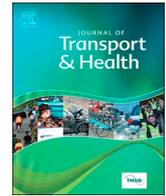


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## Journal of Transport &amp; Health

journal homepage: [www.elsevier.com/locate/jth](http://www.elsevier.com/locate/jth)

## Transport barriers and its health implications in Asunción

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## A B S T R A C T

**Introduction:** Asunción is the capital of Paraguay, a landlock country in South America. The level of urbanisation in the city is increasing at a fast rate without proper planning. Local transport problem-symptoms can be related to health issues in the city, yet there are no official studies. This is a pioneering work describing transport-and-health-links in Asunción city.

**Scope:** Transport-and-health-links in Asunción in relation to the international context are investigated. Local transport problem-symptoms affecting health are identified and discussed based on impact on physical activity, space usage, air pollution, and noise pollution. A comprehensive framework for future empirical research and planning is proposed, and policies and recommendations are given.

**Findings:** Asunción city and peripheral areas have high rates of private vehicle usage – triggered by fast-growing urban sprawl and city population – as well as low levels of public transport service. Virtually no collaboration between transport and health authorities/planners has been identified. Infrastructure has greatly favoured usage of private vehicles, and the rate of obesity is increasing in the country and over 30% of the population have very high levels of physical inactivity. Barriers that hold back progress in transport (and could positively affect health) are identified. For the way forward, key considerations to improve polarised perceptions of users regarding private vehicle usage and lack of awareness regarding benefits and externalities of different modes of transport are indicated. In addition, suggestion of young adults on alternative usage of spaces to enhance active mobility are mentioned.

## R E S U M E N

**Introducción:** Asunción es la capital de Paraguay, un país sin salida al mar en América del Sur. El nivel de urbanización en la ciudad está aumentando a un ritmo rápido y sin una planificación adecuada. Los síntomas del problema del transporte local pueden relacionarse con los problemas de salud en la ciudad, sin embargo, no hay estudios oficiales. Este es un trabajo pionero en describir la conexión entre transporte y salud en la ciudad de Asunción.

**Alcance:** La conexión entre transporte y salud en Asunción es investigada en relación al contexto internacional. Los síntomas del problema de transporte local que afectan a la salud son identificados y discutidos en función del impacto en la actividad física, el uso del espacio, la contaminación del aire, y la contaminación sonora. Se propone un marco integral para la futura investigación empírica y la planificación, proponiendo recomendaciones de planeamiento.

**Hallazgos:** La ciudad de Asunción y las zonas periféricas tienen altos índices de uso de vehículos privados. Esto es provocado por la creciente expansión urbana y poblacional de la ciudad, así como los bajos niveles de servicio de transporte público. No se identificaron colaboraciones entre autoridades/planificadores de transporte y salud. La infraestructura local ha favorecido enormemente el uso de vehículos privados, la tasa de obesidad está aumentando en el país, y más del 30% de la población tiene niveles muy altos de inactividad física. Barreras que limitan el progreso (progreso que podría afectar positivamente a la salud) en el transporte fueron identificadas. Respecto al rumbo futuro, se indican consideraciones claves para mejorar las percepciones polarizadas de los usuarios respecto al uso de vehículos privados y la falta de conciencia sobre los beneficios e impactos de los diferentes modos de transporte. También se mencionan sugerencias de adultos jóvenes sobre el uso alternativo de espacios para mejorar la movilidad activa.

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Received 23 October 2018; Received in revised form 20 June 2019; Accepted 20 June 2019

Available online 29 June 2019

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## RESUMO

**Introdução:** Assunção é a capital do Paraguai, um país sem litoral na América do Sul. O nível de urbanização na cidade está aumentando rapidamente, porém sem um planejamento adequado. Os sintomas das dificuldades de transporte local podem estar relacionados à problemas de saúde na cidade, mas ainda não há estudos oficiais. Este é um trabalho pioneiro que descreve a conexão entre transporte e saúde na cidade de Assunção.

**Escopo:** A conexão entre transporte e saúde em Assunção é investigada em relação ao contexto internacional. Os sintomas do problema de transporte local que afetam a saúde são identificados e analisados com base no impacto sobre a atividade física, o uso dos espaços, a poluição do ar e a poluição sonora. Uma estrutura abrangente para pesquisa e planejamento empírico futuro são propostos, bem como políticas e recomendações.

**Resultados:** A cidade de Assunção e suas áreas periféricas têm altas taxas de uso de veículos particulares, desencadeadas pela crescente expansão urbana e populacional da cidade, bem como baixos níveis de serviço de transporte público. Não foram identificadas colaborações entre autoridades e/ou planejadores de transporte e de saúde. A infraestrutura local tem favorecido muito o uso de veículos particulares, a taxa de obesidade está aumentando no país e mais de 30% da população tem níveis muito altos de inatividade física. Barreiras que impedem o progresso no transporte (e que podem afetar positivamente a saúde) foram identificadas. Com relação ao futuro, são indicadas as principais considerações para melhorar as percepções polarizadas dos usuários em relação ao uso de veículos particulares e a falta de conscientização sobre benefícios e impactos dos diferentes modos de transporte. Além disso, são mencionadas sugestões de jovens adultos sobre o uso alternativo de espaços para melhorar a mobilidade ativa.

## 1. Introduction

Urban planning is getting evermore comprehensive as authorities are aiming to develop liveable cities with good mobility, spaces for social interaction, and high level of health (Lee, 2010; Meng et al., 2015; Sheller and Urry, 2000). In recent years, many researchers have investigated the links between transport and health, and it has been affirmed that aspects of transport planning can help to also create a healthy city (Pucher and Buehler, 2010; Rydin, 2012). Transport has effects in space usage, air and noise quality, and levels of physical activity, and these affect personal and social health (Rydin et al., 2012). While motorised transport has mostly negative effects, active (e.g. walking and cycling) and public modes of transport can reduce them (Batty et al., 2015; Litman, 2009; Pizarro et al., 2013; Pucher and Buehler, 2010; Urry, 2004).

A shift in transport planning, from private motorised transport to sustainable and space efficient modes of transport which can yield benefits to individuals and the society (Carver et al., 2014; Goodman et al., 2014; Ibrahim, 2003; Oliver et al., 2015) began around 4 decades ago (Kuzmyak et al., 2014; Sagaris, 2015; Wedderburn, 2015). The Netherlands and Denmark, among other European counties/cities, have been leading the shift away from motorised transport to high walking and especially cycling rates, coupled with human centric urban planning, and well-connected transport systems (Gössling et al., 2016; Pucher and Buehler, 2008). Several countries/cities in Asia, and America are also investing in public transport, and developing schemes to promote active mobility (Buliung et al., 2009; de Sá et al., 2015a; Koh et al., 2011; Poyil et al., 2017; Replogle, 1991; Timperio et al., 2006).

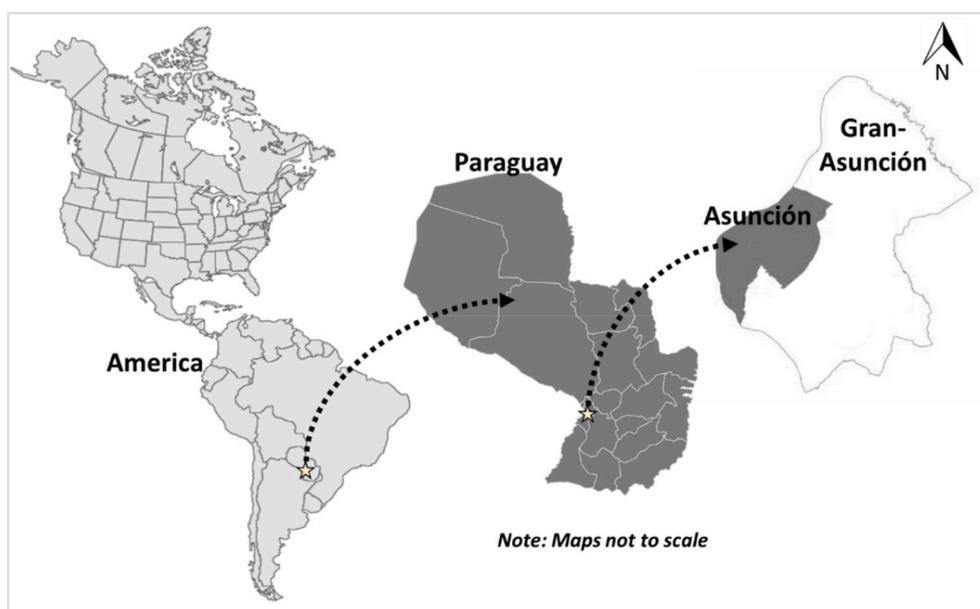


Fig. 1. Paraguay, Assunção, and Gran-Asunção maps (adapted from PLANCHA, 2016a).

Approaches and standards are constantly being adapted in response to the evolving needs of inhabitants and attendant interactions with the urban and transport systems (Sagaris, 2015).

In Latin American countries, investments in public and active modes of transport are more prominent in the capital and/or big urbanised cities where population agglomerates at increasingly fast rates (de Sá et al., 2015b; Siemens, 2010). However, this is not always true for all the countries/cities in the region. Asunción is the capital city of Paraguay, located in the centre of the South American continent. The city and overall country have high rates of private vehicle usage, triggered by the fast-growing urban sprawl and city population. In addition, different types of barriers regarding improving transport conditions exist in Asunción and peripheries. Herein, progress appears to be possible/ongoing, yet other external situations are holding back progress and these have effects in health levels in the city. These barriers are investigated in this article.

Following this introductory section, an overview of Asunción city is given, and the methodology of the study is presented. This is followed by a summary of the most common transport-and-health-links in the international context. Then, these links are translated into the local context and the developments related to transport and health in Asunción are presented, followed by a discussion on the perceptions regarding the way forward to address existing barriers. Afterwards, a framework for future empirical research (in Asunción and/or cities facing similar issues) is proposed. A summary of key findings and discussion of related factors concludes the article.

## 2. City overview and study methodology

Asunción is the capital of Paraguay, a landlock country located in the centre of South America (WB, 2017). Initially, the city was developed facing the river which, in time, has begotten horizontal urban sprawl and fast development of peripheral cities (Gran-Asunción area) – See Fig. 1. Overall, Paraguay presents a positive economic development, with an average 5% economic increase per annum in the last decade. Around 50% of Paraguay's GDP is produced in Asunción and Gran-Asunción areas. Economic development is based on exploitation of natural resources, with agriculture (mainly soy production and commercialisation) being the economic driving force of the country (WB, 2017).

Cities in Latin America are increasing their level of urbanisation faster than North American and European cities, and it is expected that by 2025, 85% of Latin America population shall live in urbanised areas (Becerra et al., 2013). In Paraguay, approximately 60% of the population are living in urbanised areas. Urbanisation is more prominent in Asunción and Gran-Asunción which, within an area of less than 1% of the country total (117 km<sup>2</sup> of total 406,757 km<sup>2</sup>), hosts over 50% the country's population (3.9 million of total 7 million inhabitants) (Daunas, 2017; PLANCHA, 2016). The quick urbanisation in Latin American cities, mainly in the capitals, is often disorganised, which poses challenges to meet economic, urban (e.g. housing and transport), environmental, and social needs (BBC World, 2018; Cervero and Kockelman, 1997; Dimitriou, 2006), which has thus affected transport and health conditions.

Internationally, many urban links between transport and health have been drawn up (Rydin et al., 2012), yet there is limited published research regarding transport and health in Asunción. To address this gap, the following research questions are considered in this study:

- As compared to the international context, what are the transport and health developments in Asunción?
- To what extent are the effects of transport situations on health levels of Asunción studied and documented? and
- How can the most common transport problem-symptoms that affect health in Asunción be improved?

To address these issues, international research works regarding transport-and-health-links (i.e. clear connections between transport and health that have been identified in the literature) were reviewed and summarised considering pointers on what make urban cities healthy (Rydin et al., 2012). Special interest was placed in the links identified in the South American context. Then, the local context was examined taking a multi-level perspective (Geels et al., 2012), where most attention has been placed in the city layout, infrastructure, and services. This examination is used to identify the local transport problem-symptoms (related to negative externalities of different modes of transport) affecting health. The study also discusses the local developments regarding these problem-symptoms and the (many times unacknowledged) barriers identified, as well as the general perceptions of the way forward. The findings are compiled in a framework for future empirical research, and policies recommendations are also given.

## 3. Common transport-and-health-links

Collaboration between transport and health researchers and planners has increased in recent years and the relationship between these two areas is ever more evident. The links between transport and health can be classified into 4 main categories based on the impacts of different modes of transport on: physical activity, space usage, air quality, and noise levels (Gössling et al., 2016; Götschi et al., 2017; Larouche et al., 2014; Rydin et al., 2012). Most research points to the negative externalities of private motorised transport, and how these can be alleviated with increased usage of active modes and public transport.

A decrease in physical activity has been related to the growing population of motorised vehicles (Laguna Nieto et al., 2011; Morency and Demers, 2010; VIC Health, 2010). This has negative effects on physical (e.g. obesity, high blood pressure, heart disease, and respiratory problems (Cohen et al., 2014; Fraser and Lock, 2011)) and mental health (e.g. depression and anxiety (Ermagun and Samimi, 2015; Tolley, 1990)). The symptoms are exacerbated in countries where people spent much time in the traffic. It has been reported that in urbanised cities in Latin America, people spend around 80 h per year in traffic (Becerra et al., 2013; INRIX, 2017),

and these rates are even higher than those of San Francisco and London – 79hrs and 74hrs, respectively (INRIX, 2017). It has also been reported that more than half of Latin American population is over-weight and/or do not meet the recommended amount of daily physical activity (Becerra et al., 2013; de Sá et al., 2015a).

Moreover, as motorised transport requires specific infrastructure, usage of space has also been affected with the growing population of motorised vehicles. This has had negative impact in cases when urban (and road) expansion occurred disorderly and without proper planning as in many countries in South America (Becerra et al., 2013; DGEEC, 2015). Many cities have been focusing on “car-oriented planning” and disregarding provision for people and thus active mobility. Highway provision and public transport infrastructure can create community severance (barrier effect that occurs when transport infrastructure prevents/hinders people's mobility to/from different sectors (Ogilvie et al., 2004; Wright, 2005)), which can lead to social problems such as social segregation (Barter, 1999; Cohen et al., 2014; Mindell and Karlsen, 2012). Several rail lines in Latin America and even the TransMilenio (bus rapid system in Bogota, Colombia) buses run in segregated roads, and they can cause severance (Rui, 2018).

Motorised transport also affects air and noise pollution levels in a country. Indeed, research has indicated that traffic is one of the major contributors of pollutants in the environment (Cepeda et al., 2017), and that majority of city noises is related to traffic (Cohen et al., 2014; Koh et al., 2012). Exposure to air pollution can cause and/or exacerbate respiratory diseases such as asthma, while noise pollution can affect mental health (Cepeda et al., 2017). Ironically, research has indicated that, while motorised vehicles are the major emitters of air and noise pollutants, active mobility users are the most exposed users and the ones who inhale the higher doses of pollutants. That said, it has also been indicated that the benefits derived from walking or cycling are higher than the risks from pollutants exposition (Cepeda et al., 2017; Tight et al., 2011).

Active mobility and public transport usage (which entails some forms of active mobility for first/last-mile (FLM) trip stages) can increase physical activity yielding health benefits. Provision for active modes can result in the transport network becoming more inclusive (accessible by different types of users including, children, elders, and users with special needs), and this enhances social cohesion. Moreover, active modes are quiet and emission-free modes of transport and thereby can alleviate pollution levels. Public transport can also help to reduce pollution by reducing the number of private vehicles on the roads (Batty et al., 2015; Litman, 2009; Pizarro et al., 2013; Pucher and Buehler, 2010; Rojas López and Wong, 2017a). Cities in Chile, Brazil, and Colombia have invested in enhancing the walking environment and have provided cycling infrastructure. This has generally resulted in improvements in mobility, health levels, and social interaction in the cities (Becerra et al., 2013; Certero et al., 2009; de Sá et al., 2015b; Sagaris, 2015).

#### 4. Transport and health in Asunción

The tendency to consider transport and health individually is still present in many countries in Latin America, including Paraguay. While much research has highlighted and affirmed that these topics are inter-related (Carver et al., 2008; Marshall et al., 2014; Preston and Rajé, 2007; Procter et al., 2017), the link is still weak in Paraguay. Indeed, virtually no research, to the best of authors' knowledge, exists linking transport and health in Asunción and Gran-Asunción areas. Transport planning developments (including traffic regulations) are handled by the National Transport Directorate (Dirección Nacional de Transporte – DINATRA), the development of physical infrastructures such as roads, viaducts, etc. is handled by the Ministry of Public Works and Communications (Ministerio de Obras Públicas y Comunicaciones – MOPC) with DINATRA's guidance, and traffic enforcement is handled by the National Police. The Ministry of Public Health and Social Welfare (Ministerio de Salud Pública y Bienestar Social – MSPyBS) is the entity that handles social and health services in Paraguay. The authors have not encountered projects being handled in collaboration with transport and health entities.

By a glance on the common diseases in urbanised areas such as Asunción and Gran-Asunción, many can be related to the high rates of private vehicle usage. One of the main health issues is the increased rate of obesity, especially among school-aged children and adolescents (PAHO & WHO, 2017). Moreover, statistics have also revealed that circulatory problems (19%), diabetes (8%), vascular diseases (8%), and respiratory diseases (6%) are among the leading causes of death, especially in urban areas, in Paraguay (PAHO & WHO, 2017). The mentioned health issues and diseases can be related to lifestyle and environmental conditions in the area, where almost 30% of the population have limited physical activity participation (Cañete et al., 2017). The conditions are exacerbated considering that in Asunción, there are barriers and lack of abiding regulations, thereby stopping or slowing improvements in the

**Table 1**  
Transport issues in Asunción and related health-link by category.

|                  | Health-links based on effects on:   |                              |  |              |
|------------------|---|------------------------------|--|--------------|
|                  | Physical activity   | Space usage                  | Air quality  | Noise levels |
| Transport issues | High usage of private motorised transport                                     | Roads widening               | Elevated number of motorcycles<br>Many diesel vehicles |              |
|                  |   | Bad public transport service | Lack of control & regulations                          |              |
|                  | Public areas in bad conditions<br>Uneven pathways<br>Randomly parked vehicles |                              |  |              |

transport area. Many transport issues exist in Asunción, herein only the most pressing ones and those that are deemed to have higher impact on health are presented. The main transport issues and related health links are presented in [Table 1](#) and these are elaborated next.

Transport infrastructure developments have favoured the use of private cars. In the past 10 years, massive roads widening and introduction of viaducts and tunnels to improve road traffic have been undertaken in Asunción and Gran-Asunción areas. These developments are mainly focussed on private vehicle users as there are limited provisions of bus lanes or pedestrians' crossings ([MOPC, 2017a](#); [PLANCHA, 2016](#)). In many cases, roads are not well-maintained causing lane delineation paint to fade and/or appearance of potholes, which affect traffic flow and road safety. Such is an example of institutional barriers limiting progress. Where transport infrastructural investments are being made, maintenance of assets and enforcement of proper usage are disregarded, thereby negatively affecting usage of space.

Together with the rising urban and population rates, the number of private vehicles has also been growing alarmingly in Asunción and Gran-Asunción areas ([Lescano Barreto, 2018](#)). Regardless the alarming rate, there is no public available information about future policies or measures to restrain such growth. Today, due to the high number of cars, pick-up trucks, and mainly motorcycles, as well as inadequate infrastructure provision, congestion occurs readily ([Daunas, 2017](#)). As presented in the previous section, vast amount of literature has suggested that high usage of private motorised transport results in greater physical inactivity, which in turn affects health issues and diseases ([Lambiase et al., 2010](#)).

Moreover, it is relatively easy for inhabitants to access private vehicles as motor companies, and even the government ([La Nacion, 2017](#)), offer easy financing plans and the additional registration costs are not high. In many cases, people opt for second-hand vehicles, some of which are not in good operating conditions ([Economia, 2013](#); [La Nacion, 2017](#)). These have negative effects on emissions and noise level, which reach very high levels during morning and evening peak periods due to congestions. Moreover, the fact that obtaining a driving licence in Paraguay is easy, increases the desire for private vehicles ([GMA, 2016](#)), even though obtaining a driving licence does not mean drivers are fit to drive ([Upahita et al., 2018](#)). In Asunción and Gran-Asunción areas, many users not only flout traffic rules and traffic controls thereby increasing the accident risks, but also constantly honk their horns even for small matters – which further exacerbates noise pollution. There are no schemes aimed to improve traffic congestions and the outdated traffic signals do not ameliorate the situation. In addition, traffic regulations enforcement is rare, and sanctions are usually minimal.

Regarding public transport, bus service is practically the only public transport mode in Asunción and Gran-Asunción areas, yet they operate in a disorderly manner by not respecting schedules, nor following established stops. In 2010, the ratio of public and private transport usage, as the primary mode of transport, was close to 50-50 and is very likely that the rates have further shifted towards the greater use of private vehicles in recent years ([ABC, 2017](#); [PLANCHA, 2018](#)). The rates of active modes of transport differ across Latin American capitals, Asunción and Gran-Asunción do not show active mobility rates as main modes of transport (in fact, registered active modes are 0%) – see [Table 2](#) ([PLANCHA, 2016](#)). This is an alarming situation considering the negativities of motorised transport and the reduced opportunities for physical activities from walking and cycling.

In Asunción, the bus systems are operated by the private sector, with each company operating a small fleet fewer than 40 buses, and transporting relatively few passengers per vehicle per day ([DINATRAN, 2018, 2015](#)). Although the buses move relatively few passengers in a day, it is common to see over-crowded buses which cause personal security concerns ([DINATRAN, 2018](#); [Paraguay.com, 2014](#)). Beside unreliability and personal safety concerns, traffic safety concerns are also common among bus users. Bus captains often drive at a high speed (over the average speed limit of 50 km/h) due to their salaries being based on the number of round trips completed in a day. Overall, these factors have negative effects on the mental health of individuals. Such situation can also be classified as an institutional barrier, given that while public transport is available, much improvement is needed to provide efficient and safe service.

Similar to private vehicles, most of the bus fleet is diesel-operated and buses commonly go for maintenance at operator's own workshop. Although authorities are exploring regulations to check emissions generated from transport, to date there are no public standards nor specific regulatory body being established. The lack of regulations impacts on the environment which can beget respiratory problems. Indeed, in Asunción and Gran-Asunción areas, it is estimated that close to 37% of CO<sub>2</sub> emissions are from the transport sector, of which over 90% are generated from private vehicles ([PLANCHA, 2016](#); [SEAM, n.d.](#)). In this regard, it is timely for authorities to develop alternatives to reduce pollution such as promoting greater usage of active modes of transport.

In 2017, a modern mass transport system started to be developed with the aims to improve public transport – the Metrobus in Asunción. The Metrobus was planned as a rail service and was expected to be completed by 2019 ([MOPC, 2017b](#)). Worldwide, developments of similar services have often shown positive impacts on travelling behaviour and fostered the usage of active modes as

**Table 2**

Usage of different modes of transport– as main modes – in Latin American Capitals.

Source: Adapted from [PLANCHA, 2016a](#).

|                   | Asunción & Gran-Asunción - Paraguay | Buenos Aires -Argentina | Bogota -Colombia | Caracas -Venezuela | Lima - Peru | Montevideo - Uruguay | Santiago - Chile |
|-------------------|-------------------------------------|-------------------------|------------------|--------------------|-------------|----------------------|------------------|
| Walking           | 0%                                  | 9%                      | 15%              | 19%                | 25%         | 26%                  | 35%              |
| Cycling           | 0%                                  | 0%                      | 6%               | 0%                 | 1%          | 0%                   | 3%               |
| Private transport | 49%                                 | 51%                     | 22%              | 27%                | 21%         | 54%                  | 26%              |
| Public transport  | 51%                                 | 40%                     | 57%              | 54%                | 53%         | 20%                  | 36%              |

FLM trips (Ewing and Cervero, 2017; Hamed and Olaywah, 2000). Reviews of the budget for the Metrobus caused changes in the operating conditions to an electrical system of trolleybuses (MOPC, 2018a). Moreover, rainy weather conditions in mid-2018 year temporarily stopped infrastructural work related to the project (ABC, 2018a; MOPC, 2018b) and caused water to accumulate in adjacent streets, hence affecting travelling and business (ABC, 2018b). This has led to popular rejection of the project. Currently, the works for the Metrobus have completely stopped and there have not been announcements regarding the specific way forward. It is estimated that the loss in the failed project is over 50 million USD (ABC, 2019a; La Nacion, 2018). The abandoned Metrobus project has negatively affected traffic in the area as well as business and commerce – See Fig. 2.

Moreover, Asunción and Gran-Asunción have neglected infrastructure provision for pedestrians and cyclists. While public spaces constitute around 40% of the total land area in Asunción and Gran-Asunción areas, comprising parks (80%) and off-road pathways (20%), these are in poor conditions or are not functional for transport mobility (PLANCHA, 2016), thus limiting the space for physical activity and hampering active mobility. Although projects have been developed in the last few years to revive the use of these spaces, these are still under-used and/or mis-used. Common examples are uneven pathways usually with steps, and private vehicles being parked on off-road pathways thereby blocking the way of pedestrians and cyclists – see Fig. 3. Herein, not only authorities should provide the space, but users should also compromise on good usage, adherence to regulations, and maintenance of the spaces (e.g. by avoiding littering).

A positive development regarding active mobility is that in late 2018, an on-road bicycle way (called Bicisenda) was demarcated in several streets of the city centre and bicycle parking has been provided. It should be noted that the Bicisenda is only available between 6:00 in the morning, until 10:00 in the night; for the remaining hours, it operates as parking space. While Bicisenda is already in fully operating conditions, there are no reported news/statistics regarding its impact on overall mobility in the area. However news have been reported regarding motorists not respecting the usage of the space, as well as mixed reactions from shop owners (Lezcano, 2019). In addition, some negative public reactions have been reported since many people perceived that “the investment is too high and there are no immediate derived benefits” (ABC, 2019b; Lezcano, 2019). In addition, a pilot project for a docked bicycle-sharing system has been rolled out in the city centre in late December 2018. The bicycles are a public service which are free of charge (to date), and can be checked out from any of the 4 docking stations using a mobile phone App.

## 5. Perceptions of the way forward

Perceptions of the way forward are very polarised in Paraguay. The country has been car centric for a long period and vehicles are still seen as symbols of status. For instance, developments related to roads, viaducts, and tunnels commonly receive less critics than those related to public transport or active mobility. There is a clear lack of awareness about benefits and negative externalities of the different modes of transport. This is also due to the lack of attention from authorities to promote sustainable modes accordingly. Herein, another barrier is identified, which can be classified as a behavioural barrier from users as well as an institutional one. Motorists commonly select private modes due to the perceived convenience but fail to consider the related negativities, and authorities do not seem to be engaging in activities to change such perspective.

Presidential elections recently took place Paraguay, as for many other countries in South America. The change in president has entailed changes in the authorities in charge of transport and health developments (ABC, 2018d). The newly-appointed deputy minister of transport has made public announcement of national intentions of enhancing the transport system starting with the public bus sector, for which it was announced that public perceptions surveys would be conducted (ABC, 2018e). However, announcements regarding integrating transport and health planning have not been made, nor are there mentions of inter-authority collaborations to improve any of the transport problem-symptoms affecting health.

Bus users as well as drivers usually make requests to improve the transport services, with most requests being related to: (1) reduction of costs, (2) schedules and stops regularisation, and (3) bus vehicle improvements, from passengers; and regularisation of working conditions and salary, from drivers. In the past, these have received some attention from the authorities, yet pretty soon situation returns to the original condition or worse (ABC, 2018f; Ultima Hora, 2018). To address the barrier of temporary



Fig. 2. Metrobus project (adapted from La Nacion, 2018). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)



**Fig. 3.** Off-road pathways in Asunción (adapted from ABC, 2016; 2018c; and Scavone, 2013). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

interventions, the situation should be monitored to provide long range improvements. Regarding the Metrobus, the failed project has led to popular critics, yet residents and shop owners in the zone are requesting for urgent solutions as the conditions are worsening by the day and the traffic conditions shall deteriorate during school terms (ABC, 2019c, 2019a).

Concerning active mobility, even with the limited provisions and not well-maintained infrastructure, a small, yet slowly increasing, number of cyclists can be seen commuting on the road carriageways. The recent proliferation of cyclists is likely to further improve the cycling rates in the country and could help to improve overall mobility. Interestingly, these are mostly young adults; young adults have also informally (though social media) presented proposals of utilising available space to promote and enhance active mobility – see Fig. 4. However, as the proportion of cyclists population is still small, their advocacy movements are not yet accorded the required attention by authorities.

There have also been many cases and advocacy movements related to improving traffic safety and reducing community severance. In this regard, it is not uncommon that residents take the initiatives to paint pedestrian crossings or place informal traffic signals. While these have short-term effects, they quickly fade/disintegrate due to the usage of inadequate materials. Regardless whether authorities are aware of these developments, they rarely investigate the situation nor provide actual long-term solutions.

## 6. Framework for future research and planning

Paraguay is not the first country facing challenges in urban and transport planning. Many developing countries are facing barriers in the transport area. Transport situation can be improved, and intertwined health problems alleviated with integrated foresight planning. For developing accurate planning procedures, in-depth research is needed. An overview of a framework with some points for consideration in research and planning is presented in Fig. 5. It is noted that the framework is theorised based on literature review and best knowledge of the ground situation. Possible applications of the model are discussed as well as methods for data collection and framework validation. The framework is proposed in a general way so it is not only applicable in the local context but also in cities with similar problem-symptoms.

The foremost step would be about understanding the ground situation and rationalising perception of users. Indeed, prior to applying the proposed framework, it is important to validate suggestions by incorporating modifications based on interviews with



\* The photo takers granted permission to use these images in this publication

**Fig. 4.** Informal proposals for usage of spaces to enhance active mobility. (For colour figure, the reader is referred to the Web version of this article.)

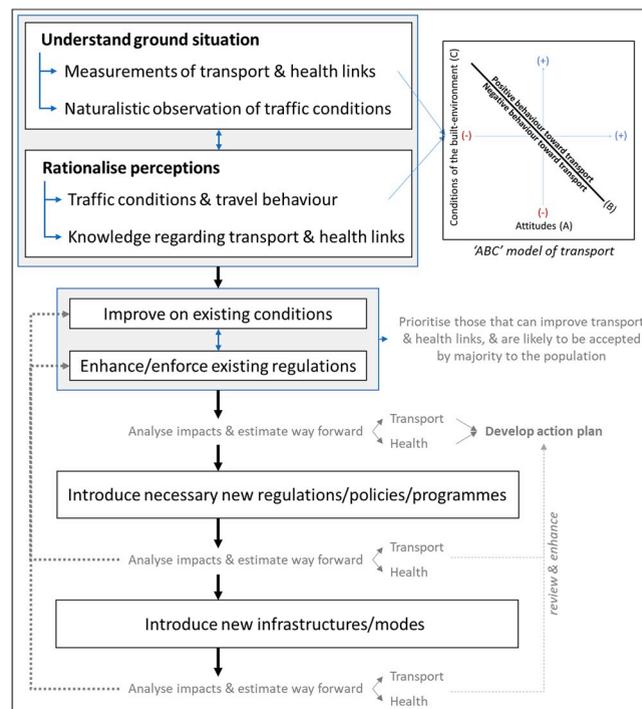


Fig. 5. Theoretical framework for future research and planning.

local practitioners, planners and policy makers, and relevant groups of the society (Meng et al., 2015; Richardson et al., 1995). Focus group interview is a commonly utilised technique to capture opinions of different groups and conceptualise ideas for implementation (Rojas López and Wong, 2017b; Then et al., 2014). Moreover, already available census data can be audited to establish the correlation between transport usage and household/individual characteristics. In Paraguay, census is conducted every 10 years and the latest one was conducted in 2012, thus data can be considered relatively recent. Authorities shall consider making census data available to researchers so the use of this set of information can be maximised. Analysing census-like data has been found to be useful in determining mobility trends in a country/city which could help to analyse changes in travel behaviour based on the relative influence of factors affecting transport (Choi and Toh, 2010; McDonald, 2007).

In addition, observations can help to gather traffic data, and panel surveys could be used to measure the overall impact of different modes of transport. Similar studies have provided a good overview of the traffic features and users' priorities (Giuliano and Golob, 1990; Kang and Fricker, 2016; Stopher and Greaves, 2007). Herein, the usage of the 'ABC model' is suggested. The ABC model was first proposed in 1999 for social studies and it has been applied to active modes of transport (Piatkowski et al., 2017; Stern et al., 1999). As applied to transport, the ABC model can help to determine positive/negative behaviours and possibly avoid barriers related to transport. The model argues that behaviour (B) towards transport (mode or infrastructure) is a function of individuals' attitudes (A) and the conditions of the built-environment (C). Based on this premise, if the conditions of the built-environment are null, likelihood to use a specific mode of transport depends on positive attitudes (Piatkowski et al., 2017; Stern et al., 1999).

Subsequently, considering the polarised views in the city, it is suggested that planners and authorities in Asunción consider to first improve existing conditions and enhance/enforce existing regulations rather than introducing new ones. Some key points for considerations include: improving traffic signals on roads, and ensuring all available crossings, bus stops, and footpaths are in good operating conditions. Improving existing conditions is not only of lower cost (as compared to investing in new projects) (Litman, 2009), but is also likely to have higher acceptance/take-up from users due to their familiarity with the areas (Kullman, 2014; Kuzmyak et al., 2014). Having improved facilities will reduce excuses from users for not utilising/respecting them due to bad conditions. Afterwards, specific regulations concerning, such as those related to emissions, bus schedules, and speed limits, should be enforced to improve traffic. Different transport users should be made aware of the existing regulations and be notified of enforcement schemes (and related penalties) (Pucher and Buehler, 2010; Schneider, 2013). Similar procedures have shown positive impacts on improved traffic conditions, increased public transport ridership, and derived health benefits (Jones, 2007; Pucher and Buehler, 2010; Shackel and Parkin, 2014; Shahid et al., 2017).

It is recommended that at this point of intervention, the impacts are weighted using similar research procedures as indicated previously, and the way forward be planned accordingly. Integrated foresight planning can help to optimise urban and transport planning and maximise available resources while focusing on meeting demands of different users and creating sustainable environments (Meng et al., 2015). Also, by conducting periodical research and local studies, community participation is also ensured, hence increasing the positive attitudes towards transport developments and reinforcing the positive behaviour (Bengston et al., 2004;

Sagaris, 2015). Furthermore, once plans have been delineated, it is recommended to first introduce “soft approaches” such as new regulations giving priority to active modes of transport, policies to foster safe traffic behaviour and compliance to regulations, and programmes to encourage people to undertake usage of sustainable modes, including public and active modes. Soft approaches are suggested to be implemented prior to infrastructural changes to identify users’ actual preference and to maximise resources (Litman, 2009).

At this stage, collaboration between transport and health agencies is the most important as the implemented policies and programmes can conjointly help to reach positive transport and health targets in the city. It is also important to consider demographic aspect of users. The population of Asunción and Gran-Asunción are mostly adults and young adults, while the population of children is also relatively high. Adults and young adults are characterised as being leaders towards changes in several areas including transport (Rojas López and Wong, 2017b). In addition, at a young age, habits are easily formed, thus, the habit of walking and cycling among children is likely to be carried to adulthood (de Sá et al., 2015b; Rojas López and Wong, 2017b). Thus, it is important to frame the various soft approaches to target on these stake-holders. After these are implemented, it is important to constantly monitor the impact on transport and on health, and review the developed plan regularly. Based on impacts of the developments, plan should be updated accordingly to obtain the most benefits.

Finally, regarding introduction of new infrastructures (e.g. bicycle lanes, viaducts, new signals) and/or “new” modes of transport (e.g. the Metrobus), careful considerations should be taken, including externalities such as weather factors. Research findings and outcomes of the ‘ABC’ model of transport can be utilised in enhancing the acceptance of these infrastructures/modes. Reaching this stage does not mean culmination of transport planning. Transport planning action plan should be constantly reviewed and enhanced by utilising suitable techniques and analyses, monitoring the most common ground situation, and conducting travel surveys (e.g. by recording detailed travel diaries) for identifying travel behaviours, and intercept or panel surveys to gather information on perception of current plan and opinions towards the way forward (Richardson et al., 1995).

## 7. Summary

This article addresses three research questions. The first is related to the transport and health developments in Asunción city as compared to the international context. This has been addressed by presenting an overview of the urban and transport situations in Asunción and Gran-Asunción areas, and highlighting the impacts of the current situations that affect health in 4 main aspects namely, physical activity, space usage, air pollution, and noise pollution. Most of these are affected by the increased usage of private vehicles and poor operating conditions of bus service, and are exacerbated by the lack of provision for active mobility. While consistent with issues in other countries in Latin America, additional barriers exist in Asunción whereby progress appears possible/ongoing, yet external situations restrain the advance.

Moreover, the second question was aimed to estimate the extent to which the actual effect of transport situation on health level has been studied and documented in the local context. While common diseases in Asunción and Gran-Asunción can be related to the high rates of private vehicle usage, no public available information has been found regarding collaborations between transport and health authorities, and limited academic research has been published linking the effect of different modes of transport on health level. This indicates a knowledge gap that needs to be addressed to improve the overall situation. By addressing this issue, Asunción and Paraguay could become a pioneer in researching, documenting, and publishing transport and health issues, thus becoming an example to other cities/counties in Latin America.

Finally, the third and last question was aimed at suggesting schemes to improve the most common transport problem-symptoms affecting health in Asunción. To do so, a theoretical framework for future research and planning has been suggested, giving inputs in terms of data collection survey approaches and specific policies/programmes that can be considered. Although the framework is backed up by findings in the literature and examples from case studies, further data collection shall be required for actual model validation. The framework is not only applicable to Asunción but also to cities/countries with similar situations.

## Acknowledgments

The authors would like to thank Mr Rafael Mongelos and Mr Fernando Orrego for providing illustrations and discussions on the topic. This study was conducted as part of first author's PhD research project. No conflict of interest is declared.

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