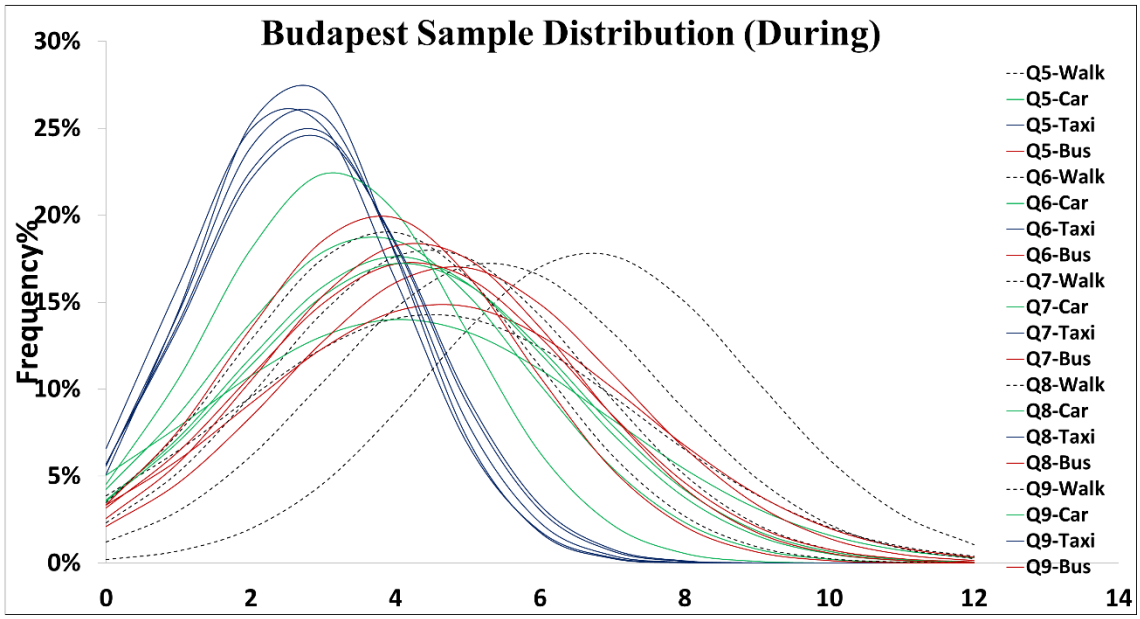


Figure 6: Budapest Distribution

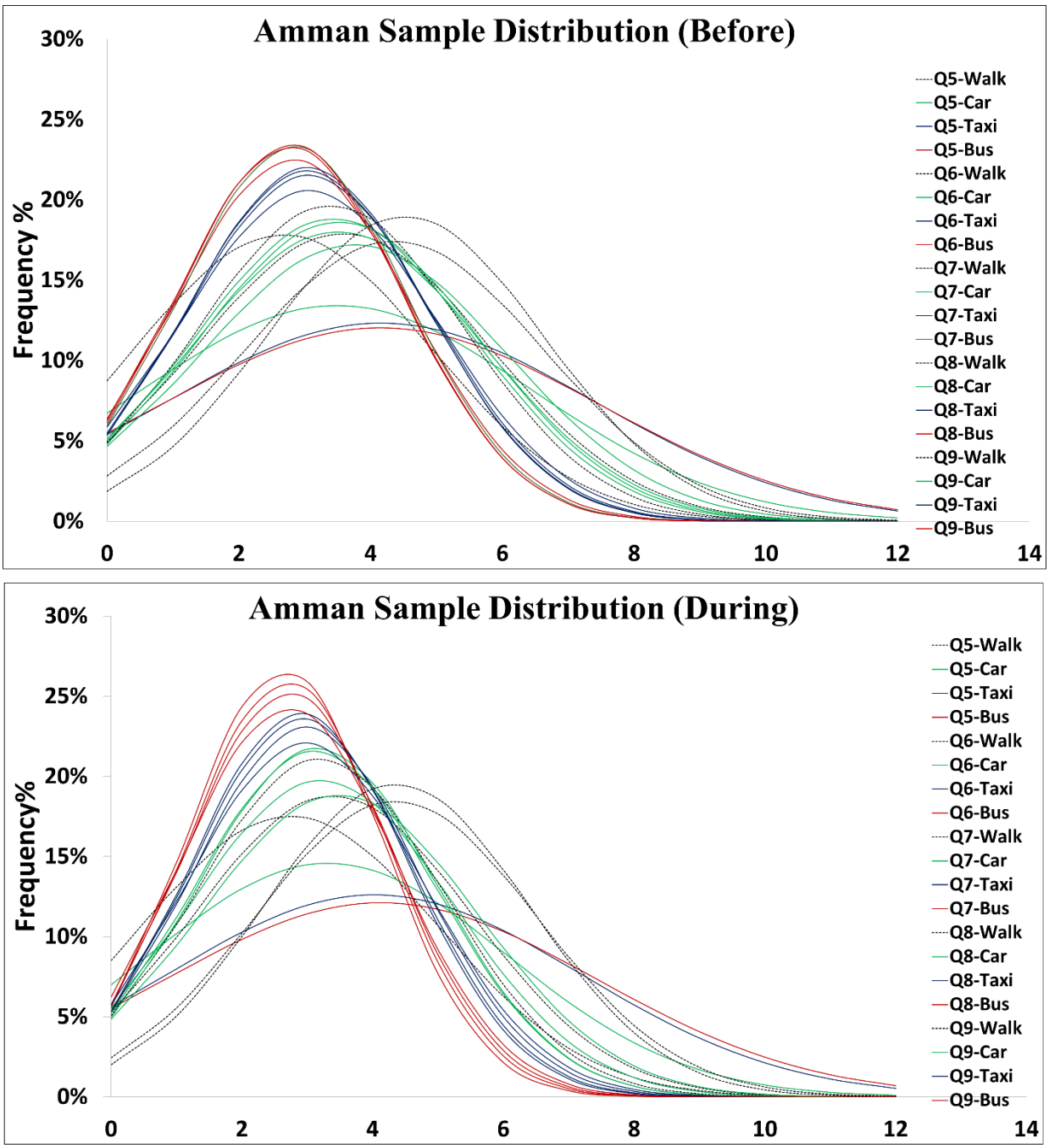


Figure 7: Amman Distribution

3.2.2 Hypothesis H2

For Amman, Table 16 shows that the distribution of the Kolmogorov-Smirnov test is statistically significant; the statistical significance values only for the variable (gender) were below the level of significance (α=0.05), this indicates that the distribution is not normal, while most of the statistical significance values for the other variables (educational level, occupation, and income) were more than the level of significance (α=0.05), this indicates that the distribution is normal for this variables. For Budapest, Table 17 shows that the distribution of the Kolmogorov-Smirnov test is statistically significant; the statistical significance values only for the variable (age, education, and income) were below the level of significance (α=0.05), this indicates that the distribution is not normal, while the statistical significance values for the variable (gender) was more than the level of significance (α=0.05) for female, this indicates that the distribution is normal for this variable. As well the tests confirm that the values of kurtosis and skewness are acceptable for all variables and located within the ranges (-10, +10) and (-3, +3), respectively [249].

Tests of Normality							
City: Amman		**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Gender	Male	0.104	196	0	0.98	196	0.006
	Female	0.096	174	0	0.974	174	0.002
Age	less than 18	0.155	38	0.022	0.962	38	0.213
	18 - 28	0.092	103	0.032	0.985	103	0.276
	29-39	0.063	78	.200*	0.991	78	0.852
	40-49	0.127	69	0.007	0.964	69	0.045
	50-59	0.106	49	.200*	0.965	49	0.146
	60-69	0.203	31	0.002	0.869	31	0.001
Education	High School or Less	0.109	160	0	0.977	160	0.009
	Bachelor's Degree	0.125	156	0	0.974	156	0.004
	Master's Degree	0.135	28	.200*	0.94	28	0.111
	Ph.D.	0.163	12	.200*	0.937	12	0.466
	Other	0.169	14	.200*	0.933	14	0.335
Occupation	Student	0.132	74	0.003	0.953	74	0.008
	Working	0.103	196	0	0.988	196	0.095
	Studying and Working together	0.17	8	.200*	0.904	8	0.314

	Retired	0.138	24	.200*	0.968	24	0.611
	Unemployed	0.09	68	.200*	0.977	68	0.238
Income	< 500	0.108	212	0	0.979	212	0.003
	501 - 1000	0.072	97	.200*	0.987	97	0.434
	1001 - 1500	0.141	33	0.093	0.919	33	0.018
	1501 - 2000	0.18	12	.200*	0.922	12	0.302
	2001- 2500	0.28	8	0.064	0.907	8	0.336
	>2500	0.158	8	.200*	0.956	8	0.773

Table 16: 2nd Hypothesis Test of Normality for Amman

Tests of Normality							
City: Budapest		**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Gender	Male	.118	172	.000	.960	172	.000
	Female	.068	167	.059	.991	167	.368
Age	less than 18	.212	11	.178	.874	11	.088
	18 - 28	.126	81	.003	.964	81	.022
	29-39	.174	129	.000	.940	129	.000
	40-49	.148	65	.001	.911	65	.000
	50-59	.138	43	.038	.921	43	.006
	60-69	.152	10	.200*	.908	10	.268
Education	High School or Less	.172	22	.088	.878	22	.011
	Bachelor's Degree	.133	115	.000	.956	115	.001
	Master's Degree	.064	106	.200*	.985	106	.264
	Ph.D.	.096	60	.200*	.951	60	.018
	Other	.140	36	.070	.899	36	.003
Occupation	Student	.088	100	.052	.959	100	.004
	Working	.112	139	.000	.975	139	.011
	Studying and	.123	61	.023	.976	61	.283

	Working together						
	Unemployed	.136	38	.074	.950	38	.092
Income	< 500	.145	47	.014	.929	47	.007
	501 - 1000	.102	112	.006	.964	112	.004
	1001 - 1500	.119	47	.095	.926	47	.006
	1501 - 2000	.159	45	.006	.963	45	.156
	2001- 2500	.156	31	.052	.972	31	.582
	>2500	.201	57	.000	.892	57	.000

Table 17:2nd Hypothesis Test of Normality for Budapest

3.2.3 Hypothesis H3

For Amman, Table 18 shows that the distribution of the Kolmogorov-Smirnov test is statistically significant; most of the statistical significance values for (gender, age, and educational level) were below the level of significance (α=0.05), this indicates that the distribution is not normal. While for (occupation and income) the statistical significance values were more than the level of significance (α=0.05), this indicates that the distribution is normal. For Budapest, Table 19 shows that the distribution of the Kolmogorov-Smirnov test is statistically significant; most of the statistical significance values for (gender, educational level, occupation, and income) were below the level of significance (α=0.05), this indicates that the distribution is not normal. While for (age), the statistical significance most values were more than the level of significance (α=0.05), this indicates that the distribution is normal. As well the tests confirm that the values of kurtosis and skewness are acceptable for all variables and located within the ranges (-10, +10) and (-3, +3), respectively.

Tests of Normality							
City: Amman		**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Gender	Male	0.228	196	0.000	0.901	196	0.000
	Female	0.091	174	0.001	0.976	174	0.005
Age	less than 18	0.104	38	.200*	0.963	38	0.240
	18 - 28	0.201	103	0.000	0.936	103	0.000
	29-39	0.127	78	0.003	0.963	78	0.022
	40-49	0.214	69	0.000	0.924	69	0.000

	50-59	0.213	49	0.000	0.900	49	0.001
	60-69	0.236	31	0.000	0.908	31	0.011
	more than 69	0.260	2	-	-	-	-
Education	High School or Less	0.205	160	0.000	0.902	160	0.000
	Bachelor's Degree	0.145	156	0.000	0.955	156	0.000
	Master's Degree	0.126	28	.200*	0.970	28	0.578
	Ph.D.	0.189	12	.200*	0.885	12	0.102
	Other	.268	14	.007	.888	14	.075
Occupation	Student	0.077	74	.200*	0.986	74	0.571
	Working	0.193	196	0.000	0.925	196	0.000
	Studying and Working together	0.176	8	.200*	0.909	8	0.347
	Retired	0.087	24	.200*	0.963	24	0.492
	Unemployed	0.268	68	0.000	0.868	68	0.000
Income	< 500	0.250	212	0.000	0.857	212	0.000
	501 - 1000	0.045	97	.200*	0.991	97	0.779
	1001 - 1500	0.124	33	.200*	0.953	33	0.168
	1501 - 2000	0.178	12	.200*	0.932	12	0.403
	2001- 2500	0.186	8	.200*	0.902	8	0.300
	>2500	0.183	8	.200*	0.957	8	0.780

Table 18: 3rd Hypothesis Test of Normality for Gender, Age, Education, Occupation, and Income for Amman

Tests of Normality							
City: Budapest		**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Gender	Male	.131	172	.000	.952	172	.000
	Female	.134	167	.000	.946	167	.000
Age	less than 18	.176	11	.200*	.866	11	.069

	18 - 28	.083	81	.200*	.975	81	.111
	29-39	.150	129	.000	.895	129	.000
	40-49	.219	65	.000	.918	65	.000
	50-59	.242	43	.000	.880	43	.000
	60-69	.226	10	.159	.884	10	.145
Education	High School or Less	.097	22	.200*	.959	22	.460
	Bachelor's Degree	.162	115	.000	.888	115	.000
	Master's Degree	.084	106	.061	.984	106	.219
	Ph.D.	.178	60	.000	.893	60	.000
	Other	.203	36	.001	.890	36	.002
Occupation	Student	.100	100	.015	.963	100	.007
	Working	.158	139	.000	.913	139	.000
	Studying and Working together	.140	61	.004	.960	61	.046
	Unemployed	.195	38	.001	.831	38	.000
Income	< 500	.123	47	.073	.945	47	.027
	501 - 1000	.161	112	.000	.933	112	.000
	1001 - 1500	.179	47	.001	.932	47	.009
	1501 - 2000	.230	45	.000	.840	45	.000
	2001- 2500	.097	31	.200	.973	31	.607
	>2500	.200	57	.000	.848	57	.000

Table 19:3rd Hypothesis Test of Normality for Gender, Age, Education, Occupation, and Income for Budapest

3.2.4 Hypothesis H4

For Amman, Table 20 shows that the distribution values of the Kolmogorov-Smirnov test are statistically significant; most of the statistical significance values for (gender, educational level, age, occupation, and income) were below the level of significance (α=0.05), this indicates that the distribution is not normal. For Budapest, Table 21 shows that the distribution values of the Kolmogorov-Smirnov test are statistically significant; most of the statistical significance values for (gender, educational level, age, occupation, and income) were below the level of significance (α=0.05), which indicates that the distribution is not normal. As well the tests confirm that the values of kurtosis and skewness are acceptable for all variables and located within the ranges (-10, +10) and (-3, +3), respectively.

Tests of Normality							
City: Amman		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Gender	male	0.251	196	0.000	0.884	196	0.000
	female	0.172	174	0.000	0.965	174	0.000
education	High School or Less	0.235	160	0.000	0.910	160	0.000
	Bachelor's Degree	0.204	156	0.000	0.936	156	0.000
	Master's Degree	0.127	28	.200*	0.969	28	0.552
	Ph.D.	0.181	12	.200*	0.928	12	0.364
	Other	0.318	14	0.000	0.732	14	0.001
Age	less than 18	.133	39	.080	.954	39	.115
	18 - 28	.224	111	.000	.931	111	.000
	29-39	.211	76	.000	.934	76	.001
	40-49	.274	69	.000	.845	69	.000
	50-59	.169	45	.003	.934	45	.013
	60-69	.313	28	.000	.821	28	.000
	more than 69	.260	2	-	-	-	-
Occupation	Student	0.193	90	0.000	0.951	90	0.002
	Working	0.236	190	0.000	0.890	190	0.000
	Studying and Working together	0.179	9	.200*	0.920	9	0.392
	Retired	0.150	25	0.150	0.946	25	0.203
	Unemployed	0.272	56	0.000	0.913	56	0.001
Income	< 500	0.294	212	0.000	0.844	212	0.000
	501 - 1000	0.123	97	0.001	0.975	97	0.065
	1001 - 1500	0.160	33	0.031	0.927	33	0.028
	1501 - 2000	0.232	12	0.073	0.877	12	0.081

	2001- 2500	0.292	8	0.043	0.859	8	0.118
	>2500	0.193	8	.200*	0.922	8	0.448

Table 20: 4th Hypothesis Test of Normality for Gender, Age, Education, Occupation, and Income for Amman

Tests of Normality							
City: Budapest		**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Gender	male	.109	172	.000	.941	172	.000
	female	.154	167	.000	.907	167	.000
education	High School or Less	.117	22	.200*	.977	22	.861
	Bachelor's Degree	.137	115	.000	.913	115	.000
	Master's Degree	.118	106	.001	.968	106	.012
	Ph.D.	.125	60	.020	.927	60	.001
	Other	.154	36	.030	.941	36	.053
Age	less than 18	.157	11	.200*	.910	11	.245
	18 - 28	.162	81	.000	.943	81	.001
	29-39	.165	129	.000	.876	129	.000
	40-49	.131	65	.008	.967	65	.078
	50-59	.201	43	.000	.890	43	.001
	60-69	.204	10	.200*	.909	10	.272
Occupation	Student	.108	100	.006	.966	100	.012
	Working	.114	139	.000	.931	139	.000
	Studying and Working together	.131	61	.011	.953	61	.019
	Unemployed	.139	38	.063	.915	38	.007
Income	< 500	.143	47	.018	.932	47	.009
	501 - 1000	.131	112	.000	.921	112	.000

	1001 - 1500	.140	47	.022	.960	47	.111
	1501 - 2000	.190	45	.000	.925	45	.006
	2001- 2500	.120	31	.200*	.952	31	.180
	>2500	.156	57	.001	.917	57	.001

Table 21: 4th Hypothesis Test of Normality for Gender, Age, Education, Occupation, and Income for Budapest

3.3 Test of Homogeneity of Variances

Homogeneity of variance [250], is the second statistical assumption that needs to be tested after normality; the purpose is to test if the variance of groups is equal (similar or homogenous); if such an assumption is violated, a statistical adjustment need to be done; it is assessed by using Levene's test for equality of variances, the values should be more than the level of significance (α=0.05) to satisfy the homogeneity of variances, in this case, the null hypothesis will be rejected, and the alternative hypothesis will be accepted which states that there are statistically significant differences between the variance, a Scheffé statistical test [251], which is a post-hoc test used to study the main and simple effects for all possible paired multiple comparisons.

3.3.1 Hypothesis H1

Tables 22 confirms that for Amman, Levene's test values are less than the level of significance (α=0.05); for (gender, educational level, occupation, and income) this indicates that there are no statistically significant differences between the variances, and this states that the performance is the same for hypothesis H1; before and during COVID-19 regardless of gender, educational level, occupation, and income, (except age) the statistical significance values more than the level of significance (α=0.05), this indicates that there are statistically significant differences between the variances for age. Table 23 confirms that for Budapest, Levene's test values are less than the level of significance (α=0.05) for (educational level, age, occupation, and income) this indicates that there are no statistically significant differences between the variances, and this states that the performance is the same for hypothesis H1; before and during COVID-19 for these variables, (except gender,) the statistical significance values more than the level of significance (α=0.05), this indicates that there are statistically significant differences between the variances for gender.

City: Amman	**Gender**		**Education**		**Age**		**Occupation**		**Income**	
	Total Before COVID-19	Total During COVID-19	Total Before COVID-19	Total During COVID-19	Total Before COVID-19	Total During COVID-19	Total Before COVID-19	Total During COVID-19	Total Before COVID-19	Total During COVID-19
Levene Statistic	1.01	2.03	2.415	3.036	1.301	0.765	4.750	4.569	6.665	6.635
df1	1.000	1.000	4.000	4.000	6.000	6.000	4.000	4.000	5.000	5.000

df2	368.000	368.000	365.000	365.000	363.000	363.000	365.000	365.000	364.000	364.000
Sig.	0.000	0.000	0.049	0.018	0.256	0.598	0.001	0.001	0.000	0.000

Table 22: 1st Hypothesis Test of Homogeneity of Variances for Amman

City: Budapest	**Gender**		**Education**		**Age**		**Occupation**		**Income**	
	Total Before COVID-19	Total During COVID-19	Total Before COVID-19	Total During COVID-19	Total Before COVID-19	Total During COVID-19	Total Before COVID-19	Total During COVID-19	Total Before COVID-19	Total During COVID-19
Levene Statistic	1.474	0.021	6.229	2.679	3.548	3.496	2.933	3.456	3.861	3.662
df1	1.000	1.000	4	4	5	5	3	3	5	5
df2	337.000	337.000	334	334	333	333	334	334	333	333
Sig.	0.226	0.885	0.000	0.032	0.004	0.005	0.034	0.017	0.002	0.003

Table 23: 1st Hypothesis Test of Homogeneity of Variances for Budapest

3.3.2 Hypothesis H2

Table 24 confirms that for Amman, Levene's test values are more than the level of significance (α=0.05) for (gender, educational level, age, occupation, and income); this indicates that there are statistically significant differences between the variances for (gender, educational level, age, occupation, and income), for Budapest as in Table 25, Levene's test values less than the level of significance (α=0.05), for (gender, educational level, occupation, and income) this indicates that there are no statistically significant differences between the variances and this states that the performance is the same for hypothesis; regardless of (gender, educational level, occupation, and income), while for (age) the statistical significance values more than the level of significance (α=0.05), this indicates that there are statistically significant differences between the variances for (age).

City: Amman	Gender			Education			Age			Occupation			Income		
	TotalQ10	TotalQ11	TOTALQ10andQ11	TotalQ10	TotalQ11	TOTALQ10andQ11	TotalQ10	TotalQ11	TOTALQ10andQ11	TotalQ10	TotalQ11	TOTALQ10andQ11	TotalQ10	TotalQ11	TOTALQ10andQ11
Levene Statistic	1.04	3.07	1.60	0.28	0.77	0.57	0.57	0.96	1.19	0.46	1.19	0.84	0.77	0.18	1.22
df1	1.0	1.0	1.0	4.0	4.0	4.0	6.0	6.0	6.0	4.0	4.0	4.0	5.0	5.0	5.0
df2	368	368	368	365	365	365	363	363	363	365	365	365	364	364	364
Sig.	0.30	0.08	0.21	0.89	0.55	0.68	0.76	0.45	0.31	0.76	0.31	0.50	0.57	0.97	0.3

Table 24: 2nd Hypothesis Test of Homogeneity of Variances for Amman

City: Budapest	Gender			Education			Age			Occupation			Income		
	TotalQ10	TotalQ11	TOTALQ10andQ11	TotalQ10	TotalQ11	TOTALQ10andQ11	TotalQ10	TotalQ11	TOTALQ10andQ11	TotalQ10	TotalQ11	TOTALQ10andQ11	TotalQ10	TotalQ11	TOTALQ10andQ11
Levene Statistic	1.57	1.66	4.83	1.71	1.3	2.68	1.18	3.47	2.02	3.03[a]	2.50[b]	2.63[c]	6.68	10.35	12.46
df1	1	1	1	4	4	4	5	5	5	3	3	3	5	5	5
df2	337	337	337	334	334	334	333	333	333	334	334	334	333	333	333
Sig.	0.21	0.2	0.03	0.15	0.27	0.03	0.32	0.005	0.08	0.03	0.06	0.05	0	0	0

Table 25: 2nd Hypothesis Test of Homogeneity of Variances for Budapest

3.3.3 Hypothesis H3

Table 26 confirms that Amman Levene's test values are less than the level of significance (α=0.05) for (gender and education); this indicates that there are no statistically significant differences between the variances, and this states that the performance is the same for hypothesis H3, regardless of (gender and educational level). While for (age, occupation, and income), the statistical significance values more than the level of significance (α=0.05), this indicates that there are statistically significant differences between the variances for (age, occupation, and income). Table 27 confirms that for Budapest Levene's test values are less than the level of significance (α=0.05) for (gender, education, and occupation); this indicates that there are no statistically significant differences between the variances and this states that the performance is the same for hypothesis H3, regardless of (gender, educational and occupation level). While for (age and income), the statistical significance values more than the level of significance (α=0.05), this indicates that there are statistically significant differences between the variances for (age and income).

City: Amman	**Gender**			**Education**			**Age**			**Occupation**			**Income**		
	TOTALQ13a	TOTALQ13b	TOTALQ13.a.b.	TOTALQ13a	TOTALQ13b	TOTALQ13.a.b.	TOTALQ13a	TOTALQ13b	TOTALQ13.a.b.	TOTALQ13a	TOTALQ13b	TOTALQ13.a.b.	TOTALQ13a	TOTALQ13b	TOTALQ13.a.b.
Levene Statistic	6.2	6.07	4.63	4.38	5.29	4.86	1.42	0.57	0.78	0.57	0.66	0.53	2.00	2.15	1.18
df1	1	1	1	4	4	4	6	6	6	4	4	4	5	5	5
df2	368	368	368	365	365	365	363	363	363	365	365	365	364	364	364
Sig.	0.01	0.01	0.03	0.002	0.00	0.001	0.21	0.76	0.59	0.69	0.62	0.71	0.08	0.06	0.32

Table 26: 3rd Hypothesis Test of Homogeneity of Variances for Amman

City: Budapest	**Gender**			**Education**			**Age**			**Occupation**			**Income**		
	TOTALQ13a	TOTALQ13b	TOTALQ13.a.b.	TOTALQ13a	TOTALQ13b	TOTALQ13.a.b.	TOTALQ13a	TOTALQ13b	TOTALQ13.a.b.	TOTALQ13a	TOTALQ13b	TOTALQ13.a.b.	TOTALQ13a	TOTALQ13b	TOTALQ13.a.b.
Levene Statistic	13.26	6.609	9.508	6.888	7.978	8.184	0.520	0.836	0.535	4.421	7.210	5.56	0.41	1.43	0.65
df1	1	1	1	4	4	4	5	5	5	3	3	3	5	5	5

df2	337	337	337	334	334	334	333	333	333	334	334	334	333	333	333
Sig.	0.00	0.011	0.002	0.00	0.00	0.00	0.76	0.525	0.749	0.005	0.000	0.001	0.84	0.21	0.66

Table 27 :3rd Hypothesis Test of Homogeneity of Variances for Budapest

3.3.4 Hypothesis H4

Table 28 confirms that Amman Levene's test values are more than the level of significance (α=0.05) for (gender, educational level, age, occupation, and income), which states that there are statistically significant differences between the variances, while Table 29 confirms that for Budapest Levene's test values less than the level of significance (α=0.05) for (educational level, age, occupation, and income) this indicates that there are no statistically significant differences between the variances and this states that the performance is the same for hypothesis H4, regardless of variables (educational level, age, occupation, and income), while for (gender) the statistical significance values more than the level of significance (α=0.05), this indicates that there are statistically significant differences between the variances for (gender).

City: Amman	**Gender**	**Education**	**Age**	**Occupation**	**Income**
	TOTALQ14-Q17	TOTALQ14-Q17	TOTALQ14-Q17	TOTALQ14-Q17	TOTALQ14-Q17
Levene Statistic	0.138	1.214	0.987	0.41	1.267
df1	1	4	6	4	5
df2	368	365	363	365	364
Sig.	0.71	0.304	0.434	0.802	0.277

Table 28: 4th Hypothesis Test of Homogeneity of Variances for Amman

City: Budapest	**Gender**	**Education**	**Age**	**Occupation**	**Income**
	TOTALQ14-Q17	TOTALQ14-Q17	TOTALQ14-Q17	TOTALQ14-Q17	TOTALQ14-Q17
Levene Statistic	0.025	**6.667**	**6.929**	**10.120[a]**	**8.093**
df1	1	**4**	**5**	**3**	**5**
df2	337	**334**	**333**	**334**	**333**
Sig.	0.876	**0**	**0**	**0**	**0**

Table 29 : 4th Hypothesis Test of Homogeneity of Variances for Budapest

3.4 Test for Multicollinearity

Multicollinearity value measures the correlation between variables and logistic regression, multicollinearity means that there should be no interaction between the independent variables [252], [253], because the existence of interaction will cause confusion and the results will be misleading, the Variance Inflation Factor (VIF) values should be measured less than three to guarantee the independency between variables [254], as seen in Tables 30 and 31.

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	Amman		**Budapest**	
	Collinearity Statistics		**Collinearity Statistics**	
Variable	Tolerance	VIF	Tolerance	VIF
	Before/During COVID	Before/During COVID	Before/During COVID	Before/During COVID
Gender	.884	1.131	.938	1.066
Education level	.917	1.091	.930	1.075
Age	.731	1.368	.966	1.036
Occupation	.806	1.241	.898	1.113
Income	.886	1.129	.950	1.053

Table 30: Multicollinearity Statistics

3.5 Reliability and Validity

Reliability measures the stability of the sample [255], meaning the sample should measure the same characteristic; Cronbach's Alpha [256], is used since it measures the internal consistency, that is, how closely related a set of acceptable levels of reliability; the higher the value, the greater the stability; the value 0.8 or greater is considered a very good level of stability. However, to check the independent variables and their interaction, i.e., how they act with each other, the ANOVA test was used under the conditions of normality distribution and homogeneity with values less than the level of statistical significance ($\alpha = 0.05$) [257], see Tables 32 and 33 for Amman and Budapest, respectively; although such tests explain the significance of the hypothesis, it does not specify which variable or variables have the greatest impact. On the other hand, validity is a measurement of the correlation between variables, degree, and direction of the relationships; Pearson Coefficient [258], is used to generate a correlation matrix for all items of the hypothesis; it is found significant at 0.01 level (2- tailed), that is, the phrases of hypothesis are understandable and clear to the participant and do not need to be modified, changed or reformulated.

	Variable	Model summary [b]			
		R	R^2	Adj R^2	Std. Error of Estimate
Amman	Total Before	.171	.159	21.99875	.413[a]
	Total During	.387[a]	.150	.138	20.85320
Budapest	Total Before	.375[a]	.140	.127	20.62244
	Total During	.360[a]	.129	.116	19.92867
a. Predictors: (Constant), Income, Occupation, Gender, Education Level, Age. b. Dependent Variable					

Table 31: Regression model Hypothesis H1

City: Amman	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
All Hypotheses (H1, H2, H3 & H4)	.882	.884	74
Hypothesis H1	.933	.949	40
Hypothesis H2	.749	.748	8
Hypothesis H3	.964	.964	22
Hypothesis H4	.581	.551	4

Table 32: Amman Reliability Statistics

City: Budapest	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
All Hypotheses (H1, H2, H3 & H4)	.874	.881	74
Hypothesis H1	.905	.923	40
Hypothesis H2	.690	.688	8
Hypothesis H3	.953	.953	22
Hypothesis H4	.840	.841	4

Table 33: Budapest Reliability Statistics

3.6 Analysis of Exploratory factor (EFA)

Exploratory factor analysis (EFA) [227], [228], is a technique to discover underlying variables or factors. Hence EFA was conducted for all hypotheses; hypothesis H1 with frequency before and during the COVID-19 to measure the influencing transport modes and preferences during the pandemic and to extract the underlying factors; hypothesis H2 studied the probability of catching the disease during the usage of each transport modes and the effectiveness of the restrictions and procedures applied to prevent the spread in each one, hypothesis H3 rate the passengers' satisfaction of public transportation modes and services, and hypothesis H4 rate the digital transformation for learning, work and services even after the end of the pandemic, from the participants' point of view. Once discovering the underlying factors, the factor scores were computed to represent the relative standing of each respondent. A very important analysis is the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of Sphericity [259], see Tables 34 and 35 for Amman and Budapest; the test measures sampling adequacy for each variable in the model and the complete model.

3.6.1 Analysis of Exploratory factor (EFA) for Amman

	KMO and Bartlett's Test		
Before COVID-19	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.891
	Bartlett's Test of Sphericity	Approx. Chi-Square	15473.935
		df	1431
		Sig.	.000
During COVID-19	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.894
	Bartlett's Test of Sphericity	Approx. Chi-Square	15577.402
		df	1431
		Sig.	.000
Change *(Before - During COVID 19)*	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.718
	Bartlett's Test of Sphericity	Approx. Chi-Square	1436.029
		df	190
		Sig.	<.001

Table 34: Amman EFA before COVID 19, during COVID-19 and the change between them.

3.6.2 Analysis of Exploratory factor (EFA) for Budapest

	KMO and Bartlett's Test		
Before COVID-19	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.875
	Bartlett's Test of Sphericity	Approx. Chi-Square	12276.555

		df	1431
		Sig.	.000
During COVID-19	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.877
	Bartlett's Test of Sphericity	Approx. Chi-Square	12268.974
		df	1431
		Sig.	.000
Change *(Before - During COVID 19)*	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.874
	Bartlett's Test of Sphericity	Approx. Chi-Square	2300.692
		df	190
		Sig.	.000

Table 35: Budapest EFA before COVID -19, during COVID 19 and the change between them.

3.7 Confirmatory Factor Analysis (CFA)

CFA allows the assessment of fit for the model that specifies the hypothesized causal relations between latent factors and their indicator [229]. Whereas EFA aims to create consistent factors from the dataset without trying to represent all the variables, a more detailed analysis of CFA will be represented in the next chapter.

3.8 Descriptive Statistics Analysis and Demographical Characteristics Results

To understand the data in a straightforward and precise manner, the frequency and percentage are measured for the variables Table 36 will help to understand the data, and it is usually the first step in the analysis; it also can lead to preliminary ideas.

Demographic Variables		**Amman**		**Budapest**	
		Percent	Frequency	Frequency	Percent
Gender	Male	196	53.0	172	50.7
	Female	174	47.0	167	49.3
	Total	370	100.0	339	100.0
Age	less than 18	38	10.3	11	3.2
	18 - 28	103	27.8	81	23.9
	29-39	78	21.1	129	38.1
	40-49	69	18.6	65	19.2

	50-59	49	13.2	43	12.7
	60-69	31	8.4	10	3.2
	more than 69	2	.5	0.0	0.0
Education	High School or Less	160	43.2	22	6.5
	Bachelor's Degree	156	42.2	115	33.9
	Master's Degree	28	7.6	106	31.3
	Ph.D.	12	3.2	60	17.7
	Other	14	3.8	36	10.6
Occupation	Student	74	20.0	100	29.5
	Working	196	53.0	139	41.0
	Studying and Working	8	2.2	61	18.0
	Retired	24	6.5	1	0.3
	Unemployed	68	18.4	38	11.2
Income	< 500	212	57.3	47	13.9
	501 - 1000	97	26.2	112	33.0
	1001 - 1500	33	8.9	47	13.9
	1501 - 2000	12	3.2	45	13.3
	2001- 2500	8	2.2	31	9.1
	>2500	8	2.2	57	16.8
Online Learn or Work	yes	15	4.1	75	22.1
	No	316	85.4	153	45.1
	Partially	39	10.5	111	32.7

Table 36: variables and Descriptive Statistics

According to the analysis of the demographic data of 370 and 339 respondents for Amman and Budapest, there was some difference by gender, educational background, occupation, and income; different categories with other characteristics were added, and respondents answered the same questionnaire in each city but with different languages. The respondents of Amman composed of 53% males and 47% females, and Budapest consisted of 50.7% males and 49.3% females. For Amman and Budapest, 10.8% and 49%, respectively, are at the level of r higher education, and 55.2% and 59%, respectively, are working or working and studying together. The income less than 500 was for Amman and Budapest at 57.3% and 13.9%, respectively. The online, remotely, or partially working or studying was 14.6 % in Amman city and 54.8% in Budapest. Initially, reliability coefficients of Cronbach's Alpha were used to test the reliability of the scale, and the internal consistency of the questionnaire [260], which is presented previously, the results were reliable since the values exceeds 0.60, [261], [262], and the significant value (alpha value) should be less than 0.05 ($\alpha \leq 0.05$) [263], [264], [265].

3.8.1 Mobility Before and During the COVID-19

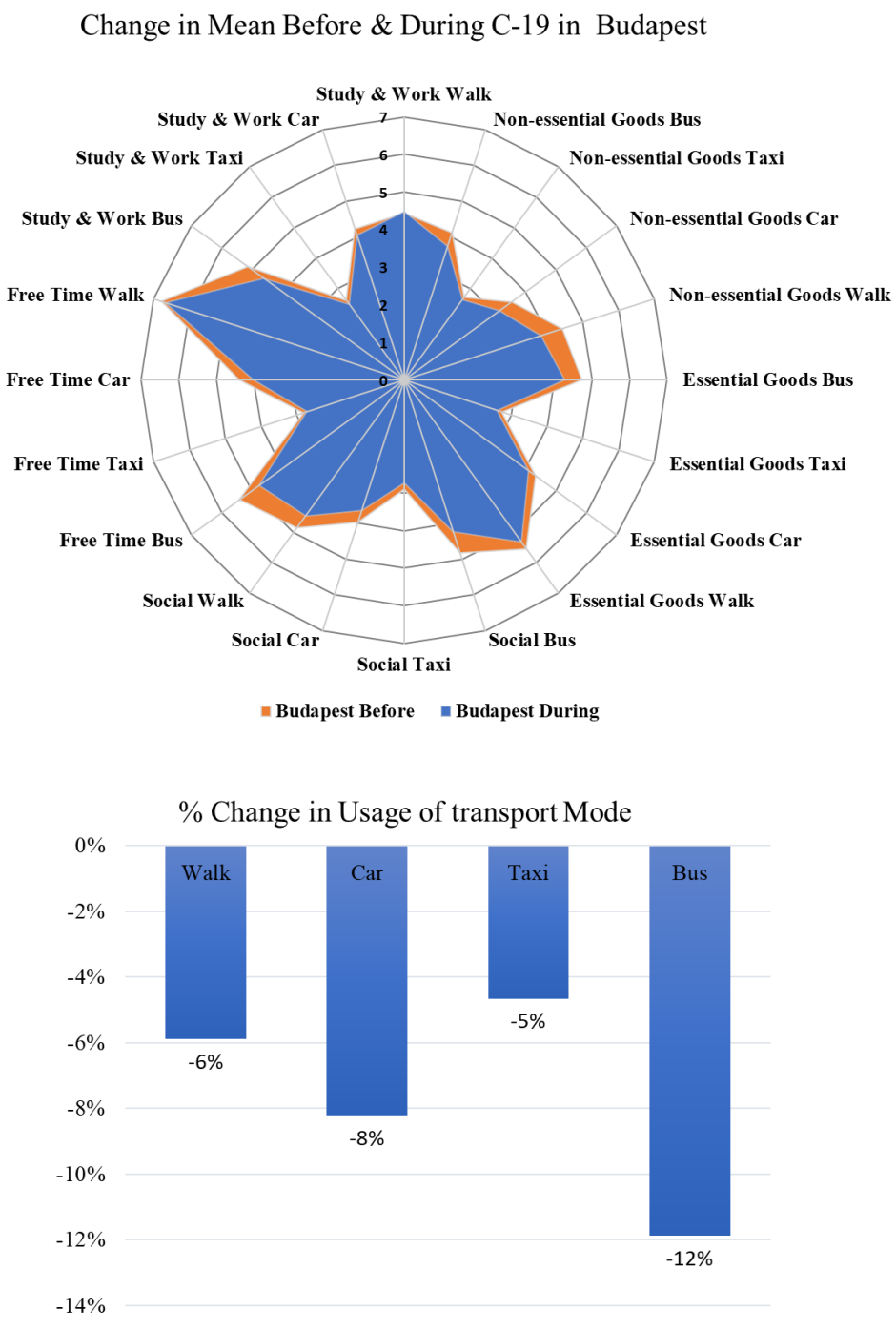
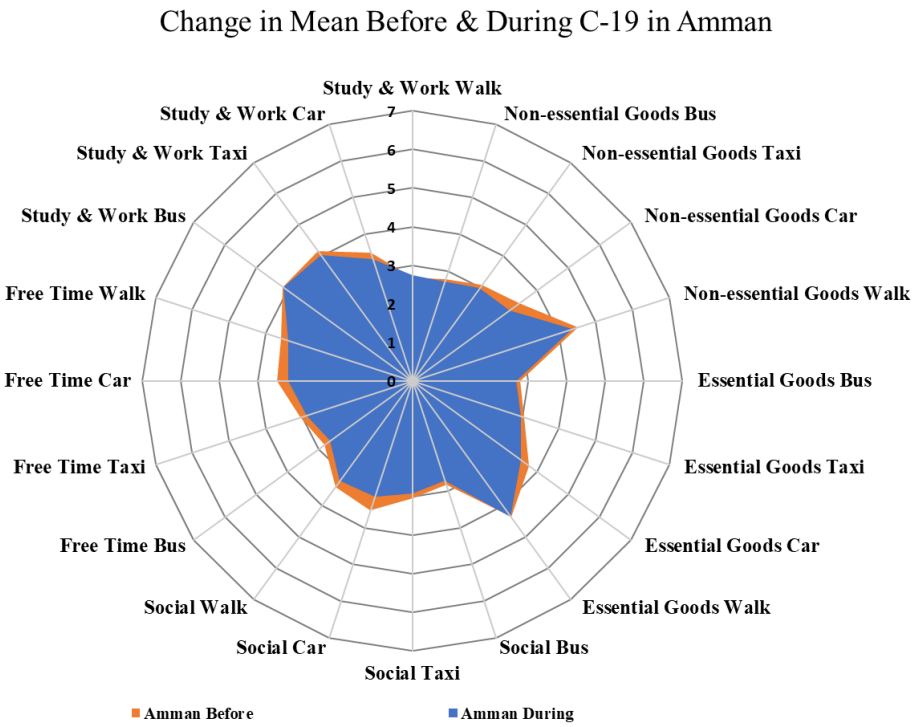


Figure 8: Change in Mean Before and During COVID-19 in Budapest



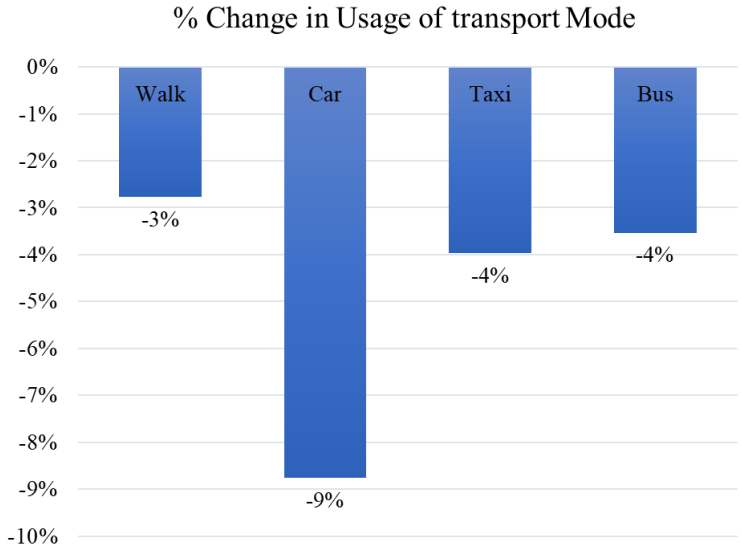


Figure 9:Change in Mean Before and During COVID-19 in Amman

The transport sector during the pandemic was exposed to several stoppages and a high reduction in global mobility and tourism due to the imposing global lockdown. For Amman and Budapest samples concerning the first hypothesis and based on the mean values for the frequency of usage of transport modes for each outdoor activity and on the total frequency of the sample before against during the pandemic, the respondents to the questionnaire showed a reduction in mobility to estimate this reduction of each mode an index was calculated, it was estimated that the reduction average index pandemic is 8% in Budapest and 5% in Amman. The only transport modes that showed an increase in the frequency of mobility during the pandemic compared to before for the two cities were the non-motorized modes, such as walking and bike riding, which was for the study and work activities, the effect of coronavirus on the non-motorized modes of transportation was the lowest compared to other since it's the safest mode to avoid the contact or getting infected. At the same time, walking and riding a bike was the available choice during the first period of the pandemic when the public transportation system wasn't fully functioning.

The impact on other mode of transportation was different in both cities due to the different structures of transportation modes in each city; Budapest is characterized by its reliance on public transportation in the first place, public transport due to the presence of a developed transportation system and various mobility network patterns, while Amman depends primarily on private cars and taxis because the city lacks a presence of a well-developed and reliable public transport system. The highest impact in Budapest was on public transport, which decreased by 12%, while in Amman, the mobility of private cars decreased by 9%, which is the main mode of transportation, as shown in Figures 8 and 9 above, it seems that the most significant increase in the frequency of usage when comparing before and during COVID-19 was in work, studies and buying essential goods.

3.8.2 Assess COVID-19 within Modes of Transportation

To assess the modes of transportation and the probability of catching COVID-19 while movements which presented in the questions below to the respondents in Amman and Budapest. Safety and health concerns were also addressed in the presence of this pandemic, which is likely to continue to apply health procedures after the end of this pandemic and become a new lifestyle. Most of the respondents' answers in both cities were to some extent identical despite the great difference in the level of public transport services in the two cities, where Budapest is characterized by the presence of an efficient network of public transport, including wide varieties, on the other hand, the main means of movement in Amman is private cars followed by taxis and Amman is far away in the construction of smart, developed and modern transport network.

	Amman							Budapest						
	Extremely low	low	Slightly low	Average	Slightly high	High	Extremely high	Extremely low	low	Slightly low	Average	Slightly high	High	Extremely high
Walk or Ride a bike	32%	22%	7%	25%	9%	5%	1%	38%	27%	15%	8%	1%	3%	1%
Motorbike /Private car	34%	23%	6%	26%	6%	3%	1%	36%	29%	10%	14%	1%	1%	1%
Taxi services /auto sharing	4%	10%	10%	39%	19%	13%	5%	4%	13%	12%	32%	14%	9%	7%
Bus /metro /tram / train	3%	6%	5%	26%	19%	23%	17%	2%	3%	3%	21%	17%	31%	15%

Table 37: Probabilities of Catching COVID-19 from the use of the listed transport modes

Table 37 above shows that catching C-19 is extremely low in the modes that are not crowded, such as walking or riding a bike; the also private car was one of the options considered in both cities as a safe mode to avoid catching the disease compared to PT which was ranked as high to extremely high probability to catch. The measures and restrictions taken by the authorities in both cities were in the range of slightly low to average in almost all of the modes of transportation, as shown in Table 38 below.

	Amman							Budapest						
	Extremely low	low	Slightly low	Average	Slightly high	High	Extremely high	Extremely low	low	Slightly low	Average	Slightly high	High	Extremely high
Walk or Ride a bike	20%	21%	11%	31%	11%	5%	2%	24%	23%	10%	20%	8%	4%	2%
Motorbike /Private car	17%	18%	11%	33%	14%	5%	3%	22%	20%	10%	24%	4%	9%	2%
Taxi services /auto sharing	11%	18%	11%	36%	13%	8%	3%	6%	12%	11%	31%	10%	13%	8%
Bus /metro /tram / train	13%	18%	10%	34%	13%	9%	5%	5%	6%	7%	26%	14%	19%	14%

Table 38: The Ratings of Restrictions on the listed transport modes that limit the spread of COVID-19

3.8.3 Public Transportation Modes and Services Satisfaction

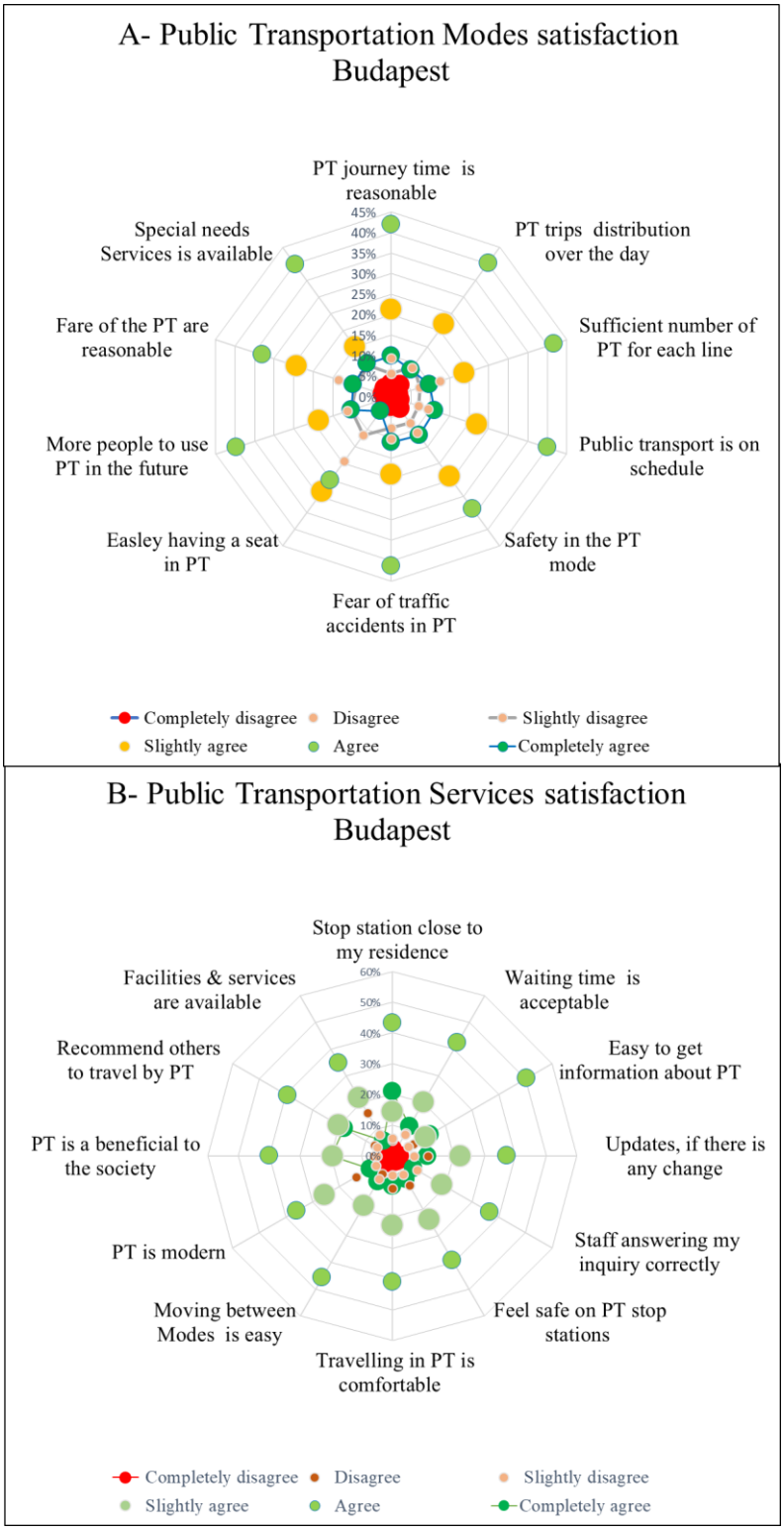


Figure 10: Public Transportation Satisfaction in Budapest

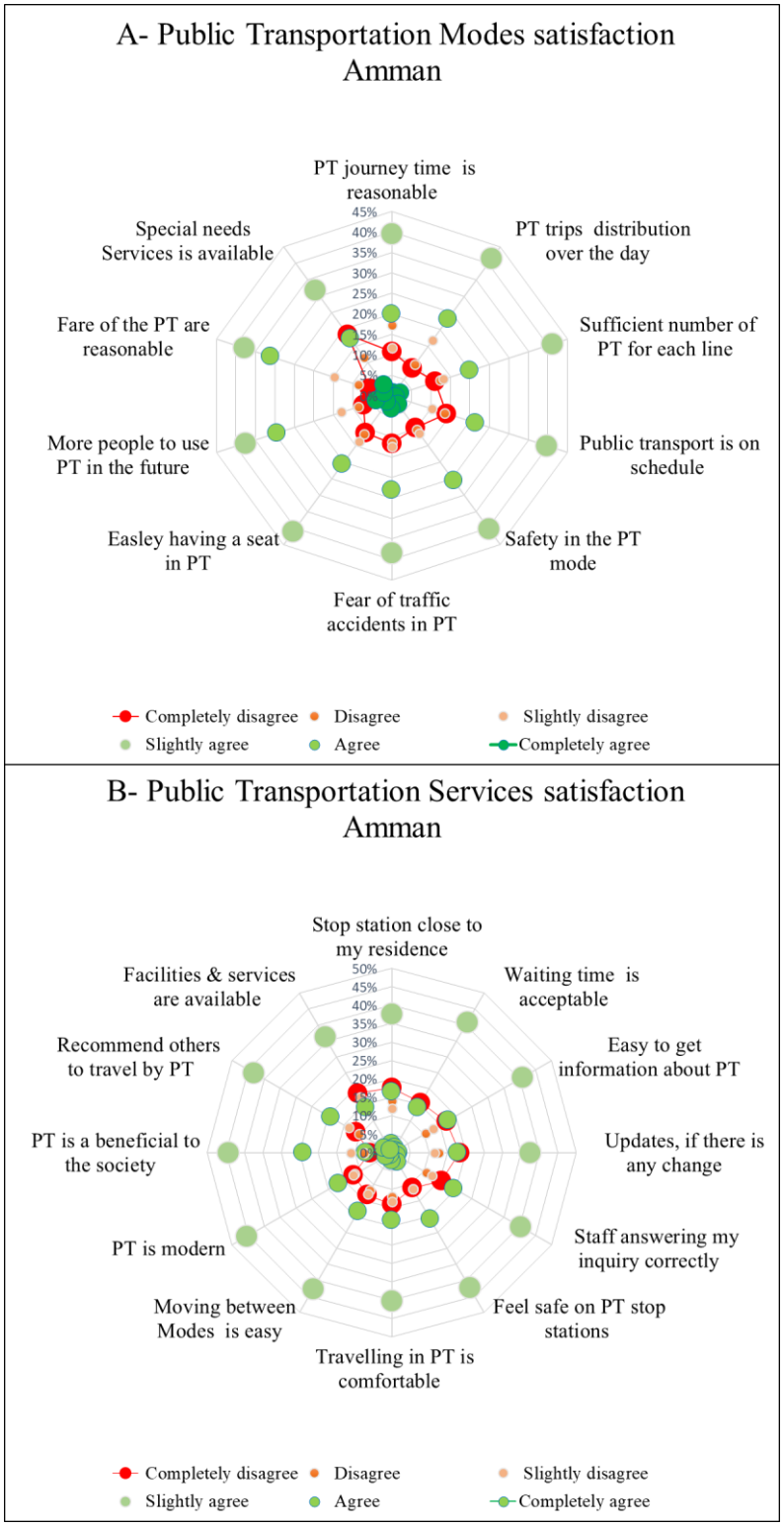


Figure 11:Public Transportation Satisfaction in Amman

The satisfaction on the PT is shown in Figures 10 and 11 above; almost all of the respondents in Amman are in the range of slightly agree compared to Agree in Budapest [266]; this reflects the quality of the developed PT system in Hungary.

3.8.4 Digital Transformation

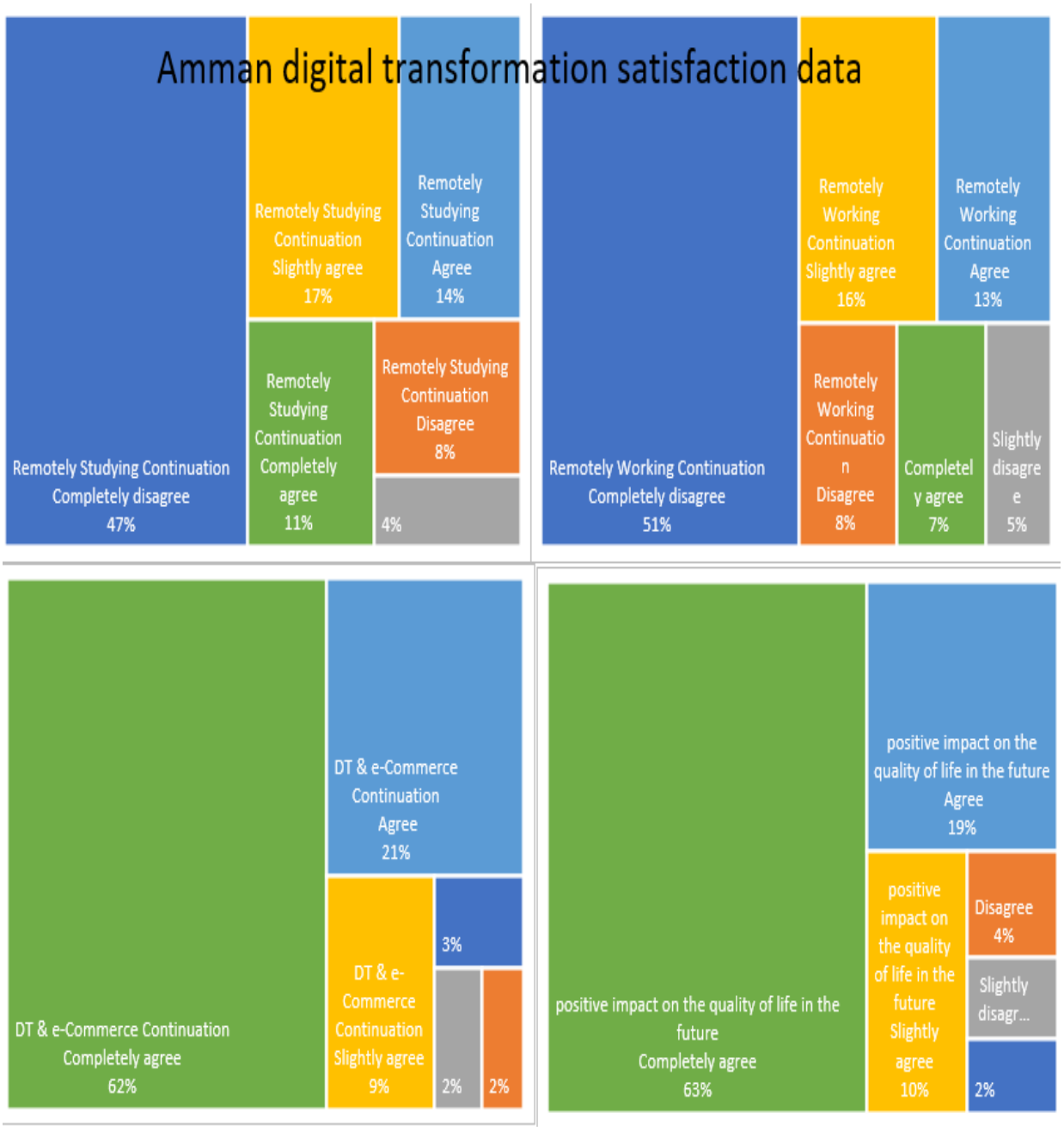


Figure 12: Digital Transformation in Amman

Figure 12 shows that the respondents in Amman completely disagreed that remotely or partially (studying and working) will continue in the future even after the end of this pandemic; this is an indication that they are unsatisfied with the experience that occurred during the pandemic and perhaps it is a new experience and needs time to adapt to it. On the contrary, respondents from Budapest were different and often Agreed that the work and study would continue beyond the pandemic [266] .

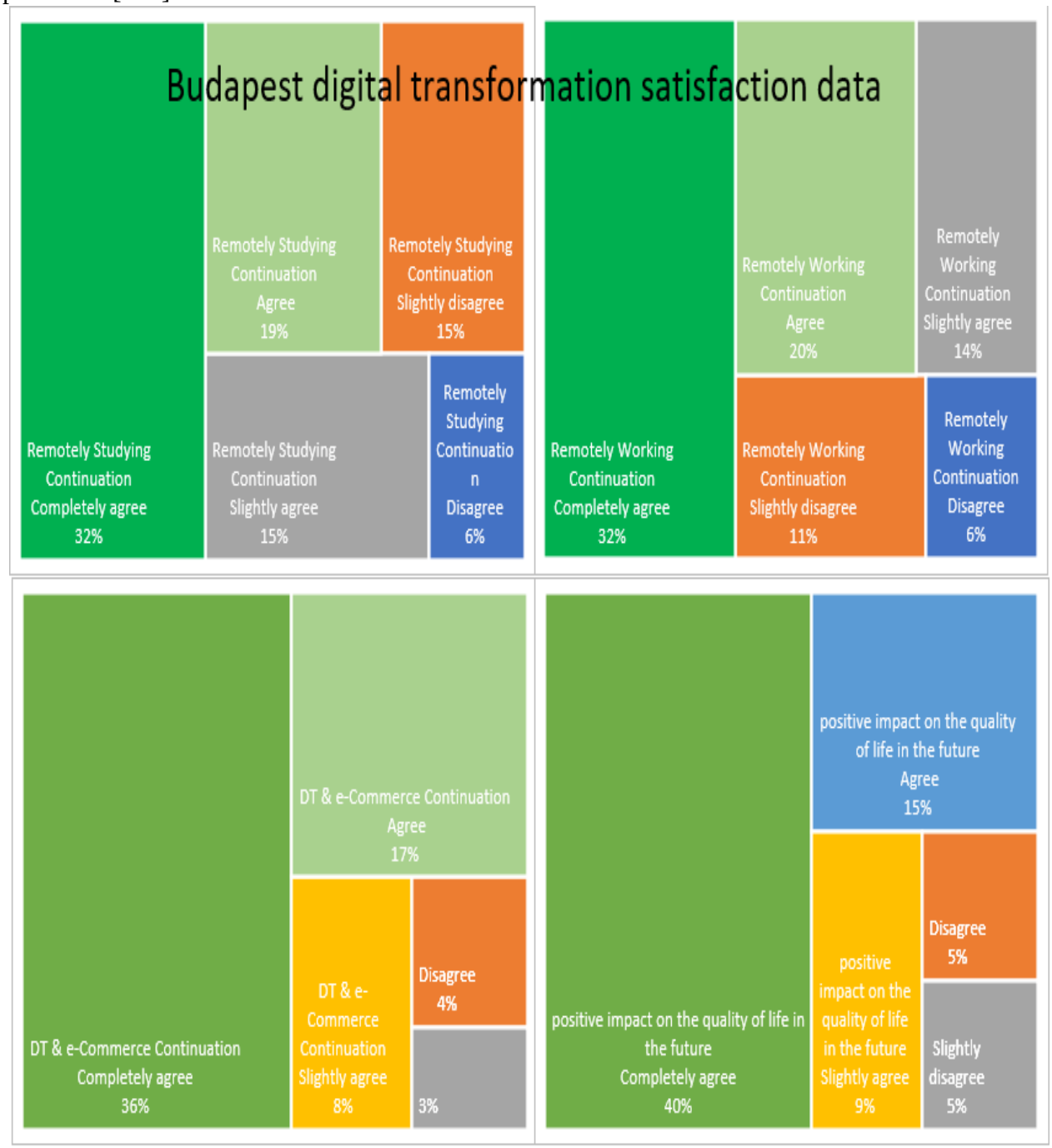


Figure 13: Digital Transformation in Budapest

Figure 13 shows that both Amman and Budapest respondents agreed that the global acceleration toward digital transformation and the use of smart applications to obtain e- payments, delivery and services would continue to grow even after the end of the pandemic, also the use of smart applications and e- (payments, and services) will have a positive impact on the quality of life in the future [266].

4. RESEARCH FINDINGS

Statistical Analysis for the First Hypothesis H1

The hypothesis is formulated as a Null hypothesis; H0, the complement of the alternative hypothesis, is measured by the significance level (α).

As stated previously, the results of the tests will be reviewed and evaluated; the data analysis and the hypotheses correlation for Amman and Budapest showed a nonparametric statistical inference; as an alternative to the paired t-test usually used in the parametric statistical inference, the Wilcoxon test was used. Wilcoxon test applied for the frequency of usage before and during the pandemic, for each mode of transportation; either the non-motorized (walking on foot/ riding a bicycle) or the motorized modes such as (using a motorcycle or private car, taxi services and public transportation) for the first hypothesis the analysis found as a nonparametric test with several levels for each variable to compare the ordinal repeated measurements under two different conditions and to measure the number of outdoor activities and movements for each mode of transportation before and during the COVID-19 pandemic, following the results for each hypothesis and sub hypothesis:

4.1 Results for the First Hypothesis Amman and Budapest H1

From statistical point of view H1 is formulated as Null hypothesis H0; there are no statistically significant differences at the level of significance ($\alpha \leq 0.05$) in the average respondents' answers for the items related to the frequent use of all modes of transportation. The means and standard deviations of the respondents' answers were computed to verify the first hypothesis; the results in Table 39 show apparent differences in the means between the respondents' answers to the paragraphs related to the frequent use of transport modes and activities before and during the pandemic for both Amman and Budapest.

	Variable	N	Before Corona		During Corona	
Amman	All modes of transportations	370	Mean	Std. Deviation	Mean	Std. Deviation
			67.98	23.99	64.96	22.46
Budapest	All modes of transportations	339	84.54	22.08	78.54	21.20

Table 39: H1; Means and SD of All Modes of Transportation in Amman and Budapest

The nonparametric Wilcoxon Signed Ranks Test was applied to compare between before and during the pandemic and to reveal the statistical significance of these differences; the results as in Table 40 below show that the Wilcoxon's test reached (-7.550), (-10.018) for Amman and Budapest respectively with statistical significance value equal (0.00), it is less than the level of statistical

significance (α = 0.05), this indicates the rejection of the null hypothesis and acceptance of the alternative hypothesis, which states that there are statistically significant differences between the two means of the answers of the respondents before and during the pandemic and in favor of frequency of use before the pandemic.

	Variable		N	Mean Rank	Sum of Ranks	Z Wilcoxon Signed Ranks Test	Sig
Amman	During Corona and Before Corona	Negative Ranks	148[a]	108.67	16083.50	-7.550	.000
		Positive Ranks	51[b]	74.83	3816.50		
		Ties	171[c]				
		Total	370				
Budapest	During Corona and Before Corona	Negative Ranks	226[a]	156.65	35402.00	- 10.018	.000
		Positive Ranks	64[b]	106.14	6793.00		
		Ties	49[c]				
		Total	339				

a. During Corona< Before Corona, b. During Corona > Before Corona, c. During Corona = Before Corona

Table 40: H1; Wilcoxon test results for Amman and Budapest

4.1.1 Results of the First Sub Hypothesis H1.1

From statistical point of view H1.1 is formulated as Null hypothesis H0; there are no statistically significant differences at the level of significance (α≤0.05) in the average respondents' answers for the items related to the frequent use of non-motorized modes of transportation (Walk or Ride a Bike) before and during COVID-19.

4.1.2 The Second Sub Hypothesis H1.2

From statistical point of view H1.2 is formulated as Null hypothesis H0; there are no statistically significant differences at the level of significance (α≤0.05) in the average respondents' answers for the items related to the frequent use of private modes of transportation (Motorbike or Private Car) before and during COVID-19.

4.1.3 The Third Sub Hypothesis H1.3

From statistical point of view H1.3 is formulated as Null hypothesis H0; there are no statistically significant differences at the level of significance (α≤0.05) in the average respondents' answers for the items related to the frequent use of demand-responsive transport services (Taxi services or auto sharing; with or without other passengers) before and during COVID-19.

4.1.4 The Fourth Sub Hypothesis H1.4

From statistical point of view H1.4 is formulated as Null hypothesis H0; there are no statistically significant differences at the level of significance (α≤0.05) in the average respondents' answers for the items related to the frequent use of Public Transportation modes (Bus, Metro, Tram, or Train) before and during COVID-19.

For the sub hypotheses H1.1, H1.2, H1.3 and H1.4, Amman and Budapest the means and standard deviations of the respondents' answers were computed to verify each sub hypothesis, as shown in Table 41 below. The results show apparent differences in the means between the respondents' answers to the paragraphs related to mobility and activities for each mode of transportation before and during the pandemic for Amman and Budapest.

Variables	N	City	Before Corona		During Corona	
			Mean	S.D.	Mean	S. D
H1.1, Walk or Ride a Bike	370	Amman	18.54	7.37	18.03	6.81
H1.2, Motorbike /Private Car			17.71	9.81	16.29	8.61
H1.3, Taxi services /Auto sharing; with or without other passengers			16.38	7.62	15.76	7.13
H1.4, Bus /Metro /Tram /Train			15.36	7.07	14.88	6.52
H1.1, Walk or Ride a Bike	339	Budapest	26.05	9.15	24.75	8.22
H1.2, Motorbike /Private Car			20.47	9.97	18.96	9.21
H1.3, Taxi services /Auto sharing; with or without other passengers			13.79	7.05	13.18	6.35
H1.4, Bus /Metro /Tram /Train			24.23	9.25	21.64	9.12

Table 41: Sub Hypotheses H1; Means and standard deviations for Amman and Budapest

The nonparametric Wilcoxon Signed Ranks test was applied to reveal the statistical significance of these differences; the results for Amman as in Table 42 below show that the Wilcoxon's test with statistical significance value equal (0.006) for the non-motorized mode (Walk or Ride a Bike) and value equal (0.00) for the motorized modes, all values are less than the level of statistical significance ($\alpha = 0.05$), this indicates the rejection of the null hypothesis and the acceptance of the alternative hypothesis, which states that there are statistically significant differences between the two means of the respondents' answers to the items related to mobility by using each mode of transportation before and during the pandemic and in favor of repeated use before.

Variables			**N**	**Mean Rank**	**Sum of Ranks**	**Z Wilcoxon Signed Ranks Test**	**Sig.**
H1.1, Walk or Ride a Bike	During Corona Before Corona	Negative Ranks	94[a]	80.79	7594.50	-2.774	.006
		Positive Ranks	61[b]	73.70	4495.50		
		Ties	215[c]				
		Total	370				
H1.2, Motorbike /Private Car	During Corona Before Corona	Negative Ranks	103[a]	67.09	6910.50	-6.627	.000
		Positive Ranks	25[b]	53.82	1345.50		

		Ties	242[c]				
		Total	370				
H1.3, Taxi services /Auto sharing; with or without other passengers	During Corona Before Corona	Negative Ranks	81[a]	56.70	4592.50	*- 4.841*	.000
		Positive Ranks	28[b]	50.09	1402.50		
		Ties	261[c]				
		Total	370				
HA1.4, Bus /Metro /Tram /Train	During Corona Before Corona	Negative Ranks	52[a]	37.63	1957.00	-3.916	.000
		Positive Ranks	19[b]	31.53	599.00		
		Ties	299[c]				
		Total	370				

a. During Corona< Before Corona, b. During Corona > Before Corona, c. During Corona = Before Corona

Table 42: Sub Hypotheses H1; Wilcoxon test results for Amman

The nonparametric Wilcoxon Signed Ranks test was applied to reveal the statistical significance of these differences; the results for Budapest as in Table 43 below show that the Wilcoxon's test with statistical significance value equal (0.00) for the non-motorized and motorized modes, the values are less than the level of statistical significance ($\alpha = 0.05$), this indicates the rejection of the null hypothesis and the acceptance of the alternative hypothesis, which states that there are statistically significant differences between the two means of the respondent's answers to the items related to mobility by using each mode of transportation before and during, and in favor of repeated use before.

Variables			N	Mean Rank	Sum of Ranks	Z Wilcoxon Signed Ranks Test	Sig.
H1.1, Walk or Ride a Bike	During Corona Before Corona	Negative Ranks	147[a]	135.72	19950.50	-4.138	.000
		Positive Ranks	100[b]	106.78	10677.50		
		Ties	92[c]				
		Total	339				
H1.2, Motorbike /Private Car	During Corona Before Corona	Negative Ranks	130[a]	91.42	11884.50	-6.824	.000
		Positive Ranks	42[b]	71.27	2993.50		
		Ties	167[c]				
		Total	339				
H1.3, Taxi services	During Corona	Negative Ranks	57[a]	42.26	2409.00	-3.544	.000

/Auto sharing; with or without other passengers	Before Corona	Positive Ranks	24[b]	38.00	912.00		
		Ties	258[c]				
		Total	339				
H1.4, Bus /Metro /Tram /Train	During Corona Before Corona	Negative Ranks	197[a]	125.46	24715.00	-9.719	.000
		Positive Ranks	42[b]	94.40	3965.00		
		Ties	100[c]				
		Total	339				

During Corona< Before Corona, b. During Corona > Before Corona, c. During Corona = Before Corona
Table 43: Sub Hypotheses H1; Wilcoxon test results for Budapest

4.2 Statistical Analysis for the Second Hypothesis; Amman and Budapest H2

The hypothesis is formulated as a Null hypothesis; H0, the complement of the alternative hypothesis, is measured by the significance level (α).

From statistical point of view H2 is formulated as Null hypothesis H0; there are no statistically significant differences at the level of significance ($\alpha \leq 0.05$) in the average respondents' answers to the items related to the probability of catching the disease and the applied procedures and restrictions to limit coronavirus spread during mobility through different modes of transportation. The means and standard deviations of the respondents' answers were computed to verify the hypothesis according to the independent variables (gender and educational level); the results for Amman and Budapest show apparent differences in the means between the respondents' answers. When examining the nonparametric Kruskal-Wallis test for Amman and Budapest to reveal the statistical significance of the differences and reviewing the Chi-Square test, which allows inferences from the sample regarding the hypothesis relationships, the results for Amman, as shown in Table 44 below, reveal that the value of the (Chi-Square) test has no statistically significant differences between the means of the respondents' answers to the item related to the probability of catching the disease and the applied procedures and restrictions to limit coronavirus spread during mobility through different modes of transportation due to the variables (gender and education level) which indicate that the respondents are not affected by the gender or by the education level during the assessment.

	Variable		N	Mean Rank	Chi-Square	df	Sig.	Notes
Amman	Gender	Male	196	192.86	1.981	1	0.159	(Chi-Square) with statistical significance values more than the level of statistical significance (α = 0.05), indicates the acceptance of the null
		Female	174	177.21				
	Education	High School or Less	160	192.35	3.703	4	0.05	
		Bachelor's Degree	156	174.74				
		Master's Degree	28	18379				

		Ph.D.	12	217.38				hypothesis and the reject of the alternative one.
		Other	14	203.14				
		Total	370					

Table 44: H2; Amman Sample Kruskal-Wallis test for Gender and Education

As shown in Table 45 below, the results for Budapest reveal that the value of the (Chi-Square) test states that there are statistically significant differences between the means of the respondents' answers for both gender and education level variables. And it was found that the females' evaluation of the applied procedures and restrictions to limit the spread of the disease was higher than males. On the other hand, according to the educational level and to figure out the direction of these differences and in favor of which level, the Mann-Whitney test was used.

	Variables		**N**	**Mean Rank**	**Chi-Square**	**df**	**Sig.**	**Notes**
Budapest	**Gender**	Male	172	155.91	7.241	1	0.007	(Chi-Square) test with statistical significance values less than the level of statistical significance (α = 0.05), indicates the rejection of the null hypothesis and acceptance of the alternative hypothesis.
		Female	167	184.51				
	Education	High School or Less	22	200.61	37.537	4	0.000	
		Bachelor's Degree	115	196.28				
		Master's Degree	106	151.66				
		Ph.D.	60	117.16				
		Other	36	209.43				
		Total	339					

Table 45: H2; Budapest Sample Kruskal-Wallis test for Gender and Education

As in Table 46 below, Mann-Whitney test results show that the higher the educational level of the individuals, the lower the evaluation rate for the probability of catching the disease and the applied procedures and restrictions to limit coronavirus spread during mobility, except for the answers of the secondary and Bachelor categories which shows no statistically significant differences between them.

Education levels	N	Z	Sig	Notes
High School or Less **Bachelor's Degree** **Total**	22 115 137	-.127	.899	Mann-Whitney test results show that there are statistically significant differences between the answers of the secondary category or less and the high education categories (master's and Ph.D.) in favor of the first category, which is the secondary; also, there are statistically significant differences between the answers of Bachelor category and the high education categories (Master's and Ph.D.) in favor of the first category which is the Bachelor, as well as there are statistically significant differences between the answers of Master's category and the Ph.D. category in favor of the first category which is the Master, this indicates that the higher the educational level of the individuals, the lower the evaluation for the applied procedures and restrictions to limit the spread of the disease. Finally, there are no statistically significant differences between the answers of the secondary and Bachelor category.
High School or Less **Master's Degree** **Total**	22 106 128	-2.171	.030	
High School or Less **Ph.D.** **Total**	22 60 82	-3.601	.000	
High School or Less **Other** **Total**	22 36 58	-.556	.578	
Bachelor's Degree **Master's Degree** **Total**	115 106 221	-3.439	.001	
Bachelor's Degree **Ph.D.** **Total**	115 60 175	-5.042	.000	
Bachelor's Degree **Other** **Total**	115 36 151	-.799	.424	
Master's Degree **Ph.D.** **Total**	106 60 166	-2.341	.019	
Master's Degree **Other** **Total**	106 36 142	-3.137	.002	
Ph.D. **Other** **Total**	60 36 96	-4.057	.000	

Table 46: H2; Budapest Sample Mann-Whitney test for Education

4.3 The Third Main Hypothesis Amman and Budapest H3

The hypothesis is formulated as a Null hypothesis; H0, the complement of the alternative hypothesis, is measured by the significance level (α).

From statistical point of view H3 is formulated as Null hypothesis H0; there are no statistically significant differences at the level of significance ($\alpha \leq 0.05$) in the means of the respondents' answers to the items related to the rate of satisfaction with public transportation. The means and standard deviations were computed for Amman and Budapest to verify the hypothesis, and the results show

apparent differences in the means between the respondents' answers to the paragraphs related to the rate of satisfaction with public transportation according to the independent variables (gender, educational level, occupation, and income). The nonparametric Kruskal-Wallis test was applied to reveal the statistical significance of these differences; Tables 47 and 48 below show the values of the (Chi-Square) test for some demographical variables at Amman and Budapest, for example, the answers of the respondents in both cities according to gender were in favor of the males which means that the males are more satisfied with public transportation than the females. On the other hand, the Mann-Whitney test was used for the other demographical characteristics to figure out the direction of these differences and in favor of which level.

	Variables		N	Mean Rank	Chi-Square	df	Sig.	Notes
Amman	Gender	Male	196	211.75	25.200	1	0.000	(Chi-Square) test with statistical significance values less than the level of statistical significance (α = 0.05), indicates the rejection of the null hypothesis and acceptance of the alternative hypothesis.
		Female	174	155.93				
	Education	High School or Less	160	222.95	47.467	4	0.000	
		Bachelor's Degree	156	165.59				
		Master's Degree	28	110.00				
		Ph.D.	12	98.83				
		Other	14	204.64				
	Occupation	Student	74	159.07	18.872	4	0.001	
		Working	196	196.60				
		Studying and Working together	8	108.06				
		Retired	24	137.31				
		Unemployed	68	208.38				
	income	< 500	212	222.94	62.928	5	.000	

		501 - 1000	97	136.58				
		1001 - 1500	33	147.47				
		1501 - 2000	12	129.50				
		2001-2500	8	119.31				
		>2500	8	93.56				
		Total	370					

Table 47: H3; Amman Sample Kruskal-Wallis test for Gender, Education, Occupation and Income

	Variables		**N**	**Mean Rank**	**Chi-Square**	**df**	**Sig.**	**Notes**
Budapest	**Gender**	Male	172	149.07	15.938	1	0.000	(Chi-Square) test with statistical significance values less than the level of statistical significance (α = 0.05), indicates the rejection of the null hypothesis and acceptance of the alternative hypothesis,
		Female	167	191.55				
	Education	High School or Less	22	94.70	29.741	4	0.000	
		Bachelor's Degree	115	196.40				
		Master's Degree	106	145.96				
		Ph.D.	60	187.75				
		Other	36	172.86				
	Occupation	Student	100	170.41	9.688	4	0.046	
		Working	139	169.89				
		Studying and Working together	61	150.02				
		Retired	1	24.00				

		Unemployed	38	205.26				
	income	< 500	47	169.32	17.912	5	.003	
		501 - 1000	112	169.72				
		1001 - 1500	47	185.48				
		1501 - 2000	45	149.47				
		2001- 2500	31	118.71				
		>2500	57	202.46				
		Total	339					

Table 48: H3; Budapest Sample Kruskal-Wallis test for Gender, Education, Occupation and Income

The Mann-Whitney test was used in Table 49 below to investigate the differences in the remaining demographical variables for Amman and Budapest.

For the Education level, Mann-Whitney test results show that there are statistically significant differences between the answers of the secondary category and the other categories in favor of the first category, which is the secondary category; this indicates that the higher the educational level of the individuals, the lower the rate of satisfaction with public transportation. Except for the answers of the master's and the Ph.D. categories, which show no statistically significant differences between them.

Education levels	N	Z	Sig	
High School or Less Bachelor's Degree Total	160 156 316	-4.708	.000	Mann-Whitney test results show that there are statistically significant differences between the answers of the secondary category and the other categories (Bachelor, Master's, Ph.D.) in favor of the first category, which is the secondary. There are statistically significant differences between the answers
High School or Less Master's Degree Total	160 28 188	-5.136	.000	
High School or Less Ph.D. Total	160 12 172	-3.760	.000	
High School or Less Other Total	160 14 174	-1.079	.281	
Bachelor's Degree Master's Degree Total	156 28 184	-2.452	.014	

Bachelor's Degree Ph.D. Total	156 12 168	-2.120	.034	of Bachelor category and the high education categories (master's and Ph.D.) in favor of the first category which is the Bachelor. There are statistically significant differences between the answers of the Master's, Ph.D. and (others cataogry) in favor of the second category which is the others
Bachelor's Degree Other Total	156 14 170	-1.532	.126	
Master's Degree Ph.D. Total	28 12 40	-.458	.647	
Master's Degree Other Total	28 14 42	-3.580	.000	
Ph.D. Other Total	12 14 26	-2.998	.003	

Table 49: H3; Amman Sample Mann-Whitney test for Education

For occupation, the Mann-Whitney test results show statistically significant differences between the answers of the students and (employee and un-employee) categories in favor of the second and third categories. There are statistically significant differences between the employee's answers from one side and the answers of the working student category and retired people in favor of the employee category. On the other hand, there are no statistically significant differences between the student category and the working student category; this indicates that most of the students category is less satisfied with public transportation.

Finally, for the income level, Mann-Whitney test results show that there are statistically significant differences between the answers of the category (with 500 or less) and the other higher categories in favor of the first category, which indicates that the people with low income are more satisfied with public transportation, or we can say that it is the only and the sole transport mode that they can bear and afford.For other categories, it was found that there are no statistically significant differences between their answers, as shown in Tables 50 and 51.

Occupation	**N**	**Z**	**Sig**	
Student Working Total	74 196 270	-2.568	.010	Mann-Whitney test results show statistically significant differences between the answers of the students and (working and un-employee) categories in favor of the second and third categories. There are statistically significant
Student Studying and Working Total	74 8 82	-1.657	.097	
Student Retired Total	74 24 98	-.921	.357	
Student Unemployed Total	74 68 142	-2.884	.004	
Working Studying and Working	196 8	-2.150	.032	

Total	204			differences between the answers of employee and (working students and retired people) categories in favor of the employee.
Working Retired Total	196 24 220	-2.551	.011	
Working Unemployed Total	196 68 264	-.726	.468	
Studying and Working Retired Total	8 24 32	-1.199	.231	
Studying and Working Unemployed Total	8 68 76	-2.303	.021	
Retired Unemployed Total	24 68 92	-2.885	.004	

Table 50: H3; Amman Sample Mann-Whitney test for Occupation

Income	**N**	**Mean**	**Z**	**Sig**	
< 500 501 - 1000 Total	212 97 309	84.27 67.78	-6.569	.000	Income shows that there are statistically significant differences between the answers of the category (less than or equel 500) and the other categories in favor of the first category. While the rest categories have no statistically significant differences, the other income categories show that there are no statistically significant differences between their answers.
< 500 1001 - 1500 Total	212 33 245	84.27 70.39	-4.062	.000	
< 500 1501 - 2000 Total	212 12 224	84.27 66.42	-2.835	.005	
< 500 2001- 2500 Total	212 8 220	84.27 61.37	-2.368	.018	
< 500 >2500 Total	212 8 220	84.27 60.25	-3.416	.001	
501 - 1000 1001 - 1500 Total	97 33 130	67.78 70.39	-.848	.396	
501 - 1000 1501 - 2000 Total	97 12 109	67.78 66.42	-.358	.720	

501 - 1000 2001- 2500 Total	97 8 105	67.78 61.37	-.828	.408	
501 - 1000 >2500 Total	97 8 105	67.78 60.25	-1.009	.313	
1001 - 1500 1501 - 2000 Total	33 12 45	70.39 66.42	-.925	.355	
1001 - 1500 2001- 2500 Total	33 8 41	70.39 61.37	-1.153	.249	
1001 - 1500 >2500 Total	33 8 41	70.39 60.25	-1.499	.134	
1501 - 2000 2001- 2500 Total	12 8 20	66.42 61.37	-.579	.563	
1501 - 2000 >2500 Total	12 8 20	66.42 60.25	-.695	.487	
2001- 2500 >2500 Total	8 8 16	61.37 60.25	-.263	.793	

Table 51: H3; Amman Sample Mann-Whitney test for Income

For Budapest, as in Table 52 below, the Mann-Whitney test results show that almost the higher the educational level of the individuals, the higher the rate of satisfaction with public transportation; by comparing with Amman, this result is the opposite. Finally, there are no statistically significant differences between the answers of the Ph.D. category and the Bachelor and others category.

Education levels	N	Z	Sig	
High School or Less Bachelor's Degree Total	22 115 137	-4.769	.000	Mann-Whitney test results show that there are statistically significant differences between the answers of the secondary category and the other categories (Bachelor, Master's, Ph.D. and others) in favor of the second, third, fourth and fifth categories respectively. there are statistically significant differences between the answers of the Bachelor and
High School or Less Master's Degree Total	22 106 128	-2.050	.040	
High School or Less Ph.D. Total	22 60 82	-3.309	.001	

High School or Less Other Total	22 36 58	-3.270	.001	Master's catagories in favor of the first one which is the Bachelor. There are statistically significant differences between the answers of the Master's and (Ph.D. and others) cataogries in favor of the second and third which is Ph.D. and others respectively.
Bachelor's Degree Master's Degree Total	115 106 221	-3.981	.000	
Bachelor's Degree Ph.D. Total	115 60 175	-.036	.971	
Bachelor's Degree Other Total	115 36 151	-1.514	.130	
Master's Degree Ph.D. Total	106 60 166	-2.197	.028	
Master's Degree Other Total	106 36 142	-3.580	.000	
Ph.D. Other Total	60 36 96	-.637	.524	

Table 52: H3; Budapest Sample Mann-Whitney test for Education

For Budapest, as in Tables 53 and 54 below, Mann-Whitney test results show that almost there are no statistically significant differences between the answers according to the occupation level of individuals, only there are statistically significant differences between the answers of the unemployed category and the working and studying categories, in favor of the unemployed, i.e., they are more satisfied with public transportation comparing with the working and studying categories.

Occupation	N	Z	Sig	
Student Working Total	100 139 239	-.024	.981	Mann-Whitney test results show that there are statistically significant differences between the answers of the unemployed and (working Studying and Working) catagories in favor of the unemployed category.
Student Studying and Working Total	100 61 161	-1.105	.269	
Student Retired Total	100 1 101	-1.407	.159	
Student Unemployed Total	100 38 138	-1.574	.115	

Working Studying and Working Total	139 61 200	-1.414	.157	
Working Retired Total	139 1 140	-1.523	.128	
Working Unemployed Total	139 38 177	-2.136	.033	
Studying and Working Retired Total	61 1 62	-1.425	.154	
Studying and Working Unemployed Total	61 38 99	-2.845	.004	
Retired Unemployed Total	1 38 39	-1.614	.107	

Table 53: H3; Budapest Sample Mann-Whitney test for Occupation

Income	**N**	**Mean**	**Z**	**Sig**	
< 500 501 - 1000 Total	47 112 159	93.45 94.29	-.100	.920	For income, the Mann-Whitney test results show statistically significant differences between the answers of the category (501-1000) and the category (2001-2500) in favor of the lower category. There are statistically significant differences between the answers of the category (501-1000) and (more than 2500) in favor of the higher category. There are statistically significant
< 500 1001 - 1500 Total	47 47 94	93.45 97.13	-.851	.395	
< 500 1501 - 2000 Total	47 45 92	93.45 89.91	-.977	.329	
< 500 2001- 2500 Total	47 31 78	93.45 85.39	-2.216	.027	
< 500 >2500 Total	47 57 104	93.45 98.77	-1.541	.123	
501 - 1000 1001 - 1500 Total	112 47 159	94.29 97.13	-.997	.319	
501 - 1000 1501 - 2000 Total	112 45 157	94.29 89.91	-.991	.322	
501 - 1000 2001- 2500 Total	112 31 143	94.29 85.39	-2.737	.006	

501 - 1000 >2500 Total	112 57 169	94.29 98.77	-2.023	.043	differences between the answers of the category (1501 - 2000) and (more than 2500) in favor of the higher category. There are statistically significant differences between the answers of the category (2500 - 2001) and (more than 2500) in favor of the higher category. And for other categories, it was found that there are no statistically significant differences between their answers.
1001 - 1500 1501 - 2000 Total	47 45 92	97.13 89.91	-1.747	.081	
1001 - 1500 2001- 2500 Total	47 31 78	97.13 85.39	-2.723	.006	
1001 - 1500 >2500 Total	47 57 104	97.13 98.77	-.912	.362	
1501 - 2000 2001- 2500 Total	45 31 76	89.91 85.39	-1.465	.143	
1501 - 2000 >2500 Total	45 57 102	89.91 98.77	-3.104	.002	
2001- 2500 >2500 Total	31 57 88	85.39 98.77	-3.596	.000	

Table 54: H3; Budapest Sample Mann-Whitney test for Income

4.4 Statistical Analysis for the fourth Hypothesis; Amman and Budapest H4

The hypothesis is formulated as a Null hypothesis; H0, the complement of the alternative hypothesis, is measured by the significance level (α).

From statistical point of view H4 is formulated as Null hypothesis H0; there are no statistically significant differences at the level of significance ($\alpha \leq 0.05$) in the average respondents' answers to the items related to the digital transformation and the use of e- (work, study, shopping and services) even after the end of the pandemic.

The means and standard deviations of the respondents' answers were computed to verify the hypothesis according to the independent variables (gender, educational level, occupation, and income); the results for Amman and Budapest show apparent differences in the means between the respondents' answers. For Amman, as shown in Tables 55, 56, and 57 below, the nonparametric Kruskal-Wallis test was applied to reveal the statistical significance of the differences; there are no statistically significant differences between the respondents' answers to the items related to the digital transformation and the use of e- (work, study, shopping and services) even after the end of the pandemic due to the variables (gender, education level, occupation, and family members) which indicate that the respondents' answers are not affected these variables, while for the variables (age and income) there are statistically significant differences between the respondents' answers, the Mann Whitney test was used to figure out the trend of these differences in favor of which level.

Gender	N	Mean Rank	Chi-Square	df	Sig.	
Male	196	182.36	.381	1	.537	(Chi-Square) for Gender, Education level, Occupation and family memebers with statistical significance values more than the level of statistical significance (α = 0.05), indicates the acceptance of the null hypothesis and the rejection of the alternative one. (Chi-Square) for Age and income with statistical significance values less than the level of statistical significance (α = 0.05), indicates the rejection of the null hypothesis and the acceptance of the alternative one.
Female	174	189.03				
Total	370					
Age						
less than 18	39	230.82	14.682	6	.023	
18 - 28	111	177.38				
29-39	76	194.61				
40-49	69	164.41				
50-59	45	195.26				
60-69	28	160.55				
more than 69	2	263.25				
Total	370					
Education level						
High School or Less	160	182.38	7.323	4	.120	
Bachelor's Degree	156	177.68				
Master's Degree	28	225.93				
Ph.D.	12	227.96				
Other	14	191.00				
Total	370					
Occupation						
Student	74	194.18	4.579	4	.333	
Working	196	184.65				
Studying and Working together	8	183.75				
Retired	24	216.13				
Unemployed	68	167.89				
Total	370					
Income						
< 500	212	165.24	26.761	5	.000	
501 - 1000	97	202.98				
1001 - 1500	33	213.11				
1501 - 2000	12	254.00				
2001- 2500	8	187.56				
>2500	8	291.69				
Total	370					

Family members					
1	14	170.71	1.530	4	.821
2	38	190.11			
3	31	203.60			
4	75	179.82			
5 or more	212	185.01			
Total	370				

Table 55: H4; Amman Nonparametric Kruskal-Wallis test

Age	N	Z	Sig	
less than 18 18 - 28 Total	39 111 150	-2.673	.008	For the age, Mann-Whitney test results show that there are statistically significant differences between the answers of the category (less than 18) and ((18-28), (40-49), and (60-69) categories in favor of the first category which is less than 18, while the rest categories have no statistically significant differences with less than 18 categories. The evaluations for the other category shows that there are no- statistically significant differences between their answers.
less than 18 29-39 Total	39 76 115	-1.675	.094	
less than 18 40-49 Total	39 69 108	-3.209	.001	
less than 18 50-59 Total	39 45 84	-1.683	.092	
less than 18 60-69 Total	39 28 67	-2.699	.007	
less than 18 more than 69 Total	39 2 41	-.061	.951	
18 - 28 29-39 Total	111 76 187	-1.095	.274	
18 - 28 40-49 Total	111 69 180	-.783	.434	
18 - 28 50-59 Total	111 45 156	-.956	.339	
18 - 28 60-69 Total	111 28 139	-.737	.461	
18 - 28 more than 69 Total	111 2 113	-1.155	.248	
29-39 40-49	76 69	-1.727	.084	

Total	145			
29-39 50-59 Total	76 45 121	-.005	.996	
29-39 60-69 Total	76 28 104	-1.472	.141	
29-39 more than 69 Total	76 2 78	-.869	.385	
40-49 50-59 Total	69 45 114	-1.670	.095	
40-49 60-69 Total	69 28 97	-.175	.861	
40-49 more than 69 Total	69 2 71	-1.614	.107	
50-59 60-69 Total	45 28 73	-1.472	.141	
50-59 more than 69 Total	45 2 47	-.801	.423	
60-69 more than 69 Total	28 2 30	-1.657	.098	

Table 56: H4; Amman Sample Mann-Whitney test for Age

Income	N	Z	Sig	
< 500 501 - 1000 Total	212 97 309	-2.981	.003	For income, the Mann-Whitney test results show statistically significant differences between the answers of the category equel or less than 500 and all other categories in favor of the other categories, except the category (2001-2500). There are statistically significant differences between the answers of the category
< 500 1001 - 1500 Total	212 33 245	-2.611	.009	
< 500 1501 - 2000 Total	212 12 224	-2.874	.004	
< 500 2001- 2500 Total	212 8 220	-.680	.496	
< 500 >2500	212 8	-3.617	.000	

Total	220			(501-1000) and (more than 2500) in favor of the higher category. There are statistically significant differences between the answers of the category (1001-1500) and (more than 2500) in favor of the higher category, and for other categories, it was found that there are no statistically significant differences between their answers.
501 - 1000 1001 - 1500 Total	97 33 130	-.436	.663	
501 - 1000 1501 - 2000 Total	97 12 109	-1.635	.102	
501 - 1000 2001- 2500 Total	97 8 105	-.474	.635	
501 - 1000 >2500 Total	97 8 105	-2.125	.034	
1001 - 1500 1501 - 2000 Total	33 12 45	-1.379	.168	
1001 - 1500 2001- 2500 Total	33 8 41	-.514	.607	
1001 - 1500 >2500 Total	33 8 41	-2.003	.045	
1501 - 2000 2001- 2500 Total	12 8 20	-1.632	.103	
1501 - 2000 >2500 Total	12 8 20	-.310	.757	
2001- 2500 >2500 Total	8 8 16	-1.954	.051	

Table 57: H4; Amman Sample Mann-Whitney test for Income

For Budapest, as shown in Table 58 until Table 63 below, the nonparametric Kruskal-Wallis test was applied to reveal the statistical significance of the differences;
the results show there are no statistically significant differences between the respondents' answers to the items related to digital transformation and the use of e- (work, study, shopping and services) even after the end of the pandemic due to the variable (gender)
which indicates that the respondents' answers are not affected by gender, while due to the variables (age, education level, occupation, family members, and income), there is a statistically significant difference between the respondents' answers, the Mann-Whitney test was used to figure out the direction of these differences in favor of which level.

Gender	N	Mean Rank	Chi-Square	df	Sig.	
male	172	167.35	.258	1	.611	For Gender (Chi-Square), with statistical significance values more than the level of statistical significance (α = 0.05), indicates the acceptance of the null hypothesis and the rejection of the alternative one. For age, education level , occupation, family memebers and income (Chi-Square) with statistical significance values less than the level of statistical significance (α = 0.05), indicates th rejection of the null hypothesis and the acceptance of the alternative one.
female	167	172.73				
Total	339					
Age						
less than 18	11	140.41	41.916	5	.000	
18 – 28	81	223.94				
29-39	129	158.46				
40-49	65	140.95				
50-59	43	175.37				
60-69	10	80.20				
Total	339					
Education level						
High School or Less	22	170.61	29.211	4	.000	
Bachelor's Degree	115	155.03				
Master's Degree	106	196.99				
Ph.D.	60	189.75				
Other	36	105.06				
Total	339					
Occupation						
Student	100	199.33	41.710	3	.000	
Working	139	147.18				
Studying and Working together	61	211.43				
Unemployed	39	111.35				
Total	339					
Income						
< 500	47	205.34	27.266	5	.000	
501 – 1000	112	179.39				
1001 – 1500	47	151.39				
1501 – 2000	45	178.98				
2001- 2500	31	193.35				
>2500	57	117.96				
Total	339					
Family members						
1	57	185.47	25.087	4	.000	
2	79	170.73				
3	81	192.81				
4	88	127.70				
5 or more	34	197.50				
Total	339					

Table 58: H4; Budapest Nonparametric Kruskal-Wallis test

Age	N	Z	Sig	
less than 18 18 - 28 Total	11 81 92	-2.971	.003	For age, Mann-Whitney test results show that there are statistically significant differences between the answers of the category (less than 18) and (18-28) in favor of the second catagory and between the answers of the category (less than 18) and (60-69) category in favor of the first category which is less than 18, while the rest categories have no statistically significant differences with the catagory less than 18. There are statistically significant differences between the answers of the category (18-28) and other older catagories in favor of the first category. There are statistically significant differences between the answers of the category (29 - 39) and (60 - 69) category in favor of the firtst category. There are statistically significant differences between the answers of the category (40 - 49) and (60 - 69) in the favor of thr first category, and there are statistically significant differences between the answers of the category (50 - 59) and (60 - 69) in the favor of first catogry. The evaluations for the other category shows that there are no statistically significant differences between their answers.
less than 18 29-39 Total	11 129 140	-.631	.528	
less than 18 40-49 Total	11 65 76	-.282	.778	
less than 18 50-59 Total	11 43 54	-1.104	.270	
less than 18 60-69 Total	11 10 21	-2.350	.019	
18 - 28 29-39 Total	81 129 210	-4.677	.000	
18 - 28 40-49 Total	81 65 146	-5.354	.000	
18 - 28 50-59 Total	81 43 124	-2.352	.019	
18 - 28 60-69 Total	81 10 91	-4.208	.000	
29-39 40-49 Total	129 65 194	-1.135	.257	
29-39 50-59 Total	129 43 172	-1.037	.300	
29-39 60-69 Total	129 10 139	-2.458	.014	
40-49 50-59 Total	65 43 108	-1.532	.125	
40-49 60-69 Total	65 10 75	-2.268	.023	

50-59 60-69 Total	43 10 53	-2.073	.038	

Table 59: H4; Budapest Sample Mann-Whitney test for Age

Education levels	N	Mean	Z	Sig	
High School or Less Bachelor's Degree Total	22 115 137	17.27 15.83	-.731	.465	results show that there are statistically significant differences between the answers of the category (high school or less) and (others catagory) in favor of the first category, and between the answers of the category (Bachelor) with (Master and Ph.D.) categories in favor of the second and third category respectively, between Bachelor and others category in the favor of first catory , between Masters and others catagory in the favor of the first category, and between Ph.D. and others category in the favor of first category, while the rest categories have no statistically significant differences.
High School or Less Master's Degree Total	22 106 128	17.27 18.17	-1.247	.212	
High School or Less Ph.D. Total	22 60 82	17.27 17.82	-.968	.333	
High School or Less Other Total	22 36 58	17.27 13.58	-2.864	.004	
Bachelor's Degree Master's Degree Total	115 106 221	15.83 18.17	-3.118	.002	
Bachelor's Degree Ph.D. Total	115 60 175	15.83 17.82	-2.176	.030	
Bachelor's Degree Other Total	115 36 151	15.83 13.58	-2.475	.013	
Master's Degree Ph.D. Total	106 60 166	18.17 17.82	-.530	.596	
Master's Degree Other Total	106 36 142	18.17 13.58	-4.870	.000	
Ph.D. Other Total	60 36 96	17.82 13.58	-4.268	.000	

Table 60: H4; Budapest Sample Mann-Whitney test for Educational Level

Occupation	N	Mean	Z	Sig	
Student Working Total	100 139 239	18.2 9 15.6 8	- 4.162	.00 0	Results show that there are statistically significant differences between the answers of the category (student) and (working, and unemployee) catagories in favor of the first category, between the answers of the category (working) with (studying and working) category in favor of the second category, between working and unemployed category in the favor of first catory , between Masters and others in the favor of the first category, and between sutdding and working category and unemployeed in the favor of first category while the rest categories have no statistically significant differences.
Student Studying and Working Total	100 61 161	18.29 18.72	- 1.017	.30 9	
Student Unemployed Total	100 39 139	18.29 13.72	- 4.886	.00 0	
Working Studying and Working Total	139 61 200	15.68 18.72	- 4.190	.00 0	
Working Unemployed Total	139 39 178	15.68 13.72	- 2.060	.03 9	
Studying and Working Unemployed Total	61 39 100	18.72 13.72	- 4.730	.00 0	

Table 61: H4; Budapest Sample Mann-Whitney test for Occupation

Income	N	Mean	Z	Sig	
< 500 501 - 1000 Total	47 112 159	18.42 17.10	- 1.4 70	.142	Results show that there are statistically significant differences between the answers of the category (less than or equel 500) and (1001-1500) and more than 2500 catagories in favor of the first category, between the answers of the category (501 -1000) with (more than 2500) category in favor of the first category, between (1001 - 1500) and (2001 – 2500) category in the favor of second catory , between Masters and others in the favor of the first category, and (1501 - 2000) and (more than 2500) category and
< 500 1001 - 1500 Total	47 47 94	18.42 16.45	- 3.0 19	.003	
< 500 1501 - 2000 Total	47 45 92	18.42 17.42	- 1.4 52	.147	
< 500 2001- 2500 Total	47 31 78	18.42 18.13	- .75 4	.451	
< 500 >2500 Total	47 57 104	18.42 13.77	- 4.0 56	.000	

					unemployeed in the favor of first catagory while the rest categories have no statistically significant differences.
501 - 1000 1001 - 1500 Total	112 47 159	17.10 16.45	-1.699	.089	
501 - 1000 1501 - 2000 Total	112 45 157	17.10 17.42	-.100	.921	
501 - 1000 2001- 2500 Total	112 31 143	17.10 18.13	-.633	.527	
501 - 1000 >2500 Total	112 57 169	17.10 13.77	-3.653	.000	
1001 - 1500 1501 - 2000 Total	47 45 92	16.45 17.42	-1.461	.144	
1001 - 1500 2001- 2500 Total	47 31 78	16.45 18.13	-2.207	.027	
1001 - 1500 >2500 Total	47 57 104	16.45 13.77	-2.438	.015	
1501 - 2000 2001- 2500 Total	45 31 76	17.42 18.13	-.682	.495	
1501 - 2000 >2500 Total	45 57 102	17.42 13.77	-3.345	.001	
2001- 2500 >2500 Total	31 57 88	18.13 13.77	-3.426	.001	

Table 62: H4; Budapest Sample Mann-Whitney test for Income

Family members	N	Mean	Z	Sig	
1 2 Total	57 79 136	17.65 16.82	-.927	.354	For family memebers results show that there are statistically significant differences between the answers of (one member) category and (4 members) catagories in favor of the first category, between the answers of the category (two members) and (4 members) category in favor of the first category, between (three memebers) and (four members) category in the favor of second catory, between Masters and others in the favor of the first category, anD between (four members) and (five members or more) catagory in the favor of the second category, while the rest categories have no statistically significant differences.
1 3 Total	57 81 138	17.65 17.89	-.427	.670	
1 4 Total	57 88 145	17.65 14.54	-3.435	.001	
1 5 or more Total	57 34 91	17.65 18.26	-.615	.539	
2 3 Total	79 81 160	16.82 17.89	-1.445	.148	
2 4 Total	79 88 167	16.82 14.54	-2.875	.004	
2 5 or more Total	79 34 113	16.82 18.26	-1.296	.195	
3 4 Total	81 88 169	17.89 14.54	-4.272	.000	
3 5 or more Total	81 34 115	17.89 18.26	-.145	.885	
4 5 or more Total	88 34 122	14.54 18.26	-3.615	.000	

Table 63: H4; Budapest Sample Mann-Whitney test for Family Members

4.5 Structural Equation Models SEM

The Structural Education Models SEM were computed by utilizing SPSS and AMOS; it is the final approach to test the model; it consists of several statistical methods, the models' values and paths with Confirmatory Factor Analysis CFA used to make certain assumptions and to prove that the relations and results based EFA that used to analyze the initial model, sometimes the result of CFA, path and coefficient analysis don't achieve complete acceptable criteria which will cause limits in the goodness of fit. Therefore, this initial model should be adjusted to achieve a better good model fit to check the hypothesis that indicates there is a significant correlation between the indicators and other variables; some indexes are involved in the Structural Equation Models SEM [230], and such indexes should be taken into consideration when applying for SEM, categories classify it, and each one has its checked value which determines the significance and acceptance; Chi-squared goodness of fit test, normed Chi-squared test, Chi-squared = Ratio (Chi-squared/df) <= 3, Goodness of fit

index (GFI), Adjusted goodness of fit index (AGFI), Normed fit index (NFI), Tucker-Lewis Index (TLI), Comparative fit index (CFI), between 0.9 and 1.0, and Root mean square error of approximation (RMSEA) less than 0.08, [267].

After computing the measurement models and utilizing the fit statistics tests, the results show that the best fit models for Amman and Budapest are significant for hypotheses H1 and H2 as the first model and H3 and H4 as the second model for each city. For H1 and H2, identify the relationship between COVID-19 and transport mode as the correlation between the difference (change) in mobility for the same activities (before and during) and the probability of catching the disease while using the different transport modes; both hypotheses are statistically significant as depicted figures 11 to 14, below, also, by obtaining the p-value (probability) of less than 0.05 as in table 64 the p-value was acceptance, and the findings revealed that the moderate degree of infection or catching the disease is the core factor influencing the respondents in deciding mobility. The finding matched the theoretical suggestions as explained previously;

Thus, related to the hypotheses; H1 and H2 for Amman and Budapest have supported the assumptions, and the results improved significantly by utilizing H1 and H2 together to represent structural model. Figures 14 and 16 below show a structural model of assessing the current situation of transport modes compared with pre-COVID19; it consists of many items, all related to the transport modes and movements in the light of the COVID-19 pandemic. The result of this model is associated with the test of indicators that contributed to generating a significant model; however, omitting or modifying some engagement parameters improved the models.

According to the hypotheses; H3 and H4 for Amman and Budapest [266]; by utilizing both hypotheses together to represent the structural model, which related to the satisfaction with public transportation and the using of digital transformation, it is essential to point out that the link is vital because generally most people are dis-satisfied with public transportation, whether in terms of services, fare, or proximity to housing. The desire to keep studying and working remotely or partially remotely and providing e- services and facilitating transactions electronically are part of people's desire to decrease contact with others by staying away from PT which is considered a hotspot for virus transmit.

4.5.1 Amman Structural First Model

Structural model for H1 and H2 Figure 14 and Table 64 (Mediation Model or parallel Mediation Model = assess direct and indirect effects).

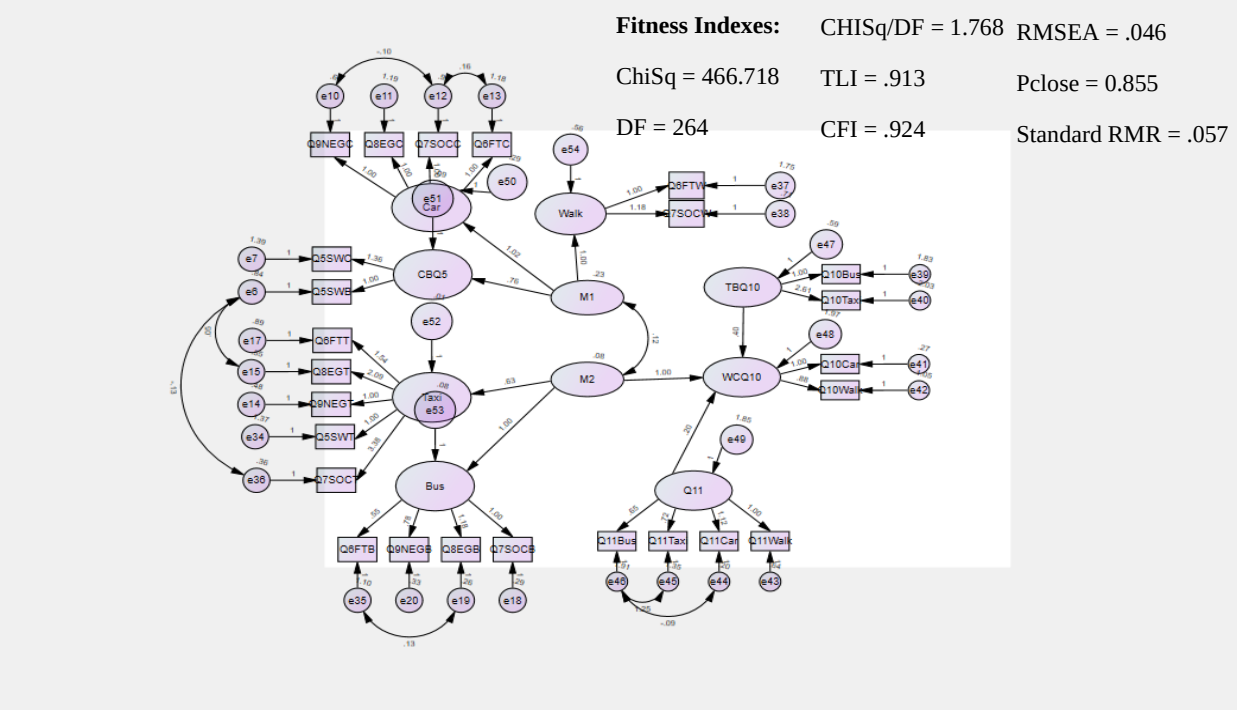


Figure 14: SEM correlation for change of movement due to COVID-19 for transport modes of Amman

			Estimate	S.E.	C.R.	P
WCQ10	<---	M2	1.000			
Walk	<---	M1	1.000			
CBQ5	<---	M1	.763	.219	3.489	***
Bus	<---	M2	1.000			
Taxi	<---	M2	.634	.158	4.025	***
Car	<---	M1	1.023	.240	4.258	***
WCQ10	<---	TBQ10	.399	.076	5.266	***
WCQ10	<---	Q11	.195	.057	3.412	***
Q5SWB	<---	CBQ5	1.000			
Q5SWC	<---	CBQ5	1.361	.324	4.200	***
Q9NEGT	<---	Taxi	1.000			
Q8EGT	<---	Taxi	2.090	.467	4.473	***
Q6FTT	<---	Taxi	1.539	.419	3.672	***
Q7SOCB	<---	Bus	1.000			
Q8EGB	<---	Bus	1.178	.158	7.481	***
Q9NEGB	<---	Bus	.777	.121	6.436	***

Q6FTB	<---	Bus	.552	.192	2.878	.004
Q6FTC	<---	Car	1.000			
Q7SOCC	<---	Car	1.000			
Q8EGC	<---	Car	1.000			
Q9NEGC	<---	Car	1.000			
Q5SWT	<---	Taxi	1.000			
Q7SOCT	<---	Taxi	3.379	.706	4.787	***
Q6FTW	<---	Walk	1.000			
Q7SOCW	<---	Walk	1.183	.242	4.894	***
Q10Bus	<---	TBQ10	1.000			
Q10Taxi	<---	TBQ10	2.611	1.088	2.400	.016
Q10Car	<---	WCQ10	1.000			
Q10Walk	<---	WCQ10	.879	.098	9.016	***
Q11Walk	<---	Q11	1.000			
Q11Car	<---	Q11	1.117	.058	19.151	***
Q11Taxi	<---	Q11	.724	.052	13.971	***
Q11Bus	<---	Q11	.648	.062	10.525	***

Table 64: Regression Weights of H1 and H2 of Amman

4.5.2 Amman Structural Second Model

Structural model for H3 and H4 Figure 15 and Table 65.

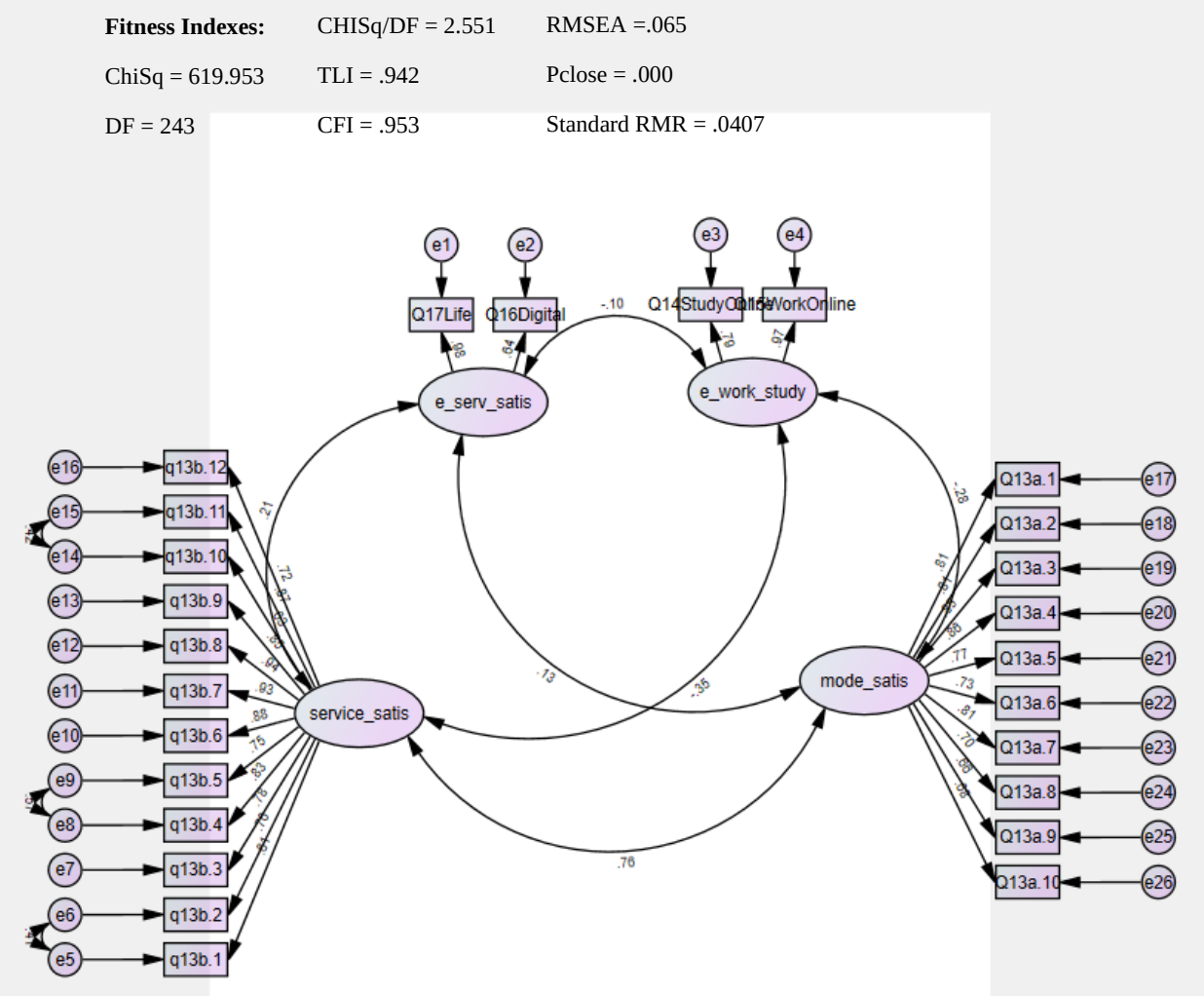


Figure 15: SEM correlation satisfaction from PT and digital transformation of Amman

			Estimate	S.E.	C.R.	P
q13b.1	<---	satis_service	1.000			
q13b.2	<---	satis_service	1.180	.077	15.243	***
q13b.3	<---	satis_service	1.175	.092	12.710	***
q13b.4	<---	satis_service	1.337	.103	12.964	***
q13b.5	<---	satis_service	1.195	.098	12.174	***
q13b.6	<---	satis_service	1.338	.098	13.631	***
q13b.7	<---	satis_service	1.455	.108	13.488	***
q13b.8	<---	satis_service	1.418	.100	14.224	***
q13b.9	<---	satis_service	1.274	.095	13.364	***

q13b.10	<---	satis_service	.868	.082	10.565	***
q13b.11	<---	satis_service	1.285	.096	13.428	***
Q16Digital	<---	Digital	1.000			
Q17Life	<---	Digital	1.328	.349	3.804	***
Q14StudyOnline	<---	e_work_study	1.000			
Q15WorkOnline	<---	e_work_study	1.181	.147	8.062	***
Q13a.10	<---	Satis_mode	1.000			
Q13a.9	<---	Satis_mode	.776	.067	11.520	***
Q13a.8	<---	Satis_mode	.905	.072	12.479	***
Q13a.7	<---	Satis_mode	1.083	.077	14.048	***
Q13a.6	<---	Satis_mode	1.119	.084	13.361	***
Q13a.5	<---	Satis_mode	1.028	.077	13.436	***
Q13a.4	<---	Satis_mode	1.181	.082	14.437	***
Q13a.3	<---	Satis_mode	1.094	.078	14.037	***
Q13a.2	<---	Satis_mode	.929	.071	13.151	***
Q13a.1	<---	Satis_mode	1.065	.077	13.778	***

Table 65: Regression Weights of H3 and H4 of Amman

4.5.3 Budapest Structural First Model

Structural model for H1 and H2 Figure 16 and Table 66 ((Mediation Model = assess direct and indirect effects).

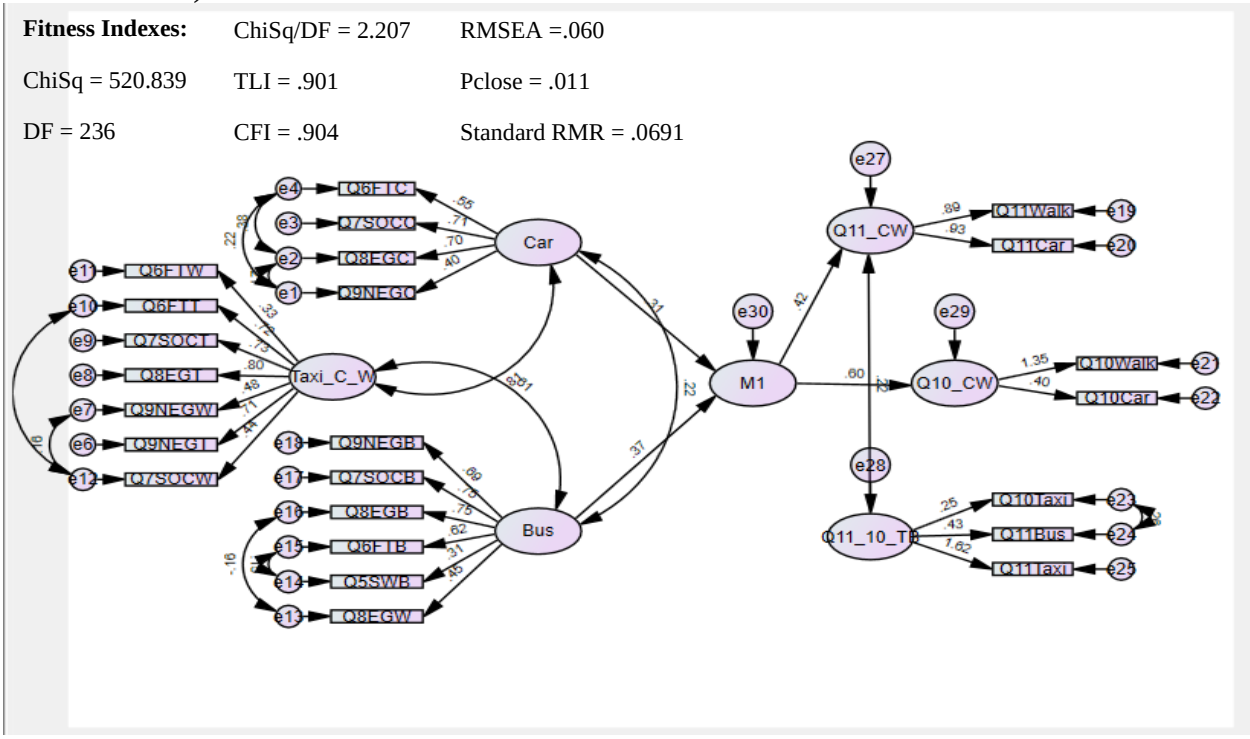


Figure 16: SEM correlation for change of movement due to COVID-19 for transport modes of Budapest

			Estimate	S.E.	C.R.	P
M1	<---	F1	.560	.124	4.510	***
M1	<---	Car	1.000			
Q11_CW	<---	Q11_10_TB	.825	.166	4.981	***
Q10_CW	<---	M1	1.000			
Q11_CW	<---	M1	.572	.137	4.169	***
Q9NEGC	<---	Car	1.476	.397	3.723	***
Q8EGC	<---	Car	2.690	.631	4.264	***
Q7SOCC	<---	Car	2.723	.636	4.279	***
Q6FTC	<---	Car	2.103	.515	4.086	***
Q9NEGT	<---	Taxi_C_W	1.000			
Q9NEGW	<---	Taxi_C_W	1.622	.198	8.193	***
Q8EGT	<---	Taxi_C_W	1.475	.109	13.542	***
Q7SOCT	<---	Taxi_C_W	1.347	.109	12.308	***
Q6FTT	<---	Taxi_C_W	1.124	.092	12.230	***
Q6FTW	<---	Taxi_C_W	1.865	.328	5.692	***
Q7SOCW	<---	Taxi_C_W	1.264	.169	7.462	***
Q8EGW	<---	F1	1.000			
Q5SWB	<---	F1	.720	.159	4.519	***
Q6FTB	<---	F1	1.390	.203	6.863	***
Q8EGB	<---	F1	1.620	.229	7.071	***
Q7SOCB	<---	F1	1.668	.227	7.351	***
Q9NEGB	<---	F1	1.295	.182	7.133	***
Q11Walk	<---	Q11_CW	1.000			
Q11Car	<---	Q11_CW	1.102	.071	15.545	***
Q10Walk	<---	Q10_CW	1.000			
Q10Car	<---	Q10_CW	.271	.090	3.024	.002
Q10Taxi	<---	Q11_10_TB	1.000			
Q11Bus	<---	Q11_10_TB	1.919	.245	7.839	***
Q11Taxi	<---	Q11_10_TB	7.010	3.291	2.130	.033

Table 66: Regression Weights of H1 and H2 of Budapest

4.5.4 Budapest Structural Second model

Structural model for H3 and H4 Figure 17 and Table 67

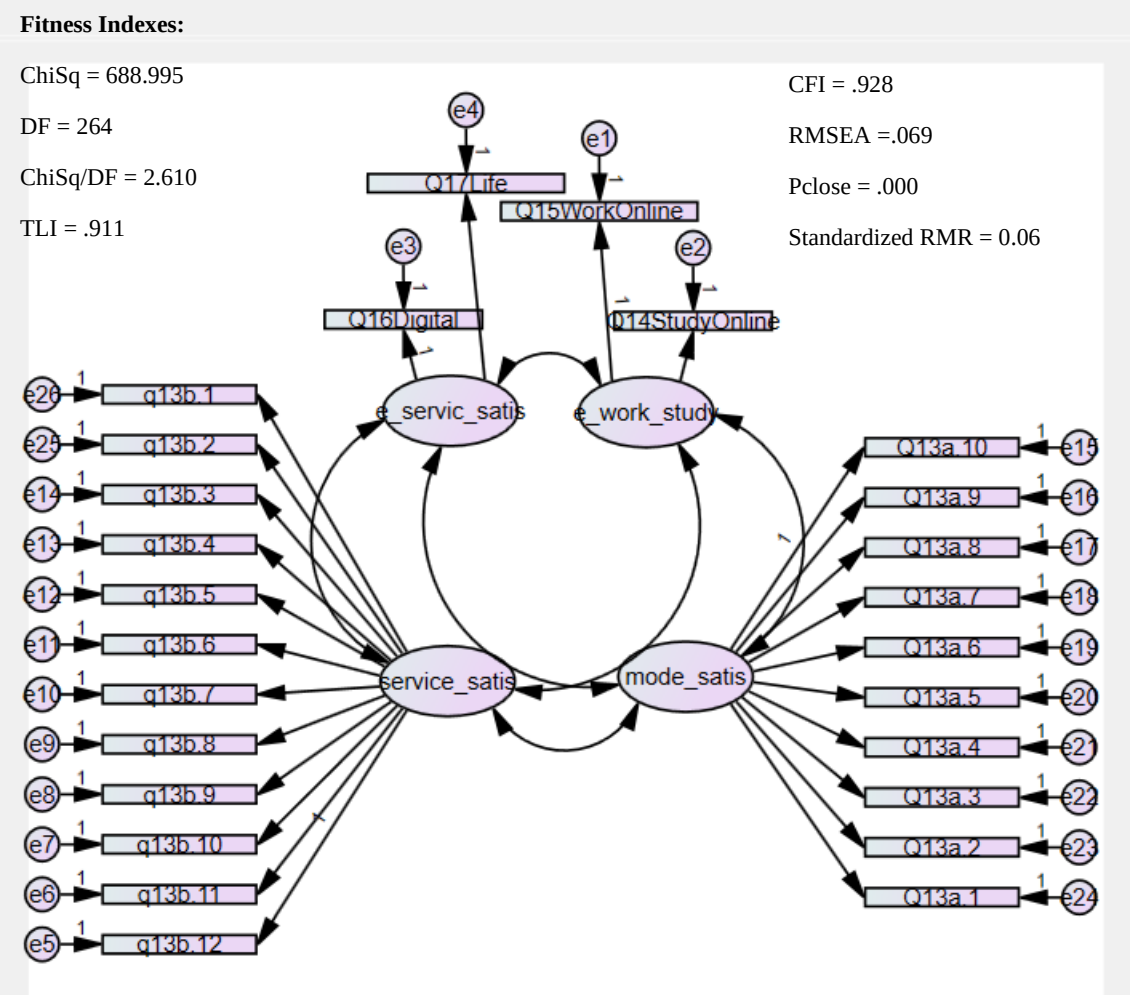


Figure 17: SEM correlation satisfaction from PT and digital transformation of Budapest

			Estimate	S.E.	C.R.	P
Q13a.10	<---	F2	1.000			
Q13a.9	<---	F2	.970	.077	12.611	***
Q13a.8	<---	F2	.836	.073	11.375	***
Q13a.7	<---	F2	.827	.079	10.444	***
Q13a.6	<---	F2	.715	.075	9.549	***
Q13a.5	<---	F2	.975	.078	12.539	***
Q13a.4	<---	F2	1.000	.079	12.741	***

Q13a.3	<---	F2	1.010	.075	13.390	***
Q13a.2	<---	F2	.893	.073	12.177	***
Q13a.1	<---	F2	.996	.075	13.285	***
q13b.1	<---	F1	1.000			
q13b.2	<---	F1	1.324	.110	12.019	***
q13b.3	<---	F1	1.319	.114	11.552	***
q13b.4	<---	F1	1.467	.152	9.664	***
q13b.5	<---	F1	1.252	.148	8.479	***
q13b.6	<---	F1	1.355	.143	9.448	***
q13b.7	<---	F1	1.561	.162	9.647	***
q13b.8	<---	F1	1.507	.147	10.222	***
q13b.9	<---	F1	1.604	.158	10.162	***
q13b.10	<---	F1	1.148	.130	8.816	***
q13b.11	<---	F1	1.264	.136	9.267	***
q13b.12	<---	F1	1.560	.162	9.603	***
Q16Digital	<---	F4	1.000			
Q17Life	<---	F4	.874	.060	14.471	***
Q14StudyOnline	<---	F3	1.000			
Q15WorkOnline	<---	F3	1.176	.093	12.602	***

Table 67: Maximum Likelihood Estimates - Regression Weights of H3 and H4 of Budapest

4.6 Summary

Initially, the theoretical research was investigated after adopting the questionnaire survey and consulting experts in the field to establish concrete hypotheses.

A design of a pilot survey before collecting actual data was implemented to make sure that questionnaire statements met both faces validity and reliability criteria; accordingly, some of the questionnaire items were modified to be clearer and more concise, and the final version of the questionnaire was developed, and real data collection started, followed by:

- Primary statistical quantitative analysis.
- Normality, Homogeneity of Variance, Multicollinearity, Descriptive statistics analysis and demographical characteristics were conducted.
- Exploratory Factor Analysis (EFA).
- Advanced and deep analysis using Confirmatory Factor Analysis (CFA) approach to establish the measurement models for structural modeling.

The methodology and sample plan implementation of the research focused on two cities, Budapest and Amman for comparison purposes.

4.7 Discussion of Results

The current study sought to establish and analyze the main factors that need to be considered in assessing transport mode usage before and during the COVID-19 pandemic based on the assumption that these factors influence the transport mode and its shift of usage for different outdoor activities. Additionally, the study evaluated the direct and indirect influences of many demographical characteristics that shape attitude and behavior.

Findings from the statistical analysis revealed that in most cases, the null hypotheses are rejected, and there are statistically significant differences between variables; this fulfills the requirements for Homogeneity and Multicollinearity.

The reliability and validity results are acceptable at its statistical threshold rates, even though there are apparent differences between the values of reliability between Amman and Budapest for both the second and fourth hypotheses; this is clearly and logically justified based on the fact that primary mode of transportation in Amman relies on private vehicles and taxis, while in Budapest it is basically trams, motors, and buses.

The probability of being exposed to viruses when using cars and taxis for mobility is relatively low compared with buses and other modes, in addition to that the effectiveness and efficiency of the applied restrictions to control the spread of COVID-19, such as safety and health conditions, social distancing, etc. can be quickly evaluated when using public transportation compared with using vehicles. On the other hand, the digital transformation questions in H4 show very high-reliability values for Budapest because the infrastructure for the digital transformation was very advanced compared with Amman.

Concerning hypothesis H1, the findings from the descriptive analysis correspond with activities and mobility showed that according to the survey, only the non-motorized modes such as walking and bike riding increased during the pandemic for the study and work activities. In contrast, the motorized transport modes decreased for Budapest and Amman by 8% and 5%, respectively.

Shopping using non-motorized modes for non-essential and essential goods has the highest mean, followed by work and studying.

Concerning hypothesis H2, by comparing the mean, how would the respondents rate the probability of catching COVID-19 while using transport modes? Bus, tram, and metro show the highest value; they were ranked as having a high to an extremely high probability of catching the disease.

Concerning hypothesis H3, related to how satisfied the respondents with Public Transportation PT are. The results indicate that the passengers are dissatisfied with the PT fare rate and with the distance between the stop-stations and the place of residence; however, it can be seen that mostly the passengers in Amman are in the range of disagreeing to slightly agree compared with agreeing in Budapest, this reflects the quality of the developed PT system in Hungary which provides satisfaction in term of PT rate vs. the value perceived.

Concerning hypothesis H4, and e- (learning, working, and e- (payments, delivery, and services) and whether these will continue to grow even after the end of this pandemic? The respondents in Budapest completely expected an increase in digital transformation even after the end of the pandemic, while in Amman, respondents disagree that remotely or partially (studying and working) will continue in the future. However, both Amman and Budapest respondents agreed that smart applications to obtain e- (payments, delivery, and services) would continue to grow even after the end of this pandemic.

All hypotheses show apparent differences in the means between the respondents' answers for both Amman and Budapest to reveal the statistical significance of these differences; the nonparametric test is used as the results showed no normal distribution, the first hypothesis H1 was less than $\alpha = 0.05$, so the hypothesis is statistically significant for each mode of transportation, this indicates the rejection of the null hypothesis and acceptance of the alternative one, which states that there are statistically significant differences between the two means of the answers before and during the COVID-19 and it was in favor of frequency of use before the pandemic.

As for the rest of the hypotheses H2, H3, and H4, the results varied according to the variables (gender, age, educational level, employment status, and income); for example, for H2, Chi-square

for gender and educational level are not statistically significant, which means that the respondents are not affected by these two variables during the assessment of the measures taken to limit the spread of coronavirus in transport modes. For H3, all tested variables showed statistically significant differences in the average respondents' answers to the items related to the rate of satisfaction with public transportation.

Finally, there are no statistically significant differences between the respondents' answers regarding the digital transformation and the use of e- (work, study, shopping and services) even after the end of the pandemic due to the variables (gender, education level, employment status (occupation), and family members) which indicate that the respondents' answers are not affected by such variables, while due to the variables (age and income) there are statistically significant differences between the respondents' answers, the directions and levels of favors are illustrated in detail in the research findings section for all such variables.

The mentioned factors that influenced the movements during the COVID-19 pandemic were interpreted by the strong relationship between the items, Kaiser-Meyer-Olkin (KMO), Approx. Chi-Square tests and the degree of freedom showed good EFA formulas and thus can be used for further analysis, and this explains why CFA was used to assess the model fitness. In summary, the EFA and CFA findings supported the critical factors that must be considered and incorporated for a transportation study to be comprehensive.

5. CONCLUSION

The world is still suffering from the consequences of the spread of the Coronavirus that affected various sectors, causing a great shock to the global economy and leading to a sharp shift in global growth rates for 2020 and 2021. This global shock is characterized by the comprehensiveness of its global spread and its non-occurrence in a specific geographical area, in addition to its persistence for a very long period, and the world may need to continue taking precautions and health measures, changing the normality of lifestyle.

Globally, the transport sector was halted during the first months of the pandemic, and historical analysis of previous health crises indicates that the transport sector will take a long time before it fully recovers. The changes that occurred in the transportation and mobility sector were the result of changes in lifestyle, mobility, and activities, even in the tendency of passengers to switch to different modes of transportation than they were before the pandemic.

Changes in mobility due to COVID-19 may last forever, not as temporary as previous crises; this can be accompanied by the desire for digital transformation due to the tremendous development of the IoT, AI, and communication systems that began to spread globally, supported by digital platform companies that have become in control of the global market and are now imposing their needs on global decision-makers.

5.1 Summary and Overall Conclusion

The overall purpose of the study was to establish a comprehensive study model that can be utilized for assessing the transportation modes during the pandemic, the objectives of the study were accomplished by following sequential steps; initially studying the factors that considered the main reasons behind making the necessary mobility decision, and this includes transport mode choice and activities, besides other direct and indirect indicators that are out of people's control such as the

digital transformation either in work or learning as well as the enforcement procedures and restrictions that applied all over the world.

The success of any research is determined by the objectives and assumptions set during the study process. Therefore, a comprehensive study should incorporate these highlighted objectives, and based on these findings, the hypothesized relationships were postulated for testing and evaluation; these appraisal approaches are needed to evaluate and make decisions more acceptably and beneficially. Accordingly, the main objectives were achieved, and the findings were listed.

In the study, I determined to compare Budapest and Amman according to changes in passenger mobility and transportation caused by the pandemic, frequency of use of each mode of transportation related to outdoor activities, compare the applied procedures and restrictions to limit coronavirus spread during mobility through different modes of transportation, the rate of satisfaction with public transportation, the digital transformation and the use of e- (work, study, shopping and services) even after the end of the pandemic. The results showed differences in mobility modes and passengers' behavior and desires in the two cities since the transport systems are unlike Budapest, which has a developed public transport system that meets the wishes of passengers; however, this wasn't a choice in Amman as most of the people use heavily individual means of transports such as private cars or taxis due to lack in public transport systems.

The major change in mobility in Budapest shows a negative shift in the use of public transport due to reduced activities because of the quarantine or as a precautionary measure to reduce the risk of catching the disease. Analysis the remotely working and studying was possible for the Budapest sample since the number of respondents who work or study partly online is large compared to Amman; this is reflected in the satisfaction of the online activities rating as it was high in Budapest compared to Amman, due to a lack of readiness in the digital infrastructure.

This section presents a conclusion drawn from the study either through the Exploratory Factor Analysis EFA or Confirmatory Factor Analysis CFA or from the description analysis; the conclusions were related to the objectives of the research as they were accomplished during the statistical analysis of the quantitative phase questionnaires.

First, EFA initial model is analyzed to achieve the objectives of the study results, to measure the degree of acceptance and the goodness of fit; then CFA with some adjustments was made to achieve a better model fit and to check the hypotheses, the classified categories and the checked value to determine the significance and acceptance level.

To determine the best combination of items, the developed models for the two cities achieved through several analyses process all of them were reliable and the factors and latent variables within the acceptable fit.

The hypotheses ranked based on the strongest impact models and best fit model from SEM, as well the values and path coefficient were used to assess the links between the estimated variables. Accordingly, all the values followed the proposed expectation of the impact of COVID-19 on transportation and mobility for each hypothesis.

After computing the measurement models and utilizing the fit statistics tests, the results show that the best fit models for Amman and Budapest are significant when joining each two hypotheses since it gave the strongest impact models as follows:

1- Model 1, consist of hypotheses H1 and H2; identify the relationship between COVID-19 and transport mode as the correlation between the difference in mobility for the same activities before and during the pandemic and the probability of catching the disease while using the different

transport modes; both hypotheses are statistically significant for Amman and Budapest as depicted the figures 2 and 3 below; by obtaining specific indexes and the p-value (probability) of less than 0.05 when applying for SEM the models were accepted, the findings revealed that the moderate degree of infection or catching the disease is the core factor influencing the respondents in deciding mobility and they matched the theoretical suggestions.

2- Model 2, consist of hypotheses H3 and H4; they have supported the assumptions and the results improved significantly by utilizing both hypotheses together the model evaluate the rate of satisfaction with PT and the using of digital transformation during the pandemic, it is essential to point out that the link is vital because generally most people are dis-satisfied with PT, especially in terms related to services, fare rate, or proximity to housing. The desire to keep studying and working remotely and providing e- services and facilitating transactions electronically are part of people's desire to decrease contact with others by staying away from PT which is considered a hotspot for virus transmit.

The comparison between Amman and Budapest for the first models showed that there is some harmony in the structure of the model for both cities, However, the second models of Amman and Budapest were different, which indicates that in Budapest, people are satisfied with public transportation, while in Amman, the top priority shall be providing a high-capacity public transportation system with highly efficient service quality in order to achieve customers satisfaction.

I surveyed with questionnaires the change in transport modes and mobility in the first degree and measured the terms of frequency of usage for each mode influenced by the type of outdoor activity and taking into account users' characteristics and from this, I developed models for the two cities after defining the hypothesis of the research, testing, and validating the factors through several analyses process using SPSS v.26 and AMOS software, which were found reliable, the models were run through EFA and CFA factor analysis to determine the best combination of items, factors and latent variables with the acceptable fit.

I came to the conclusion that the sample data and the evaluation of the hypothesis indicated that the people during the pandemic were involved directly and indirectly in new issues that should not be underestimated since such a pandemic had not been investigated previously, such factors may influence transportation decisions for long terms, this confirms that some enhancement to the performance of the PT sector should be done to face challenges in the later stages or any future pandemic.

The study established the factors that have a significant influence by adequately identifying the impact of COVID-19 on modes, mobility, and passenger satisfaction by using suitable statistical techniques and structural equation modeling.

The problem related to people's reluctance to use public transportation is required support from all involved parties, experts, and stockholders to achieve the tasks efficiently and effectively and to identify the potential risks and uncertainties that may crop up with serious issues as well as develop scenarios with several flexible alternatives that can be implemented when and where needed.

The study investigates the critical situation of the transportation sector during COVID-19 and the impact on mobility activities to support a reliable and promising method in the hands of decision-makers as a vital contribution to practice that will lead to a sustainability system that can face any possible pandemic.

5.2 Contribution and Achievements of the Study

The current research aimed to identify factors that should be considered in a comprehensive study of the transport sector during the influence of the COVID-19 pandemic.

After extensive research review and investigations of the previous studies that were tackled from both qualitative and quantitative perspectives, I found out that there is a missing case study framework that should contain a comprehensive model approach that can test the impact of the pandemic on the transportation sector by taking into account several factors at once including under control human factors and imposed emergency factors.

The major contribution of this research is that it followed a survey questionnaire to identify and validate the required processes using a holistic approach that comprises an individual's behavior, rates the effectiveness of the PT policy and compares the frequency of movement and mobility modes for various activities before and during the pandemic, in parallel, compare the applied procedures and restrictions to limit coronavirus spread during mobility through different modes of transportation, the rate of satisfaction with public transportation, the digital transformation and the use of e- (work, study, shopping and services) even after the end of the pandemic, such data was not available or documented by the authorities concerned with the transport sector in both countries. The current research analysis is needed and would be the first choice for mobility studies during any future pandemic if it occurred.

By analyzing the impact of the COVID-19 pandemic on the transportation sector and its sustainability, it can directly shape the performance of the public transportation sector during any stage of the pandemic.

In addition, the findings of the study, in light of the challenges and continuous updates that occur on the scene without enough risk management precautions, would ensure high preparations for an early alert system to handle critical and vagueness variables.

Further, as mentioned previously, the study contains indicators that connect the change in transport modes and mobility activities with the effectiveness and efficiency of the applied restriction to prevent the spread of the disease and link these with digital acceleration; this had not been investigated previously in one research, all of these are connected with the degree of satisfaction with the public transportation; however, these appraisal approaches are needed to evaluate projects and make decisions on the more acceptable and beneficial way.

The current study does support the previous studies, with a particular contribution that involves linking all aspects related to decision-making regarding the behavior of individuals towards transportation and mobility in a comprehensive and unified study that integrate models to reveal all the influential aspects; the study developed a mixed-methods and adopted several statistical techniques including using exploratory factor analysis, confirmatory factor analysis, and structural equation modeling, established models with significant factors and indicators which will enrich future research and influence decision making. Therefore, it is recommended to use similar testing studies of different reliable models to reach a sustainable transport system with continuous performance improvement.

5.3 Limitations and Future Research Recommendations

The study was conducted in two cities, Amman- Jordan, and Budapest- Hungary; similar studies could be undertaken in other cities to see if the results and priorities are different, although each city has its system of transportation as well the nature of sustainability criteria, fiscal constraints, topographical, and climatic characteristics.

Respondents were confused in their replies related to some questions during the pandemic as the restriction has changed several times during the past two years and became almost uncertain in forecasting the future. A further detailed study is needed to forecast the new trend of transportation and mobility, focusing on the digital transformation and smart city, based on the belief that most of the newly imposed restrictions and health measures remain even after the end of the pandemic.

Future research can assess and compare crisis management approaches among different countries when it comes to PT policy, and learned lessons can be benefited and generalized from successful approaches at a global level.

His study opens the door for more future research that could tickle the role that IT and digital technology can play in managing PT by using the internet of things (IoT), machine learning, artificial intelligence (AI), or any digital surveillance-system based on the behavior of people while dealing with PT in times of pandemic. Also, proceeding from the work towards achieving Sustainable Development Goals SDGs, the door is open for more attempts to achieve more of the 17th United Nations sustainable development goals (SDGs), which are: (1) No Poverty, (2) Zero Hunger, (3) Good Health and Well-being, (4) Quality Education, (5) Gender Equality, (6) Clean Water and Sanitation, (7) Affordable and Clean Energy, (8) Decent Work and Economic Growth, (9) Industry, Innovation and Infrastructure, (10) Reduced Inequality, (11) Sustainable Cities and Communities, (12) Responsible Consumption and Production, (13) Climate Action, (14) Life Below Water, (15) Life On Land, (16) Peace, Justice, and Strong Institutions, (17) Partnerships for the Goals.

Additionally, environmental factors should be considered in the future with further research, the current environmental effect cannot be determined nowadays because many characteristics are involved, but it is expected to be vital and significant in the future. Further study will validate the current model by taking a case study to investigate and establish a comprehensive performance reference with a full latent model, which was validated through the CFA; this will allow the test of the direct and indirect variables, which was the objective of the SEM.

It is essential to point out here that for future studies, it is possible to work on introducing more factors for study, whether economic or social, that were not taken in the current study, in addition to the environmental dimensions, to reduce harmful emissions that cause climate change, environmental pollution, global warming, ozone layer depletion, and much more eco-friendly and earth-friendly means, products, and equipment, which bear the responsibility of achieving sustainability for future generations, as well as focusing on the importance of educating citizens of all age on how seriously the current and upcoming stages in terms of adopting all possible means for prevention without complacency, this can be a global trend, taking into account the health and environmental dimension. Also, risk management studies and sustainable planning must take into consideration that new waves of the Coronavirus or any other viruses of similar effect may occur in the future.

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Abbreviations

ANOVA	Analysis of Variance
ASCE	American Society of Civil Engineers
BKK	Budapesti Közlekedési Központ (Budapest Centre for Transport)
CFA	Confirmatory Factor Analysis
EFA	Exploratory Factor Analysis
EPOMM	European Platform on Mobility Management
GAM	Greater Amman Municipality
H0	Null hypothesis

H1	Hypothesis 1
H2	Hypothesis 2
H3	Hypothesis 3
H4	Hypothesis 4
IEC	International Electrotechnical Commission
IUCN	International Union for Conservation of Nature
KMO	Kaiser-Meyer-Olkin
MD	Mahalanobis Distance
MDC	Multiple Discrete-Continuous
PT	Public Transportation
SDGs	the Sustainable Development
SEM	Structural Equation Modeling
VIF	Variance Inflation Factor

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Appendix (I)

Questionnaire – English Version

A-Gender

◯ Male
◯ Female

B-Age

◯ Less than 18
◯ 50-59
◯ 18-28
◯ 60-69
◯ 29-39
◯ More than 69
◯ 40-49

c-The current city of residence (City and District)

..……

D-Education

◯ High School or Less ◯ PhD
◯ Bachelor's Degree BA
◯ Master's Degree MS ◯ other

E-Are you?

◯ Student
◯ Working
◯ Studying and Working to
◯ Retired
◯ Unemployed

F-Do you Study or Work from home (Online)?

◯ Yes
◯ No
◯ Partially

G-Income in Euro / month (family income)

◯ Less than or equal 500 ◯ 2000 – 1501
◯ 1000 – 501 ◯ 2500 – 2001
◯ 1500 – 1001 ◯ more than 2500

H-Number of members living at home (including yourself)

◯

i-Has your place of residence changed during COVID-19

◯

k-Number of vehicles in the household (excluding bicycles)
before COVID-19 during COVID-19

Q2Percentage of transportation expenditure from the total family income
before COVID-19 during COVID-19

Q3What is the distance (Km) from your residence to your Work/Study place before COVID-19 during COVID-19

Q4How long (in Minutes) does it takes from your residence to your Work/Study place before COVID-19 during COVID-19

Q5. Work or Study: How often did you use each transport mode listed below to reach your Study Work place before and during the pandemic? If not student or not working please go to Q6

5days or more per week, 4days per week, 3days per week, 2days per week, 1days per week, 2or3 times per month, once or (less per) month
Never

WALK or ride a Bike (before COVID)
◯
WALK or ride a Bike (during COVID)
◯
Motorbike /Private car (before) COVID
◯
Motorbike /Private car (during) COVID
◯
Taxi services /auto sharing with or without other passengers (before) COVID
◯
Taxi services /auto sharing with or without other passengers during) COVID
◯
Bus /metro /tram /train (before) COVID
◯
Bus /metro /tram /train (during) COVID
◯

(Q6. Free time mobility): How often did you use each transport mode at your free time before and during the pandemic?

(Q7. Social mobility): How often did you use each mode for social mobility (without shopping) before and during the pandemic?

5days or more per week, 4days per week, 3days per week, 2days per week, 1days per week, 2or3 times per month, once or (less per) month
Never

WALK or ride a Bike (before COVID)
◯
WALK or ride a Bike (during COVID)
◯
Motorbike /Private car (before) COVID
◯
Motorbike /Private car (during) COVID
◯
Taxi services /auto sharing with or without other passengers (before) COVID
◯
Taxi services /auto sharing with or without other passengers (during) COVID
◯
Bus /metro /tram /train (before) COVID
◯

Bus /metro /tram /train (during) COVID

Q8. Buy essential goods: How often did you use each mode for essential shopping before and during the pandemic

(Q9. Buy non-essential goods): How often did you use each mode for non-essential shopping before and during the pandemic?

5days or more per week								
4days per week								
3days per week								
2days per week								
1days per week								
2or3 times per month once or(less per) month								
Never								
WALK or ride a Bike (before COVID)	○	○	○	○	○	○	○	○
WALK or ride a Bike (during COVID)	○	○	○	○	○	○	○	○
Motorbike /Private car (before) COVID	○	○	○	○	○	○	○	○
Motorbike /Private car (during) COVID	○	○	○	○	○	○	○	○

Taxi services /auto sharing with or without other passengers (before) COVID

Taxi services /auto sharing with or without other passengers (during) COVID

Bus /metro /tram /train (before) COVID	○	○	○	○	○	○	○	○
Bus /metro /tram /train (during) COVID	○	○	○	○	○	○	○	○

Q10How would you rate the PROBABILITY OF CATCHING COVID-19 from the use of the transport modes listed below

Extremely low, low, slightly, low, Average, Slightly high, High, Extremely high

Walk or Ride a bike							
	○	○	○	○	○	○	○
Motorbike /Private car							
	○	○	○	○	○	○	○
Taxi services /auto sharing; with or without other Passengers							
	○	○	○	○	○	○	○
Bus /metro /tram / train							
	○	○	○	○	○	○	○

Q11How would you rate your region's RESTRICTIONS on the transport mode listed below to limit the spread of COVID-19

Extremely low, low, slightly, low, Average, Slightly high, High, Extremely high

Walk or Ride a bike							
	○	○	○	○	○	○	○
Motorbike /Private car							
	○	○	○	○	○	○	○
Taxi services /auto sharing; with or without other Passengers							

○ ○ ○ ○ ○ ○ ○

Bus /metro /tram / train

○ ○ ○ ○ ○ ○ ○

Q12How long do you think it will take FOR THE TRANSPORTATION SYSTEM "to go back to normal" as it was before the pandemic

Between 1and 3 months
Between and 6 3 months
Between 6 and 12 months
Between and 18 12 months
Between 18 and 24 months
More than 24 months

In the city where you currently stay

○

In your country

○

In the world

○

Q13a.How satisfied are you with Public Transportation Modes? Please state the level of agreement with the following

Completely disagree Dis agree Slightly disagree Slightly agree Agree Completely agree

The journey time by public transport is reasonable

○ ○ ○ ○ ○ ○

Public transport trips are distributed over the day time

○ ○ ○ ○ ○ ○

There is a sufficient number of public transport for each line

○ ○ ○ ○ ○ ○

Public transport is on schedule

○ ○ ○ ○ ○ ○

I feel safe in the public transport mode

○ ○ ○ ○ ○ ○

I do not fear traffic accidents when I use public transportation

○ ○ ○ ○ ○ ○

Easley having a seat in public transportation

○ ○ ○ ○ ○ ○

More people will use public transportation in the future

○ ○ ○ ○ ○ ○

The transportation fare of the public transport is reasonable

○ ○ ○ ○ ○

A service for people with special needs is available at the stops and public transport stops and buses

○ ○ ○ ○ ○ ○

Q13b.How satisfied are you with Public Transportation services? Please state the level of agreement with the following

	Completely disagree	Dis agree	Slightly disagree	Slightly agree	Agree	Completely agree
The Stop station close to my residence	◯	◯	◯	◯	◯	◯
Waiting time at the stop station is acceptable	◯	◯	◯	◯	◯	◯
It is easy to get the necessary information about public	◯	◯	◯	◯	◯	◯
Public Transport offers good updated information when	◯	◯	◯	◯	◯	◯
The staff answered my inquiry correctly	◯	◯	◯	◯	◯	◯
I feel safe on public transport stop stations	◯	◯	◯	◯	◯	◯
Travelling with public transport is comfortable	◯	◯	◯	◯	◯	◯
Moving between modes of transportation is easy	◯	◯	◯	◯	◯	◯
Public transportation is modern	◯	◯	◯	◯	◯	◯
Public transportation is a beneficial to the society	◯	◯	◯	◯	◯	◯
I recommend others to travel by public transport	◯	◯	◯	◯	◯	◯
General facilities and services are available (umbrellas seats services, sanitation facilities, and tec.) are available	◯	◯	◯	◯	◯	◯

Q14From your point of view, remotely or partially (Studying) will continue in the future even after the end of this pandemic

◯ Completely disagree
◯ Disagree
◯ Slightly disagree
◯ Slightly agree
◯ Agree
◯ Completely agree

Q15From your point of view, remotely or partially (Working) will continue in the future even after the end of this pandemic

◯ Completely disagree
◯ Disagree
◯ Slightly disagree
◯ Slightly agree
◯ Agree
◯ Completely agree

Q16 From your point of view, the global acceleration toward digital transformation and the use of smart applications to obtain e-(payments, delivery, and services) will continue to grow even after the end of this pandemic

◯ Completely disagree
◯ Disagree
◯ Slightly disagree
◯ Slightly agree
◯ Agree
◯ Completely agree

Q17 From your point of view, the use of smart applications and e-(payments, and services) will have a positive impact on the quality of life in the future

◯ Completely disagree
◯ Disagree
◯ Slightly disagree
◯ Slightly agree
◯ Agree
◯ completely agree

Q18 Final Question; Do you have any thoughts or comments that you would like to share? (Optional answer)

.....

End of the survey, please answer all required questions to enable submit. Thank you for your time

Appendix (II)

Compare between samples

H1

Variable	Amman			Budapest		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Total before W	370	18.54	7.37	339	26.05	9.15
Total before C	370	17.70	9.80	339	20.47	9.97
Total before T	370	16.38	7.62	339	13.79	7.05
Total before B	370	15.36	7.07	339	24.23	9.25
Total During W	370	18.03	6.81	339	24.75	8.22
Total During C	370	16.29	8.61	339	18.96	9.21
Total During T	370	15.76	7.13	339	13.18	6.35

Total During B	370	14.88	6.52	339	21.64	9.12
Total before Al	370	67.98	23.99	339	84.54	22.08
Total During Al	370	64.96	22.46	339	78.54	21.20

H2

Variable	Amman			Budapest		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Total Q10 & Q11	370	28.16	7.53	339	28.07	6.57
Total Q10	370	14.47	4.48	339	13.50	3.23
Total Q11	370	13.68	5.39	339	14.57	4.93

H3

Variable	Amman			Budapest		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Total $Q13_a$	370	35.86	10.30	339	41.83	9.47
Total $Q13_b$	370	41.25	13.20	339	52.10	11.11
Total $Q13_{a\ \&\ b}$	370	77.12	21.90	339	93.93	19.59

H4

Variable	Amman			Budapest		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Total Q14 to Q17	370	15.84	3.98	339	16.77	4.47

Descriptive Statistics Amman

Descriptive Statistics, H1- Before

	N	Minimum	Maximum	**Mean**	Std. Deviation
Q5BeforeW	370	1.00	9.00	**2.6730**	2.23996
Q5BeforeC	370	1.00	9.00	**3.4892**	2.97344
Q5BeforeT	370	1.00	9.00	**4.1568**	3.23803
Q5BeforeB	370	1.00	9.00	**4.1514**	3.31602
Q6BeforeW	370	2.00	9.00	**3.5784**	2.22953
Q6BeforeC	370	2.00	9.00	**3.5054**	2.21506
Q6BeforeT	370	2.00	9.00	**3.0622**	1.85488
Q6BeforeB	370	2.00	9.00	**2.8135**	1.77313
Q7BeforeW	370	2.00	9.00	**3.4000**	2.03146
Q7BeforeC	370	2.00	9.00	**3.5216**	2.14029
Q7BeforeT	370	2.00	9.00	**3.0486**	1.81467
Q7BeforeB	370	2.00	9.00	**2.8297**	1.71101
Q8BeforeW	370	2.00	9.00	**4.3622**	2.28905

Q8BeforeB	370	2.00	9.00	**2.7919**	1.70204
Q9BeforeW	370	2.00	9.00	**4.5243**	2.10451
Q9BeforeC	370	2.00	9.00	**3.4432**	2.11800
Q9BeforeT	370	2.00	9.00	**3.0703**	1.93958
Q9BeforeB	370	2.00	9.00	**2.7730**	1.71312
Q8BeforeT	370	2.00	9.00	**3.0405**	1.83196
totaLbeforW	**370**	**9.00**	**45.00**	**18.5378**	**7.36688**
totaLbeforC	370	9.00	45.00	17.7054	9.80555
totaLbeforT	370	9.00	45.00	16.3784	7.61880
totaLbeforB	370	9.00	45.00	15.3595	7.06938
totaLbeforAl	370	37.00	180.00	67.9811	23.99226
Valid N (listwise)	370				

Descriptive Statistics, H1- During

	N	Minimum	Maximum	**Mean**	Std. Deviation
Q5DuringW	370	1.00	9.00	**2.7351**	2.27871
Q5DuringC	370	1.00	9.00	**3.3162**	2.73886
Q5DuringT	370	1.00	9.00	**4.0243**	3.16860
Q5DuringB	370	1.00	9.00	**4.1297**	3.29892
Q6DuringW	370	2.00	9.00	**3.3892**	2.12353
Q6DuringC	370	2.00	9.00	**3.2189**	2.02107
Q6DuringT	370	2.00	9.00	**2.8838**	1.66748
Q6DuringB	370	2.00	9.00	**2.6378**	1.49749
Q7DuringC	370	2.00	9.00	**3.1541**	1.83479
Q7DuringW	370	2.00	9.00	**3.1919**	1.89234
Q7DuringB	370	2.00	9.00	**2.7135**	1.58040
Q7DuringT	370	2.00	9.00	**2.9135**	1.69267
Q8DuringW	370	2.00	9.00	**4.3514**	2.16421
Q8DuringC	370	2.00	9.00	**3.4838**	2.11742
Q8DuringT	370	2.00	9.00	**2.9730**	1.73106
Q8DuringB	370	2.00	9.00	**2.6892**	1.53836
Q9DuringW	**370**	**2.00**	**9.00**	**4.3595**	**2.04502**
Q9DuringC	370	2.00	9.00	**3.1162**	1.85081
Q9DuringT	370	2.00	9.00	**2.9676**	1.80905
Q9DuringB	370	2.00	9.00	**2.7081**	1.64496
totaLDuringW	**370**	**9.00**	**45.00**	**18.0270**	**6.80820**
totaLDuringC	370	9.00	45.00	**16.2892**	8.61367
totaLDuringT	370	9.00	45.00	**15.7622**	7.13309
totaLDuringB	370	9.00	45.00	**14.8784**	6.51651

totaLDuringAl	370	36.00	180.00	**64.9568**	22.46161
Valid N (listwise)	370				

Descriptive Statistics, H2

	N	Minimum	Maximum	**Mean**	Std. Deviation
Q10Walk	370	1.00	7.00	**2.7757**	1.64653
Q10Car	370	1.00	7.00	**2.5946**	1.54883
Q10Taxi	370	1.00	7.00	**4.1919**	1.40785
Q10Bus	**370**	**1.00**	**7.00**	**4.9108**	**1.55657**
Q11Walk	370	1.00	7.00	**3.1405**	1.58130
Q11Car	370	1.00	7.00	**3.3514**	1.58783
Q11Taxi	370	1.00	7.00	**3.5784**	1.52684
Q11Bus	370	1.00	7.00	**3.6135**	1.64105
TotalQ10	370	4.00	28.00	**14.4730**	4.48250
TotalQ11	370	4.00	28.00	**13.6838**	5.38693
TOTALQ10andQ11	370	8.00	52.00	**28.1568**	7.53185
Valid N (listwise)	370				

Descriptive Statistics, H3

	N	Minimum	Maximum	Mean	Std. Deviation
Q13a.1	370	1.00	6.00	3.4297	1.30111
Q13a.2	370	1.00	6.00	3.6405	1.19981
Q13a.3	370	1.00	6.00	3.5297	1.30267
Q13a.4	370	1.00	6.00	3.4405	1.36268
Q13a.5	370	1.00	6.00	3.7000	1.29592
Q13a.6	370	1.00	6.00	3.5946	1.35069
Q13a.7	370	1.00	6.00	3.5405	1.29403
Q13a.8	370	1.00	6.00	3.8541	1.25385
Q13a.9	**370**	**1.00**	**6.00**	**3.8568**	**1.17264**
Q13a.10	370	1.00	6.00	3.2784	1.44298
q13b.1	370	1.00	6.00	3.2865	1.42151
q13b.2	370	1.00	6.00	3.2838	1.34467
q13b.3	370	1.00	6.00	3.3459	1.37113
q13b.4	370	1.00	6.00	3.2946	1.42841
q13b.5	370	1.00	6.00	3.4243	1.36981
q13b.6	370	1.00	6.00	3.5946	1.31614
q13b.7	370	1.00	6.00	3.4351	1.35245
q13b.8	370	1.00	6.00	3.4351	1.30347
q13b.9	370	1.00	6.00	3.4865	1.29040

q13b.10	**370**	**1.00**	**6.00**	**3.9405**	**1.21273**
q13b.11	370	1.00	6.00	3.5595	1.29120
q13b.12	370	1.00	6.00	3.1649	1.36044
TOTALQ13.a.b.	370	22.00	123.00	77.1162	21.90173
TOTALQ13a	370	10.00	60.00	35.8649	10.30211
TOTALQ13b	**370**	**12.00**	**72.00**	**41.2514**	**13.20914**
Valid N (listwise)	370				

Descriptive Statistics,H4

	N	Minimum	Maximum	Mean	Std. Deviation
Q14StudyOnline	370	1.00	6.00	2.7378	1.89248
Q15WorkOnline	370	1.00	6.00	2.5432	1.79868
Q16Digital	**370**	**1.00**	**6.00**	**5.2946**	**1.18126**
Q17Life with digital	370	1.00	6.00	5.2730	1.21132
TOTALQ14toQ17	370	4.00	24.00	15.8405	3.98221
Valid N (listwise)	370				

Results of H2 Amman

Variable	N	Mean	Std. Deviation
Gender			
Male	196	28.55	7.73
Female	174	27.71	7.30
Total	370	28.16	7.53
Education level			
High School or Less	160	28.49	7.33
Bachelor's Degree	156	27.35	7.31
Master's Degree	28	29.18	9.63
Ph.D.	12	30.83	6.74
Other	14	29.00	8.08
Total	370	28.16	7.53

Results of H3 Amman

Variable	N	Mean	Std. Deviation
Gender			
Male	196	82.45	20.28
Female	174	71.10	22.16
Total	370	77.12	21.90
Education level			
High School or Less	160	84.49	19.80
Bachelor's Degree	156	72.93	22.30
Master's Degree	28	62.64	19.58
Ph.D.	12	59.33	19.22
Other	14	83.64	10.53
Total	370	77.11	21.90
Occupation			
Student	74	72.28	21.98
Working	196	79.10	21.89
Studying and Working together	8	60.00	21.46
Retired	24	68.21	19.34
Unemployed	68	81.81	20.51
Total	370	77.12	21.90
Income			
< 500 Euro	212	84.27	20.00
501 - 1000 Euro	97	67.78	22.05
1001 - 1500 Euro	33	70.39	17.50
1501 - 2000 Euro	12	66.42	20.33
2001- 2500 Euro	8	61.37	23.13
>2500 Euro	8	60.25	14.08
Total	370	77.12	21.90

Results H4 Amman

Variable	N	Mean	Std. Deviation
Gender			
Male	196	15.69	4.13
Female	174	16.00	3.81
Total	370	15.84	3.98
Age			

less than 18	39	17.49	4.04
18-28	111	15.60	3.97
29-39	76	16.28	3.83
40-49	69	15.06	3.89
50-59	45	15.98	4.340
60-69	28	14.86	3.43
More than 69	2	18.00	2.83
Total	370	15.84	3.98
Education level			
High School or Less	160	15.75	4.24
Bachelor's Degree	156	15.52	3.88
Master's Degree	28	17.18	3.178
Ph.D.	12	17.75	3.65
Other	14	16.07	3.12
Total	370	15.84	3.98
Occupation			
Student	90	16.41	4.00
Working	190	15.73	4.00
Studying and Working together	9	15.78	3.90
Retired	25	16.72	3.86
Unemployed	56	14.91	3.85
Total	370	15.84	3.98
Income			
< 500 Euro	21	15.14	3.78
501 - 1000 Euro	97	16.50	4.06
1001 - 1500 Euro	33	16.79	3.51
1501 - 2000 Euro	12	18.25	4.88
2001- 2500 Euro	8	15.12	5.36
>2500 Euro	8	19.50	2.93
Total	370	15.84	3.98
Size of family			
1	14	15.64	3.27
2	38	15.81	4.16
3	31	16.29	4.47
4	75	15.56	3.76
5 or more	212	15.89	4.02
Total	370	15.84	3.98

Results H2 Budapest

Variable	N	Mean	Std. Deviation
Gender			
Male	172	26.96	6.83
Female	167	29.21	6.10
Total	339	28.07	6.57
Education level			
High School or Less	22	30.04	4.53
Bachelor's Degree	115	29.82	5.47
Master's Degree	106	27.00	6.84
Ph.D.	60	24.27	6.66
Other	36	30.80	6.58
Total	339	28.07	6.57

Results H3 Budapest

Variable	N	Mean	Std. Deviation
Gender			
Male	172	89.67	21.06
Female	167	98.30	16.93
Total	339	93.93	19.59
Education level			
High School or Less	22	80.04	16.96
Bachelor's Degree	115	99.40	14.20
Master's Degree	106	89.42	21.68
Ph.D.	60	95.33	23.63
Other	36	95.80	15.43
Total	339	93.93	19.59
Occupation			
Student	100	93.40	22.06
Working	139	94.63	17.42
Studying and Working together	61	90.18	21.53
Retired	1	60.00	.

Unemployed	38	99.63	15.21
Total	339	93.93	19.59
Income			
< 500 Euro	47	93.45	22.21
501 - 1000 Euro	112	94.29	20.50
1001 - 1500 Euro	47	97.13	18.78
1501 - 2000 Euro	45	89.91	17.89
2001- 2500 Euro	31	85.39	17.74
>2500 Euro	57	98.77	16.82
Total	339	93.93	19.59

Results H4 Budapest

Variable	N	Mean	Std. Deviation
Gender			
Male	172	16.73	4.40
Female	167	16.81	4.55
Total	339	16.77	4.47
Age			
less than 18	11	16.36	2.20
18-28	81	19.11	3.30
29-39	129	16.02	4.99
40-49	65	16.08	3.13
50-59	43	16.49	5.58
60-69	10	13.60	2.46
Total	339	16.77	4.47
Education level			
High School or Less	22	17.27	3.15
Bachelor's Degree	115	15.83	5.18
Master's Degree	106	18.17	3.44
Ph.D.	60	17.82	3.25
Other	36	13.58	5.02
Total	339	16.77	4.47
Occupation			
Student	100	18.29	2.87
Working	139	15.68	4.74
Studying and Working together	61	18.72	3.59
Unemployed	39	13.72	5.32
Total	339	16.77	4.47

Income			
< 500 Euro	47	18.42	3.35
501 - 1000 Euro	112	17.10	4.55
1001 - 1500 Euro	47	16.45	3.25
1501 - 2000 Euro	45	17.42	3.19
2001- 2500 Euro	31	18.13	2.94
>2500 Euro	57	13.77	6.00
Total	339	16.77	4.47
Size of family			
1	57	17.65	3.70
2	79	16.82	4.45
3	81	17.89	3.72
4	88	14.54	5.26
5 or more	34	18.26	2.84
Total	339	16.77	4.47

Appendix (III)

Hypothesis H1

Levene's Test of Equality of Error Variances[a]

Dependent Variable: TOTALall

F	df1	df2	Sig.
2.377	149	220	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Gender + Age + Education + Occupation + Income

Hypothesis H 2

Levene's Test of Equality of Error Variances[a]

Dependent Variable: TOTALQ10andQ11

F	df1	df2	Sig.

1.365	161	208	.017

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Gender + Educatin + Income + Age + Ocupation

Tests of Between-Subjects Effects

Dependent Variable: TOTALQ10andQ11

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1649.816[a]	20	82.491	1.493	.081
Intercept	30996.999	1	30996.999	561.007	.000
Gender	.247	1	.247	.004	.947
Educatin	197.127	4	49.282	.892	.469
Income	603.972	5	120.794	2.186	.055
Age	586.095	6	97.683	1.768	.105
Ocupation	122.584	4	30.646	.555	.696
Error	19283.092	349	55.252		
Total	314270.000	370			
Corrected Total	20932.908	369			

a. R Squared = .079 (Adjusted R Squared = .026)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
TotalQ10	Between Groups	12.762	1	12.762	.635	.426
	Within Groups	7401.468	368	20.113		
	Total	7414.230	369			

TotalQ11	Between Groups	20.040	1	20.040	.690	.407
	Within Groups	10687.963	368	29.043		
	Total	10708.003	369			
TOTALQ10andQ11	Between Groups	64.786	1	64.786	1.142	.286
	Within Groups	20868.122	368	56.707		
	Total	20932.908	369			

Hypothesis H 3

Levene's Test of Equality of Error Variances[a]

Dependent Variable: TOTALQ13.a.b.

F	df1	df2	Sig.
1.103	154	215	.254

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Age + Education + Ocupation + Income + Gender

b.

Tests of Between-Subjects Effects

Dependent Variable: TOTALQ13.a.b.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	51919.577[a]	20	2595.979	7.243	.000
Intercept	158791.966	1	158791.966	443.048	.000
Age	6154.243	6	1025.707	2.862	.010
Education	13191.661	4	3297.915	9.202	.000
Ocupation	1687.921	4	421.980	1.177	.320

Income	6249.213	5	1249.843	3.487	.004
Gender	1858.497	1	1858.497	5.185	.023
Error	125084.426	349	358.408		
Total	2377361.000	370			
Corrected Total	177004.003	369			

a. R Squared = .293 (Adjusted R Squared = .253

Hypothesis H4

Levene's Test of Equality of Error Variances[a]

ependent Variable: TOTALQ14toQ17

F	df1	df2	Sig.
.921	161	208	.708

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Gender + Educatin + Income + Age + Ocupation

Tests of Between-Subjects Effects

Dependent Variable: TOTALQ14toQ17

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	617.829[a]	20	30.891	2.060	.005
Intercept	10687.290	1	10687.290	712.654	.000
Gender	8.997	1	8.997	.600	.439

Educatin	56.778	4	14.194	.947	.437
Income	202.476	5	40.495	2.700	.021
Age	134.967	6	22.494	1.500	.177
Ocupation	46.945	4	11.736	.783	.537
Error	5233.763	349	14.996		
Total	98693.000	370			
Corrected Total	5851.592	369			

a. R Squared = .106 (Adjusted R Squared = .054)

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