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Active Transport in Brisbane: how much is happening and what are its characteristics?

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Abstract: Active transport is a term describing travel between destinations by walking, cycling and other non-motorised modes. Being 'active' this component of household travel is of interest to both the transport and health fields. Whilst we now know much about the value of active transport for physical activity there is less information available on the extent or characteristics of this travel within Australian cities. This paper reports on the South East Queensland Travel Survey 2003/04 dataset covering the weekday travel of 10,931 persons in Brisbane, Australia. The dataset was manipulated to identify all active transport travel by traveller type and travel purpose. Walking for transport is found to comprise the majority of all non-motorised travel found in the dataset. Single-mode walking trips made to and from destinations such as shops and primary schools are less important than the walking involved in multi-modal public transport trips to workplaces, shops, universities and secondary schools. The trip distances walked to destinations, whether as part of public transport trips or not, are generally much greater than established 'rules of thumb' used by planners. These active transport trips provide significant health benefits to those undertaking them. The paper demonstrates that household travel survey data can provide quantitative information on the extensity and characteristics of active transport in urban areas, with the potential to examine and compare active transport across cities.

1. Introduction

Active transport is a term used to describe travel between destinations by walking, cycling and other non-motorised modes (Cooper et al. 2003; Evenson et al. 2006; Frank et al. 2006; Sallis et al. 2004). Active transport requires human physical activity and personal energy expenditure, and walking forms the bulk of this travel in most cities (Pucher and Dijkstra 2003; Vivier 2001; Zegeer et al. 1994) including, as will be shown, in Brisbane. Walking may be undertaken for transport purposes ('walking for transport') made to access destinations or to access public transport en route to destinations. Walking may also be for exercise, sport or recreation – when accessing a destination is not the primary purpose of a trip (Litman 2003; Tudor-Locke et al. 2005). It is walking for transport that is the focus of this paper.

How much walking for transport happens in cities? And what are the characteristics of this travel? Such questions are of increasing importance as walking for transport is considered one of the easiest ways for most persons to meet established daily physical activity recommendations (Berrigan et al. 2006; Egger et al. 1999; Health Canada and Canadian Society for Exercise Physiology 1999; US Department of Health and Human Services 1999).

We report in this paper on the *South East Queensland Travel Survey 2003-04 - Brisbane Statistical Division (SEQTS)*, detailing the travel behaviour of residents in greater Brisbane, Australia. Our purpose in undertaking this work was to inform a project to develop a tool for planners and decision-makers to evaluate development proposals on their transport performance, initially presented at the previous SOAC conference (Burke and Brown 2005). The ambition of this project is to develop a tool that may rate the transport performance of a new urban development in terms of vehicular energy consumption and human energy expenditure. The conceptual model underpinning this work is shown in Figure 1.

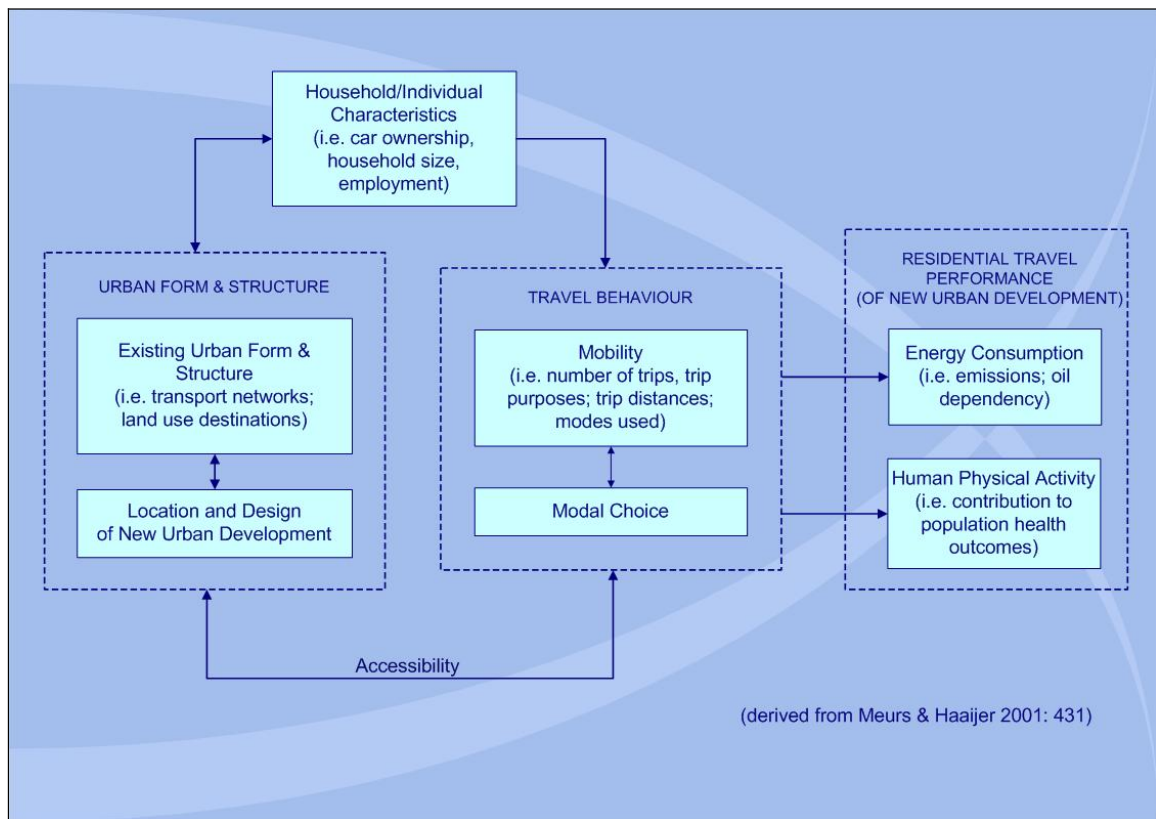


Figure 1 Conceptual model of the determinants of the transport energy consumption and human physical activity of new urban developments

Our project seeks to provide a description of the amount, length, and mode of travel associated with a proposed urban development and the potential use of alternative transport modes. To be predictive of future development we need a detailed description of current travel behaviours, including walking for transport.

2. Previous research

There has been less research into non-motorised transport, and walking, than there has been into motorised transport. Even where extensive household travel survey (HTS) data is collected in cities, often no data is actually reported on walking (Taylor and Clifford 2006). Where it is reported, analysis of non-motorised travel in HTS data has generally focussed on the amount, time and distances walked for different demographic groups, for different trip purposes, as well as spatial variation in walking across the survey area (i.e. Besser and Dannenberg 2005; Clifton and Krizek 2004; Corpuz et al. 2005). Some cross-city comparisons of the use of non-motorised modes, including walking, have been made with HTS data. The Millennium Cities Database developed by Kenworthy and Laube (UITP 2001) provided mode share comparisons, as well as walk and bicycle trip rates per capita for a large set of cities, including Australian cities. Pucher and Dijkstra (2003) produced walking and cycling mode shares comparing European and North American cities. And Polak and Alves (1997) calculated distances cycled and walked per person per year for a set of EU countries.

Of the research considering walking for transport per se, the focus has generally been on the influence of distance on trip generation rates and mode choices for walking (Hsiao 1997; Krizek and Johnson 2006; Limanond and Niemeier 2004; Loutzenheiser 1997; Polzin and Maggio 2007) and on the amount of time spent in walking for transport, primarily from a physical activity perspective (Black et al. 2001; Cooper et al. 2005; Cooper et al. 2003; Rosenberg et al. 2006; Tudor-Locke et al. 2005).

In Australia attention has primarily been given to walking distances to and from public transport, in part to assist with public transport stop spacing and land use design. Ker and Ginn (2003:75-76,79) have reported on intercept surveys of commuters at five mostly outer-

suburban rail stations in Perth to show that walking distances to rail services were much greater than the 400m to 800m 'rules of thumb' used by transport and land use planners. Wallace (2006) found similar results for walking distances to three busway stations in Brisbane. Using HTS data from the period 1997-2005, the NSW Transport and Population Data Centre (2006:3-4) found persons walked, on average, 700m from homes to train services in Sydney, and those walking from trains to their end destinations walked 600m.

3. Method

Initially we considered collecting detailed travel information from households in specific land use developments in Australian cities to describe current travel behaviours, including walking for transport. This option was rejected, partly due to the costs involved in primary data collection. We then considered secondary data sources, and especially regional HTS data for Brisbane. 1990s HTS data used in the Millennium Cities Database (UITP 2001) suggested that persons in Brisbane – and also in a set of Australian and NZ cities – made on average 0.5 walk trips per day, compared to 0.8 in a set of Western European cities, 0.6 in a set of affluent Asian cities and only 0.3 in a set of USA and Canadian cities. Given the relatively low walking trips rates identified in Brisbane, the city provides an interesting test of whether detailed examination of HTS data can provide useful insights into walking for transport.

More recent HTS data for Brisbane was selected for this work. The *South East Queensland Travel Survey 2003-04 - Brisbane Statistical Division* (SEQTS) used a multi-stage, variable-proportion, clustered sampling of households within Census Collection Districts (CCD) in 11 sub-regions. A quality dataset, the SEQTS achieved a response rate of 60% and obtained information on the travel behaviour of 10,931 respondents living in 4,057 households. Diaries were completed by respondents aged 5 and over, with diaries reconstructed from other household diaries for children aged 0-4. The respondents completed single weekday travel diaries during the periods October-December 2003 and February-March 2004. All trips made by respondents were recorded, with each trip divided into trip stages (for example, a public transport trip from home to school may involve three stages: walk stage to the public transport stop, the public transport stage, and the final walk stage from the public transport to the school). In total 41,110 trip stages were recorded for the survey sample in the 35,960 trips that they reported. The exact route travelled by respondents was not captured and trip distances were calculated using geographic information systems that determined the shortest path possible on the available street and path network. In the SEQTS, motor vehicles were defined in the survey as either a car, 4WD, van, or truck (Queensland Transport et al. 2005). To account for non-reporting, weightings for both non-response and selection bias, derived from household characteristics and Australian Bureau of Statistics 2001 census data for the areas surveyed, were included within the SEQTS data set. These weightings were applied to the sample results to estimate the active travel parameters for the city population of 1,615,579 persons (Queensland Transport et al. 2005). We are reporting population data in this paper.

4. Results

Amount of walking and cycling in comparison to other modes

Prior to looking at walking for transport per se, it is worth considering the amount of all walking made in Brisbane in comparison to travel by other modes. Aggregate average travel per person is shown in Table 1, both in terms of the mean daily travel distance and the mean travel time per person by each of the different modes - for all purposes and destinations.

Table 1 Mean travel distance and mean travel time, by mode, for a weekday – SEQTS 2003/04

	Number of trip stages per person per day	Proportion of trip stages made by all modes	Mean travel distance (km per person per day)	Proportion of travel distance by all modes	Mean travel time (minutes per person per day)	Proportion of travel time by all modes
Motor vehicle (driver + passenger)	2.8	69.8%	29.7	83.0%	52.2	74.4%
Public transport ¹	0.3	8.4%	3.8	10.6%	8.1	11.6%
Walking	0.4	20.4%	0.6	1.8%	8.3	11.8%
Cycling	0.0	1.0%	0.1	0.4%	0.8	1.1%
Other ²	0.0	0.5%	1.5	4.3%	0.8	1.1%
TOTAL	3.5	100%	35.7	100%	70.2	100%

¹Includes train, bus, ferry and taxi

²Includes motorcycle and any other modes not mentioned above

The data on non-motorised travel will be disaggregated further below, but the table shows that people in the city daily travelled 35.7 km on average. 29.7km of that travel was by motor vehicle (as either a driver or a passenger, representing 83.0% of total km travelled), compared with only 0.6km by walking (1.8% of total kilometres travelled). It also shows that people daily travelled on average for a total of 70.2 minutes, again with the majority of that time in a car, but it did include 8.3 minutes by walking (12% of total time travelled). The average amount of time spent on public transport (8.1 minutes per day) was no greater than the average time spent walking. And though the mean distance bicycled per day was 130m, on average people made 20 times more walking trip stages than bicycle trip stages. Given the small numbers of cycle trips in the data, the research focused on the walking component.

Amount of all walking that is walking for transport

The walking reported in the SEQTS was disaggregated to identify the walking for transport (travel to destinations) as well as the walking primarily for exercise, sport and recreation purposes. The latter walking was coded in the SEQTS as being for walking the dog, or as being for exercise, sport and recreation, and not having a destination where such activities occur). It was found that 97% of the walking trip stages were walking for transport. In terms of distance, this represented 96% of the total kilometres walked in Brisbane, with only 4% for exercise, sport and recreation purposes.

Comparison with data obtained on walking for transport vs. walking for exercise, sport and recreation in NSW by Cole et al. (2006), suggests that the walking for exercise, sport and recreation is significantly under-reported in the SEQTS (Burke and Brown submitted). Closer examination revealed that prior to weighting and expansion only 32 trip stages were made for walking the dog by a sample of 10,931 persons, which was suspiciously low. Though it is thought the walking for transport component was well reported, the results suggest great caution should be employed in using similar HTS data to analyse walking for exercise, sport and recreation.

Characteristics of walking for transport

Home-based travel

The walking for transport component was categorised as being either from a person's home to other places, from other places to the person's home, or as travel made between other places. Of the total kilometres walked for transport in Brisbane, approximately 36% was made from respondent's homes to other places, 25% was made from other places to homes, and 38% was travel between other places. A higher proportion of persons walked *from* public

transport to their home than walked to public transport from their home, with many persons accessing public transport or schools as a motor vehicle passenger, but returning home on foot.

On the basis that travel *from homes* by walking, and travel *to homes* by walking is largely similar but in the reverse direction, detailed examination of home-based walking for transport was made solely on the travel from homes to other places. This travel was assessed both in terms of the purpose for each trip (destination type) and whether the trip was made by walking only or whether the walking was made in conjunction with another mode.

Single stage vs. multi-stage multi-modal trips

The walking for transport made from homes to other places was found to be one of three types of trip:

Single-stage, single-mode

- Walk trips made directly to destinations (single-mode walk trips).

Multi-stage, multi-modal

- Walk trip stages made to and from public transport stops as part of public transport trips
- Walk trip stages made to or from a motor vehicle as part of vehicular trips (of which very few were captured in the SEQTS dataset due to the survey design).

Of the km walked for transport from homes to other places it was found that multi-stage multi-modal trips were responsible for 62% of the total kilometers walked, whereas single-mode walk trips represented only 38%. However the vast majority of walking for transport made between other places was by single-stage walking, such that for all travel (travel to/from homes and travel made solely between other places) it was found that multi-stage, multi-modal related walking represented 51% of the total kilometers walked, whereas single-mode walk trips represented 49%. Public transport plays a very significant role in the walking for transport made in the city, and dominates home-based walking for transport.

Table 2 shows trip rates and the proportion of trips made for different purposes, for both single-stage walking, and for multi-stage multi-modal trips involving walking.

Table 2 Proportion of walking for transport trips made from homes for different purposes, for a weekday, Single-stage trips and multi-stage trips.

<i>Single-stage walking for transport trips from homes to other places</i>			<i>Multi-stage multi-modal trips involving walking made from homes to other places</i>		
Purpose of trip (Destinations)	No. of trips to that destination per 1 000 persons	% of trips to that destination	Purpose of trip (Destinations)	No. of trips involving walking to that destination per 1 000 persons	% of trips to that destination
Primary School	26.0	27.1%	Workplaces	51.6	45.3%
Shop	22.7	23.7%	Secondary School	17.9	15.7%
Other ¹	15.7	16.4%	Universities & TAFEs	13.6	12.0%
Workplaces	9.2	9.6%	Shop	11.8	10.4%
Someone else's home	8.2	8.6%	Other ¹	9.5	8.3%
Secondary School	6.3	6.6%	Primary School	4.8	4.2%
Pre-schools & childcare	3.8	4.0%	Someone else's home	2.2	1.9%
Restaurants & cafes	2.1	2.2%	Restaurants & cafes	2.2	1.9%
Universities & TAFEs	1.8	1.9%	Pre-schools & childcare	0.1	0.1%
TOTAL	95.8	100%	TOTAL	113.8	100%

¹Includes all destinations not otherwise referred to in the table (e.g. health services, other personal services, places for exercise, sport or recreation, places for entertainment, libraries, airports and petrol stations)

Primary schools and shops are the predominant destinations for walk-only trips and, to a lesser extent, workplaces. For multi-stage multi-modal trips that involve walking, the predominant destinations are workplaces, secondary schools, universities & TAFEs, and shops.

The SEQTS dataset did not capture detailed information on walking made to or from motor vehicles and it was found that almost all (>97%) of the multi-stage active transport travel recorded in Table 2 involved public transport. The remaining 3% of travel was removed at this point so that reporting from this point on focuses on either single-stage walk trips or public transport-related walking made from home.

Distances walked

Table 3 shows the median distances walked from homes to the predominant destinations noted above, whether for single-stage walking trips or for multi-stage public transport trips involving walking.

Table 3 Median travel distance for trips involving walking for transport made from homes to other places, for a weekday. Single-stage trips and public transport-related walking.

		Median km travelled for each walking <i>trip stage</i>	% trip stages made to public transport/ % trip stages made from public transport
<i>Single-stage walking trips</i>	All destinations	0.8	n/a
	– Shops	0.7	n/a
	– Primary schools	0.8	n/a
	– Workplaces	1.0	n/a
<i>Multi-stage public transport trips involving walking</i>	All destinations	0.5	37% / 63%
	– Shops	0.4	39% / 59%
	– Secondary schools	0.6	38% / 60%
	– Universities/ TAFEs	0.6	38% / 60%
	– Workplaces	0.5	36% / 62%

For single stage walking trips, the median distance walked from home to all other places was 780m (85th percentile = 1.45km). Distances walked to shops (median = 680m; 85th percentile = 1.24km) and primary schools (median = 790m; 85th percentile = 1.34km) are less than to workplaces (median = 1.04km; 85th percentile = 1.85km).

For public-transport related walking, there were many more trip stages made *from* public transport to an end destination than made *to* public transport. This relates to persons riding as passengers in cars to access public transport from home (i.e. kiss'n'ride trips), but travelling from public transport on foot. The median distance walked per trip stage (whether to or from public transport) was 510m.

Further analysis was made of the distributions of the distances walked for the predominant trip types. The distributions of the distances walked for single-stage trips to shops, primary schools and workplaces are shown in Figure 2. The shape of these distributions is of interest as the numbers of trips made initially increases with distance, peaks (in the case of trips to primary schools at around 800m), and then decreases steadily.

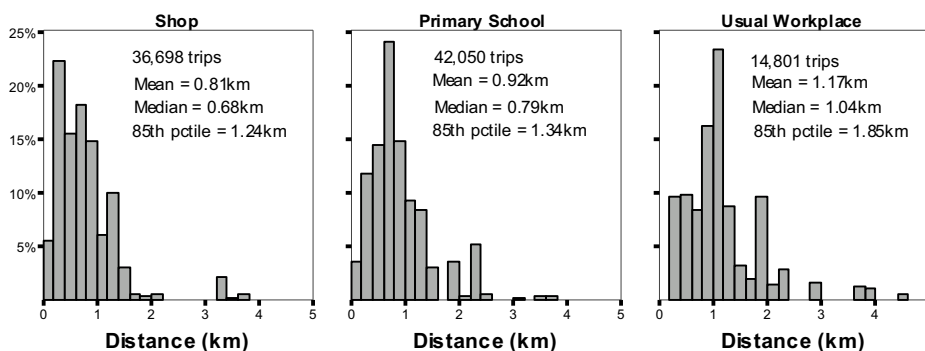


Figure 2 Distances walked for single-stage trips from home to shops, primary schools and workplaces

The distributions of the distances walked from homes to bus stops, ferry terminals and train stations are shown in Figure 3.

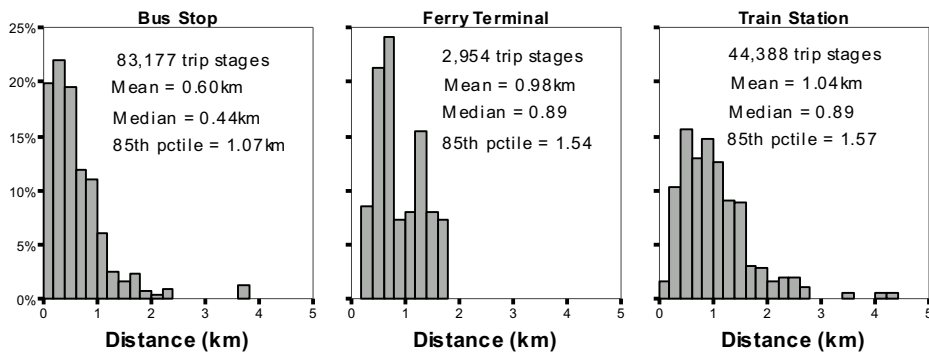


Figure 3 Distances walked from home to bus stops, ferry terminals and train stations as part of public transport trips to other places

People walk less distance from home to bus stops (median = 440m; 85th percentile = 1.07km) than they do to train stations (median = 890m; 85th percentile = 1.57km) or ferry terminals (median = 890m; 85th percentile = 1.54km). The shape of the distributions indicates that the numbers of persons walking to bus stops peaks at around 400m, then steadily declines with increasing distance, whereas it peaks at around 600m for persons walking to train stations. These results are not unexpected given the greater density of bus stops in the city in comparison to train stations, and the increased proximity to bus stops this creates for most of the population.

Figure 4 shows the distances traveled from public transport to shops, secondary schools, universities & TAFEs, and workplaces. Persons walk further from public transport stops to secondary schools (median = 570m; 85th percentile = 1.38km), universities & TAFEs (median = 590m; 85th percentile = 1.53km) and workplaces (median = 490m; 85th percentile = 990m) than they do to shops (median = 310m; 85th percentile = 760m). This in part relates to the greater use of buses than trains for shopping trips in comparison to the other trip types.

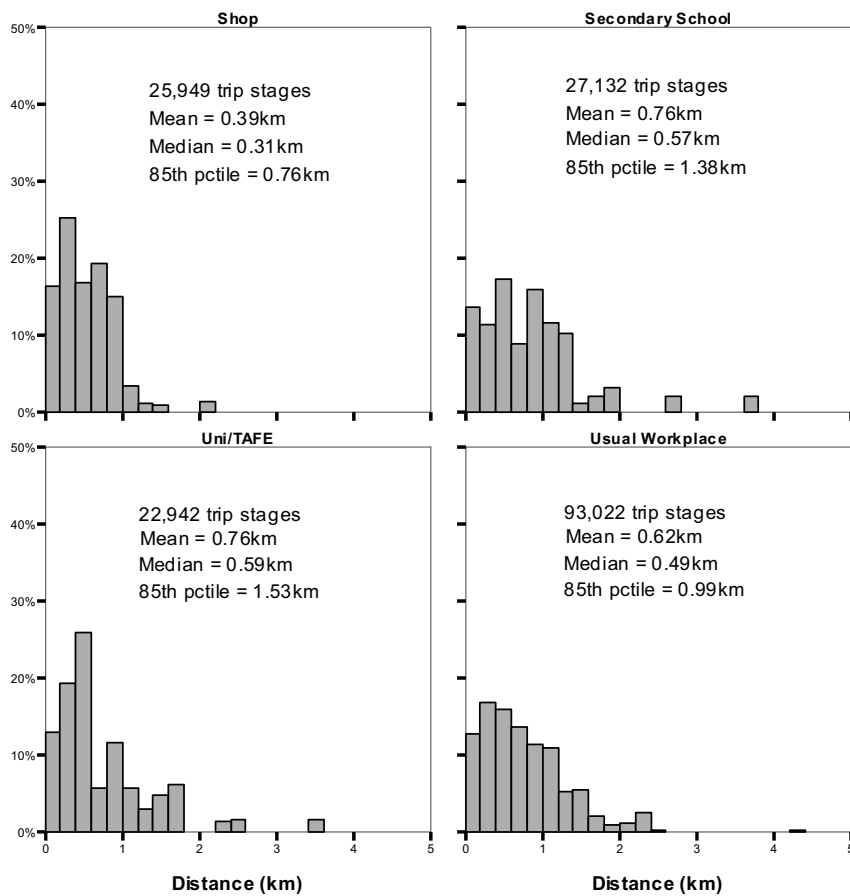


Figure 4 Distances walked from public transport nodes to shops, secondary schools, universities/TAFEs and workplaces, as part of trips from home to other places

A continuing feature of these distributions is that these do not represent exponential distance decay functions. There are actually less trips at low distances from destinations, where the 'friction' of distance is least. Why is this so? There are a number of possible reasons, but partly this may be explained by the use of population, and not individual, data in this work. The annulus of the area where residents live surrounding a land use destination increases exponentially as one moves further from that destination, as shown in Figure 5.

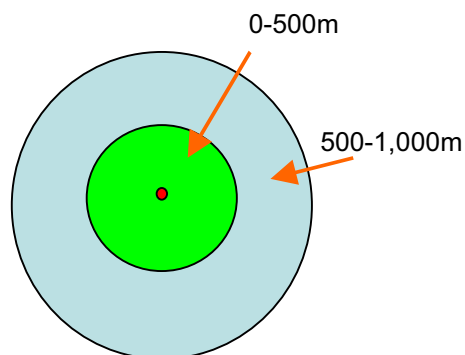


Figure 5 Annulus of areas surrounding a land use destination

For this reason, there are likely to be greater numbers of residents as distance from the land uses increase.

5. Discussion

The results demonstrate that it is possible to interrogate HTS data to provide quantitative information on the extensity, magnitude and characteristics of walking for transport in urban areas. The availability of such information is prerequisite to any attempt to influence the amount of urban travel that is made for active transport – either through attempts at behavioural change or, more fundamentally and long term, change in the future design of urban areas.

Of most interest are the findings regarding the dominance of public transport in home-based walking for transport. People are walking significant distances to access public transport in Brisbane – greater distances than identified by researchers in US cities (Hsiao 1997; Loutzenheiser 1997; Polzin and Maggio 2007). In addition, persons in Brisbane walk similar distances again on exiting public transport. Persons who are using public transport in the city (206,000 persons, 12.8% of the population) are, on average, therefore walking more than 2.3km and over 28 minutes to and from public transport). While it could be argued that such walking may not be the same as deliberate exercise, any more than any other sort of 'incidental' walking, nevertheless for these travellers, public transport related walking alone almost meets the Australian daily minimum physical activity recommendation of 30 minutes (Egger et al. 1999). This suggests further attention should be given not just to the promotion of walking for transport as a means to access public transport, but also the potential of public transport improvements per se as a means to increase walking and hence an urban population's physical activity.

Also of interest are the trip distances being walked for transport purposes. The walking distances for transport in Brisbane are current actual travel behaviour for a weekday. While they represent data for one city, given some similarities in urban form and transport systems, they may be reasonably representative of many major Australian cities. The trip distances people are walking from homes to shops, primary schools and public transport nodes are generally further than the 400m and 800m rule of thumb proximity ("¼ and ½ mile") for walking destinations promoted by New Urbanist designers (Aurbach 2005; Dover Kohl & Partners and Chael Cooper & Associates P.A. 2005). Many people in Brisbane are walking much further than these norms.

It must also be recognised that numerous people may not be undertaking walk travel due to a paucity of appropriate destinations within walkable distances from home, or of public transport stops that would take them to appropriate destinations. The information shown is also silent with respect to the quality, convenience and perceived safety of the walk route, the effectiveness of any walk/public transport interchange, and, of course, the demographic characteristics of the walkers. These issues are all areas for possible future inquiry.

As we return to our main ambition (developing a tool to rate the transport performance of new developments) a number of additional questions are raised, including:

- Is it appropriate to focus primarily on travel between homes and other places?
- Should one focus solely on the predominant destinations responsible for the most kilometres travelled?
- Can the information described be transformed to have predictive capacity?

These are topics for further research.

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