

Walking for Transport and Health: Trends in Sydney in the Last Decade

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1 Introduction

“Creating a walkable and cycleable city is an important part of creating a sustainable city - one that is equitable, livable, cost-effective, healthy, environmentally sound and safe.”

- Planning guidelines for walking and cycling (NSW Government 2004)

Transport planners have historically advocated for an increase in the use of sustainable modes of transport such as walking to reduce the adverse environmental impact from a rising trend in private vehicle use. In recent years, health practitioners have participated in this campaign after recognising the health benefits that can be gained from active modes of transport. Thus, there was a convergence of transport and health objectives. This began sometime in the mid-1990s when medical thinking shifted from the prescription of vigorous physical activity to moderate exercise on most days of the week (Pate R et al, 1995). This concept was supported and institutionalised when in 1999, the WHO Charter on Transport, Environment and Health was introduced setting out strategies primarily aimed at reducing motorised travel and its associated negative environmental outcomes but also specifically directing the “shift of transport to environmentally sound and health-promoting modes” (WHO 1999). In Australia, this new public health approach was taken on board with the implementation of a range of health promotion strategies and policies. In 1999, the National Public Health Partnership (NPHP) identified active transport by walking or cycling as a high-priority initiative to reduce physical inactivity (NPHP and SIGPAH, 2001). In 2000, the health promotion strategy recommendations included infrastructure support to encourage more cycling and walking. Cross-sectoral ‘event day’ media-based campaigns such as ‘Walk to Work Day’ and ‘Walk to School Day’ have also been implemented in NSW since 2000 and these events grew to national stature by 2003 (Merom D, Bauman A 2005).

Walking delivers wide-ranging benefits. It is a highly effective means to reduce inactivity and combat the epidemic of non-communicable ailments such as hypertension, diabetes, heart disease and obesity. It also improves mental health by reducing depression and anxiety. Walking is also a highly accessible form of transport and exercise, is cost-effective and environmentally sustainable. It has high acceptability, particularly for those that are typically sedentary (Bauman A, Bellew B, Vita P, Brown W, and Owen N. 2002; NSW Government 2004).

With the wide acceptance of the advantages of walking and initiatives already being implemented to assist in its adoption, it becomes a serious concern when trends manifest a declining incidence as what can be observed in the last decade in the Sydney Greater Metropolitan Area (GMA). This paper aims to assist in addressing this issue by informing policy formulation, identifying target groups and areas of maximum engagement through a better understanding of people’s walking behaviour and patterns of change. In this paper, data from the Transport and Population Data Centre’s 1991 Home Interview Survey (HIS) and continuous Household Travel Survey (HTS) were used to analyse the trends and characteristics of walking in the Sydney GMA in the 1991 to 2001 period. Because of the limitations in the size of the cycling data, this paper focused solely on walking. (For details about the HIS and HTS, the survey data, its geographical coverage, limitations, and the methodology used in this paper, please refer to the Appendix.)

This paper analysed the walking behaviour mainly from a transport perspective but with consideration to some health aspects. It considered the incidence of walking in relation to the level recommended by health professionals, that it be undertaken in at least 10-minute bouts accumulating to the desired 30 minutes per day on most days of the week to accrue physical benefits (Merom D, Bauman A 2005).

In the following sections, the broad movements in walking between 1991 and 2001 are first examined. The walking behaviour is then analysed in detail against a number of socio-demographic, geographic, and trip characteristics to understand the nature of the shift from walking and the factors likely affecting it. The exploration also identifies key patterns of change that may be used to better align policy with current trends.

2 Broad Trends

Between 1991 and 2001, the number of walk trips made by residents of the Sydney GMA during weekdays grew by 1.1% per annum, at a slower rate than the population (Figure 1). The result is a decline in the per capita number of walking trips and a contraction in its share as a mode of travel (Figure 2). In 1991, walking accounted for 29% of all weekday trips. This share diminished to 28% in 2001 as was the case for public transport for which the proportion also fell by 1%. The modal shift went in favour of the private vehicle which dominated with a 60% share in 1991 and further expanded to 62% due to a stronger growth in car use of 2% per annum in the following decade.

Walking during weekends was less prevalent capturing only 21% of all trips in 1991 which also fell to 20% in 2001 as a result of a low annual increase of 0.9%. Once again, this decline in the share of walking corresponded to an increase in the share of the private vehicle from 73% to 74%.

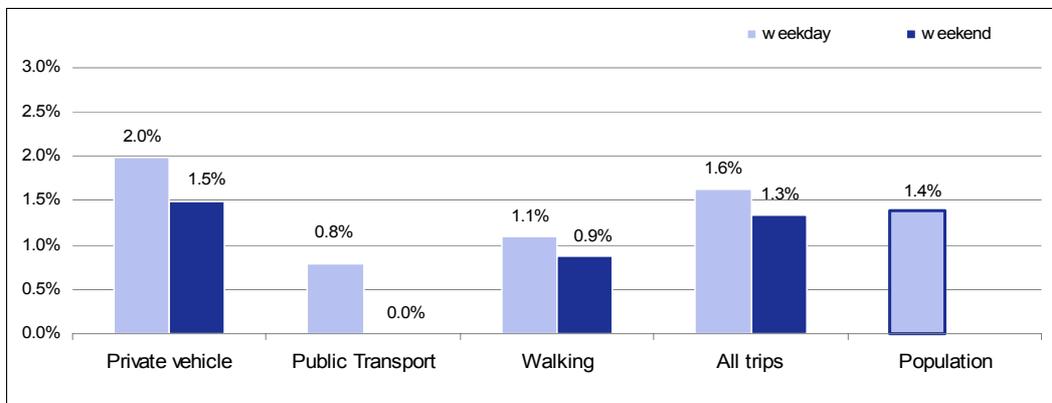


Figure 1 Annual average growth between 1991 - 2001, Sydney GMA

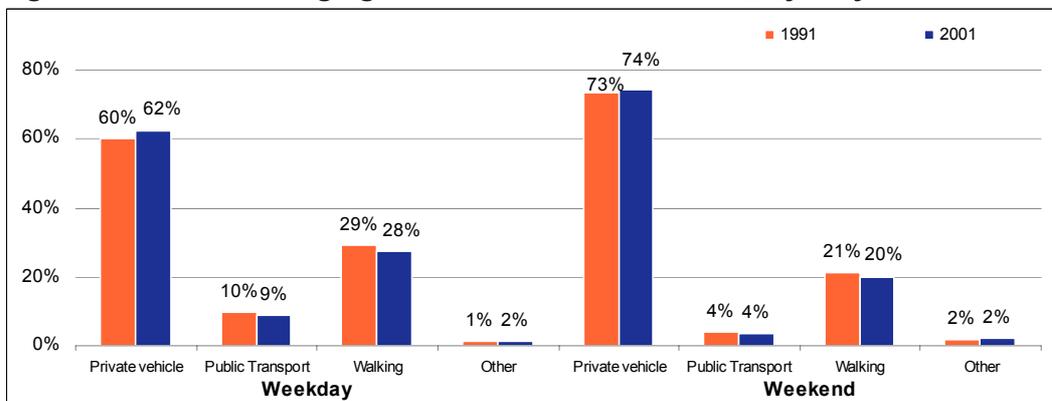


Figure 2 Mode share of trips in 1991 and 2001, Sydney GMA

To understand the factors contributing to this decline in walking, a detailed investigation with respect to a number of socio-demographic, geographic, and trip characteristics are discussed in the subsequent sections.

3 Walking by socio-demographic characteristics

The mean number of walk trips and trip time per day for residents of the Sydney GMA fell from 1.13 to 1.09 trips and 11 to 10 minutes between 1991 and 2001. These decreases were statistically significant.

Some socio-demographic groups exhibited more significant declines than others (Figures 3 and 4). The biggest decreases were for the 5 to 14 age group (1.1 to 1.0 walk trips and 11 to 8 minutes) and the primary and secondary student group (1.3 to 1.1 walk trips and 12 to 10 minutes). As a corollary, persons from households with children undertook less walking. These results attest to the general increase in inactivity among children which has been recognised and addressed in various ways but with limited success (Bauman A et al, 2002). This has serious implications as travel patterns developed during childhood, whether healthy or otherwise are likely to be carried to adulthood.

In addition to identifying which groups experienced the largest decreases in walking, it will also be informative to establish which ones undertook more or less walking relative to others. Figures 3 and 4 show that there were clear differences in the walking behaviour between socio-demographic groups. Females walked more compared to males, for whom car use particularly among adults was more dominant. The older teenagers (aged 15 to 19 years) and younger adults (aged 20-34 years) as well as the older age groups (aged 55 and above) tended to walk more than the other age groups.

The higher incidence of walking for the highly mobile young adult group was primarily due to less accessibility to the private vehicle and the greater use of public transport. Among the time-rich older groups and particularly retirees, walking for recreation was prominent. These age-related patterns were also reflected in full-time/part-time tertiary students and, to some extent, pensioners walking more than the rest of the labour force status groups.

There was also a marked difference in the incidence of walking between those with and those without driving licences. This result was supported by the similarly large difference between those persons with and those without vehicles in their households. These findings suggest that the accessibility to the private vehicle reduces the propensity to walk. Further, the group closest to accumulating the prescribed 30 minute per day healthy walking are those without access to a private vehicle.

This information about the differences in the walking patterns between socio-demographic groups and especially about those groups which undertake less walking must be applied to tailor campaigns and maximise efficacy. It should be noted that age and access to a private vehicle appear to have a strong impact on the walking behaviour and should be considered when defining policies.

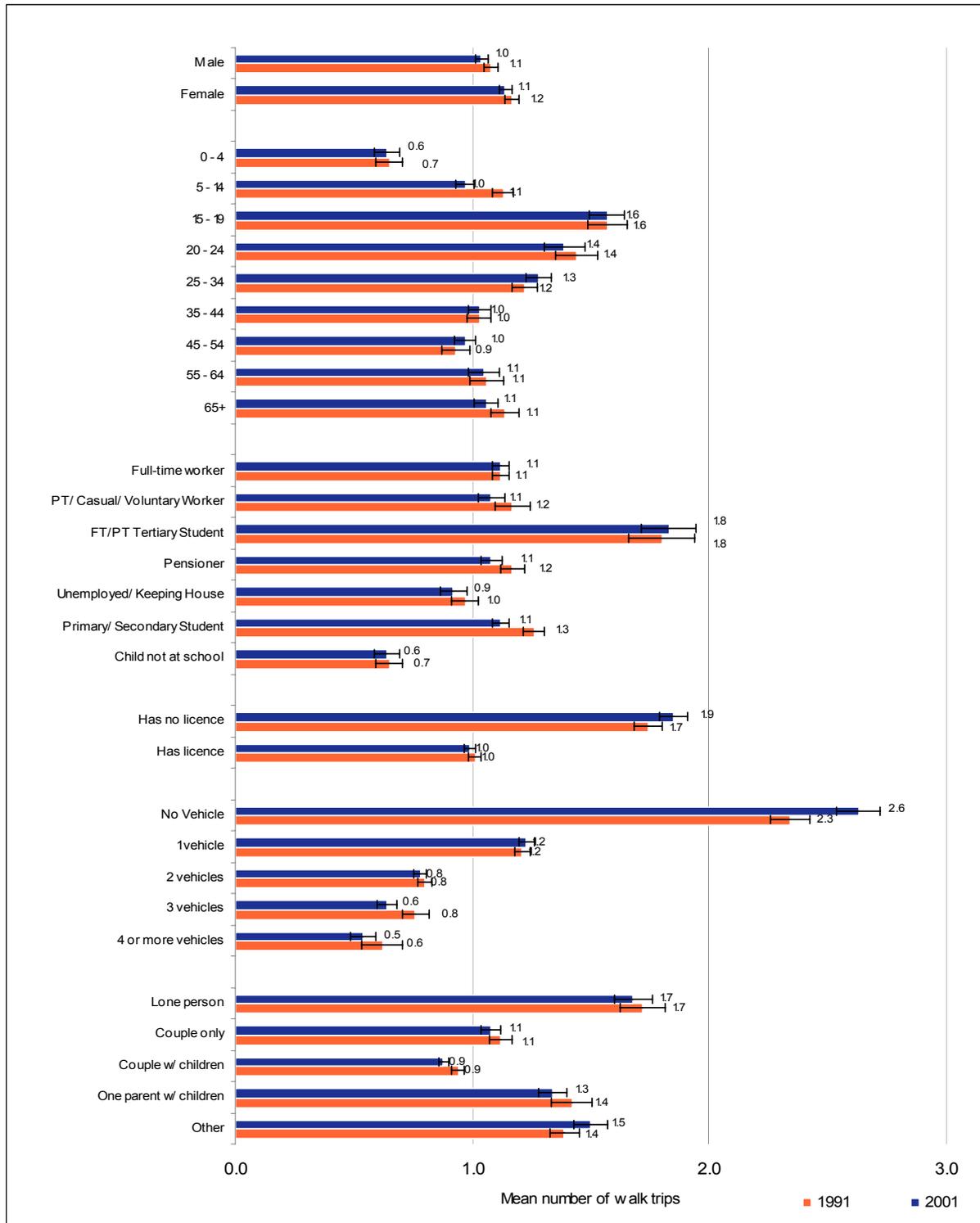


Figure 3 Mean number of walk trips per person per day by socio-demographic characteristics

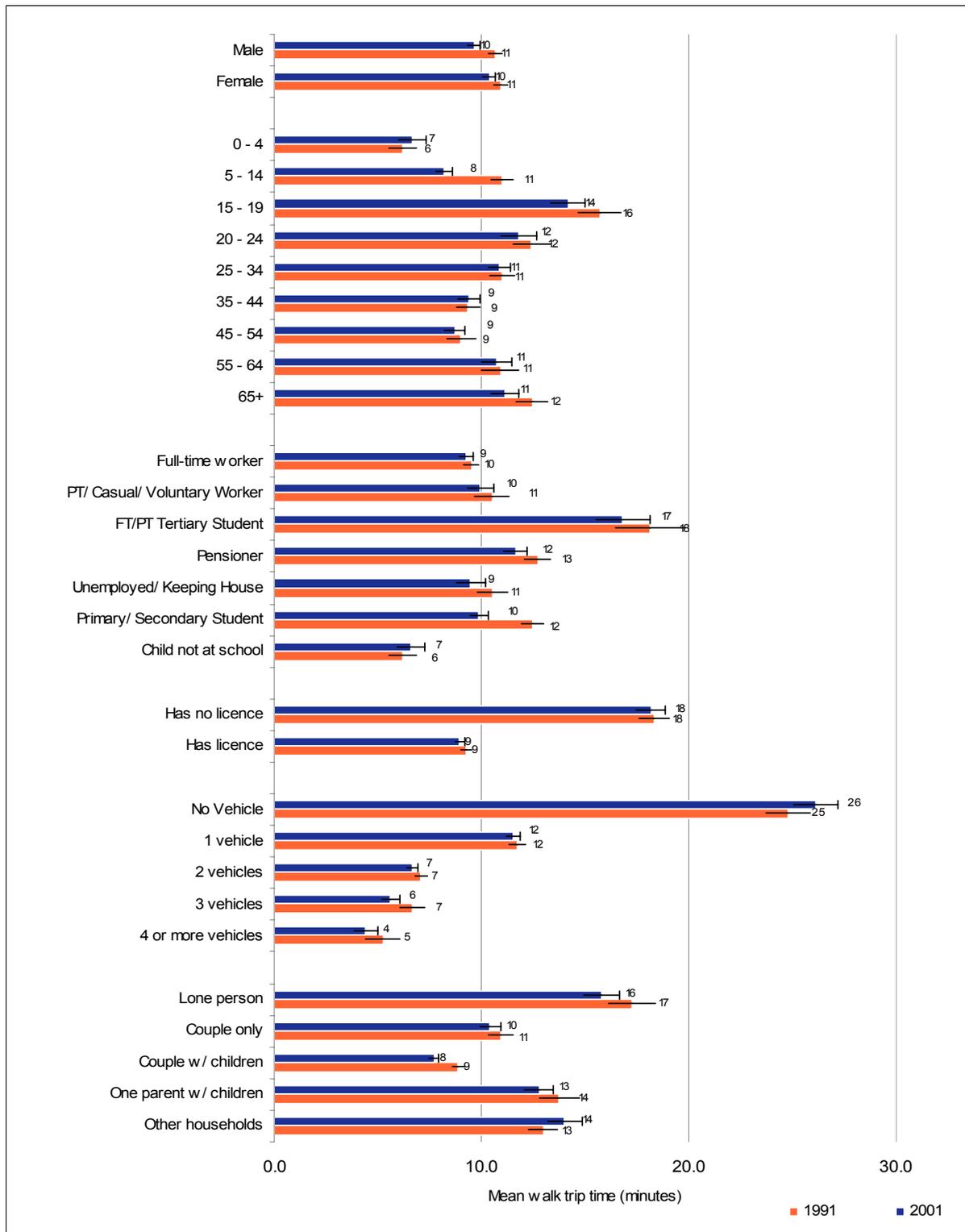


Figure 4 Mean total walk trip time per person per day by socio-demographic characteristics

4 Characteristics of the walking behaviour

In this section, the following aspects of the walking behaviour are analysed: why (purpose of walk trips), how (trip time), when (day analysis) and where (geographical analysis) people walk in the Sydney GMA.

4.1 Purpose of walking trips

The largest proportion of walking trips during weekdays are undertaken to ‘change mode’, that is to change from walking to access another mode of travel (Figure 5). A majority (87%) of these trips were accessing public transport. Between 1991 and 2001, walking trips to ‘change mode’ were also among the fastest growing, increasing annually by 2.3% and expanding its purpose share from 23% to 26%. This trend is noteworthy and is indicative of the potential to induce more walking by creating and/or improving accessibility to other modes of travel, particularly public transport.

Walking trips made for social and recreational purposes (which include walking for exercise) also grew strongly posting an average annual growth of 2.6% during the period which resulted in an increase in its purpose share (17% to 20%). This growth may be attributable to the various initiatives instituted in the 1990’s promoting walking as healthy exercise (Merom D, Bauman A, 2005). This demonstrates the merit of marketing walking for these purposes.

Also growing was walking to go or return to ‘work’ which grew 1.6% per year. Largely, these trips were for those where the previous trip was a commute by public transport (54%) or walking for another activity (41%). This high incidence of public transport use in relation to walk trips to work reinforces an earlier finding that walking is likely to be induced when associated with public transport use. It also shows how walking can be encouraged with the improvement of accessibility to services within employment centres.

The number of walking trips for education/childcare, shopping and personal business purposes during weekdays were marginally decreasing. The result is a per capita decline for these purposes and a contraction in their purpose share.

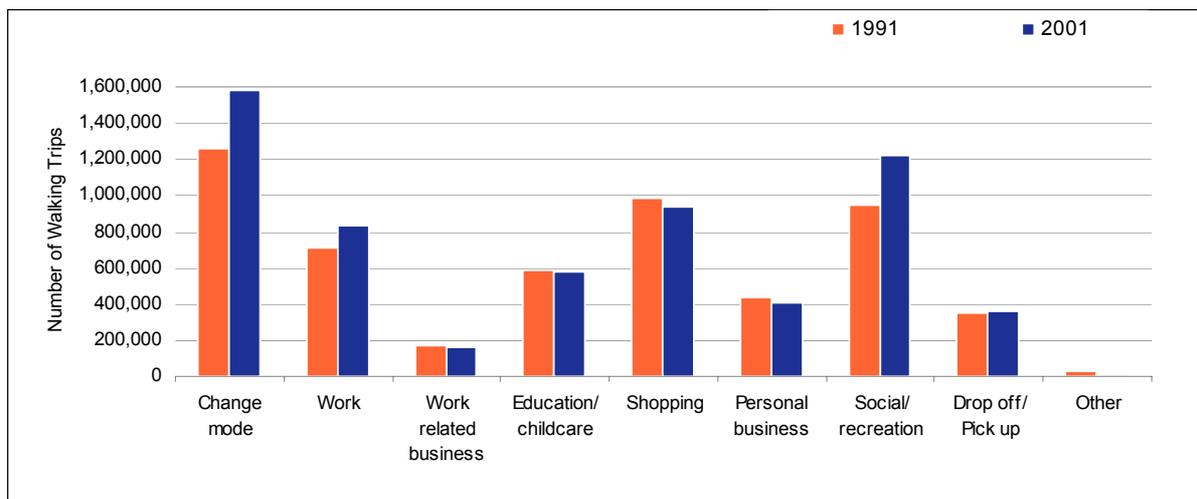


Figure 5 Walk trips by purpose on an average weekday

Similar patterns can be seen in walking trips undertaken during weekends. The largest increases in walking trips were for those made to ‘change mode’ and for social and recreational purposes. The number of walking trips for other purposes were static in the last decade.

4.2 Walking trip time

The mean travel time for all walking trips made on an average weekday by residents of the Sydney GMA has remained stable at about 9 minutes in the last decade. This average duration almost satisfies the minimum ten minute per walking trip prescribed by health professionals to accrue physical benefits which, therefore, reinforces its health-promoting

potential. There are, however, differences between trip purposes with some walk trip times shorter than the recommended duration (Figure 6).

Walking trips for social and recreational purposes had the longest average trip time of 12 minutes. Given that these trips exceeded the ten-minute prescription and were also among those with the highest growth, it should clearly be targeted for greater engagement for health purposes.

Walking trips for education and childcare on average also met the ten-minute health requirement but posted a statistically significant decline from 11 to 10 minutes between 1991 and 2001. In addition, this average trip time is only equivalent to about a kilometre or less in distance which is well within the minimum home to school distance set by the NSW Government (2.3 km for years 3 to 6 and 2.9 km for years 7 to 12) as being entitled to free school travel passes. This indicates that there is some difference between the distance students are generally prepared to walk for educational purposes and the school distance considered in current policy as accessible by non-motorised modes. This disparity is in part reflected in the per capita decline in walking trips to school in the last decade. Also consistent with this finding is the results of a 2002 survey on the travel of primary students in NSW which showed that the proportion of those doing nil active commuting trips (walking or cycling) doubled (22.8% to 44.8%) as the distance from home to school increased from 0.75 km to 1.5km. In addition, the proportion of those doing 5 or more active trips during the week dropped by more than one third, from 69.3% to 43.1% (Merom et. al. 2003).

Trips to change mode are about 7 minutes on average and indicates the type of accessibility in terms of walk trip time that will be most attractive to travellers accessing public transport modes.

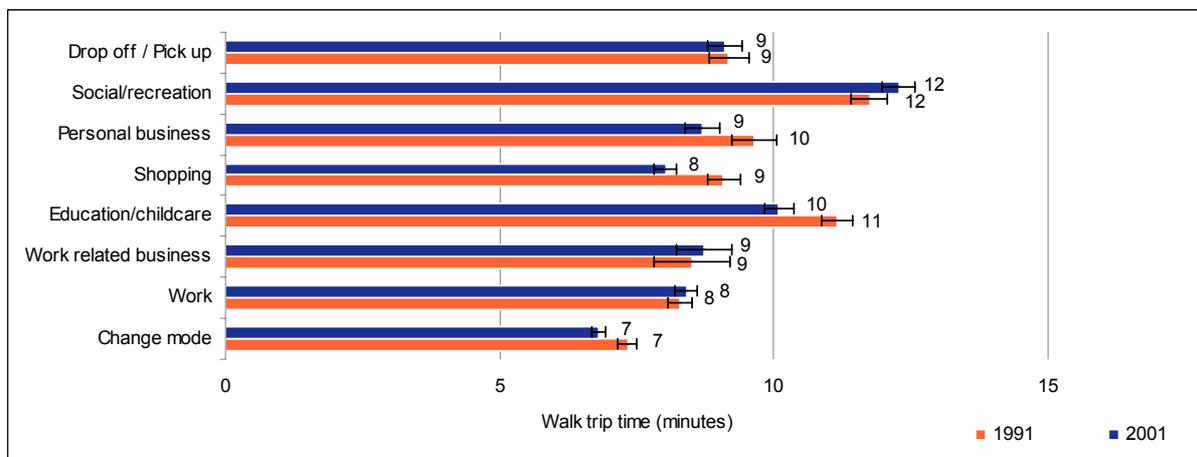


Figure 6 Average walk trip time by purpose for weekday trips

4.3 Day of week analysis

Figures 7 and 8 show the average number of walk trips and trip time per person in 1991 and 2001 by the day of the week. The graphs indicate that the incidence of walking did not differ between weekdays but were statistically higher than on weekends. Walking on a Saturday was also significantly more prevalent compared to Sunday. This is consistent with the analysis of the Australian Bureau of Statistics 1997 Time Use Survey data which indicated less walking being undertaken on Sundays. American studies using pedometers also showed similar findings (Tudor-Locke et. al. 2005).

The analysis also shows that the 2001 averages were generally lower for all days of the week from 1991 but that the decline is statistically significant for mean walk trips and mean walk trip time on a Wednesday. On this day, there was a corresponding expansion of the share of vehicle driver trips.

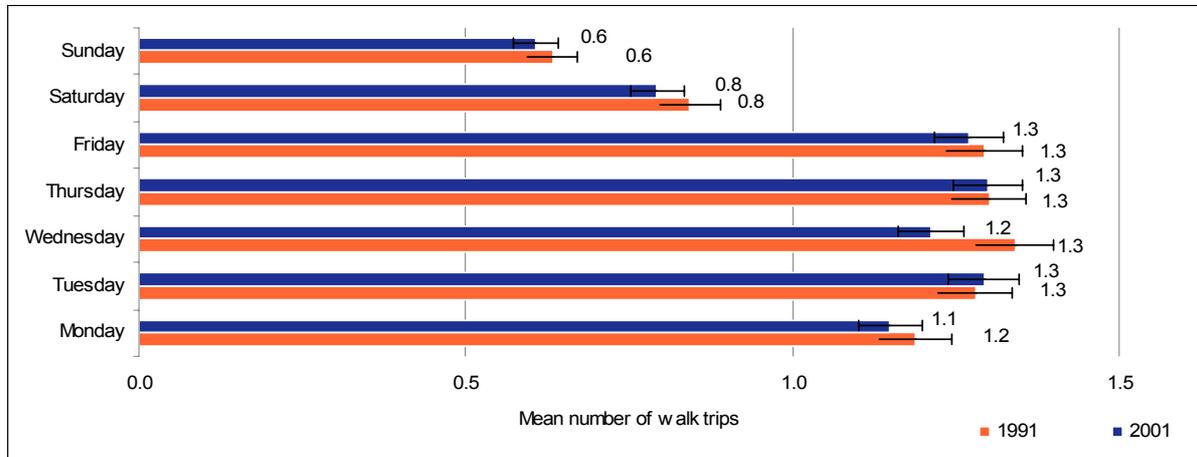


Figure 7 Mean number of walk trips per person by day

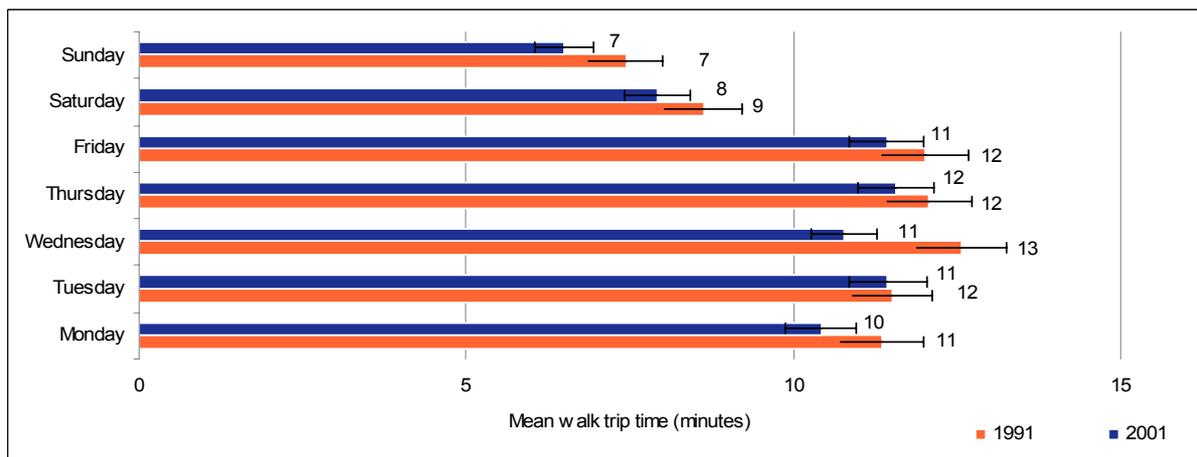


Figure 8 Mean walk trip time per person by day

4.4 Geographical analysis

The regional comparison clearly shows that there were differences in the walking behaviour between geographical areas (Figures 9 and 10). Residents in the Sydney region (refer to Figure 11 for the regional boundaries) made more walk trips (1.2) and accumulated more walk trip time (11 minutes) per person on average in 2001 compared to residents in Illawarra (0.7 trips and 7 minutes) and the Hunter (0.6 trips and 7 minutes). The variation in both the number and duration of walk trips between Sydney and the other two regions was significant but the difference between the Hunter and Illawarra was statistically valid for mean walk trips only.

Between 1991 and 2001, the mean number of walk trips per person for the entire GMA declined from 1.13 to 1.09. Figure 9 shows that this decrease was mostly driven by the reduction in walking in the areas outside the Sydney Region. The Illawarra average reduced significantly from 0.9 to 0.7 and the Hunter average fell from 0.9 to 0.6 walk trips per person per day. The Sydney average was stable at 1.2 walk trips per person.

Similarly, the mean walk trip time per person fell during the period for the two regions outside Sydney (Figure 10). The largest decrease was for the Illawarra region where the average walk trip time shortened from 9 to 7 minutes. The means for the Hunter region also decreased from 8 to 7 minutes. These changes were statistically significant.

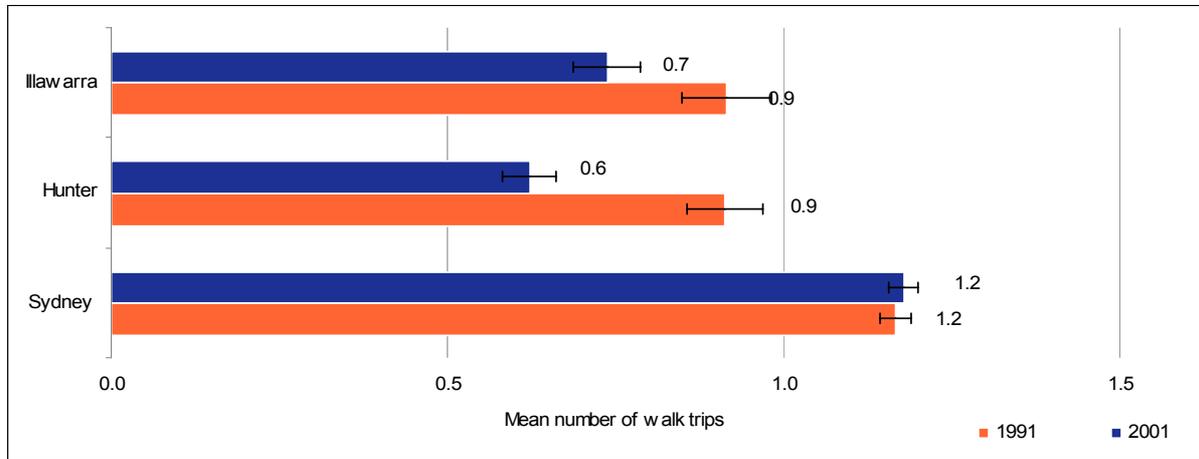


Figure 9 Mean number of walk trips per person by region

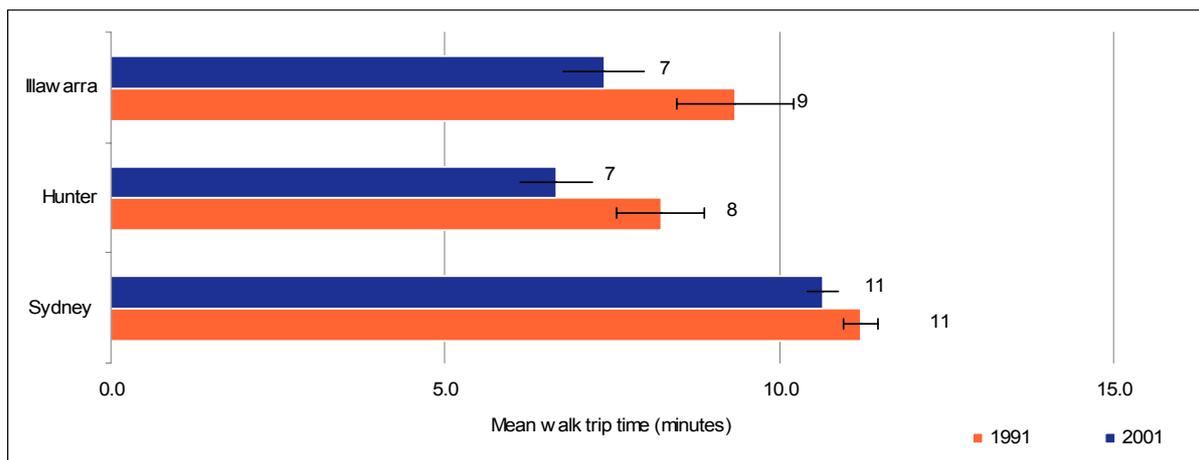


Figure 10 Mean walk trip time per person by region

Figure 11 below shows the spatial distribution of the mean trip time and mean walk trips of the residents in the Sydney GMA. On the whole, residents of highly urbanised areas in city centres where employment opportunities are concentrated, public transport services are more accessible and where services are in closer proximity tended to walk more. Outlying areas which have lower urban densities and lack good accessibility to services walked less and used the car more (TPDC, 2005).

Residents in inner Sydney and the CBD walked the most (see mark A in map). Up to the relatively urbanised and scenic Gosford in the Central Coast north of the Sydney region (see mark B), there was a reasonable level of walking. The same is true for the city centre of Newcastle in the Hunter region (mark C) and Wollongong in the Illawarra region (mark D). The Blue Mountains (marked E) which has many established tourist and recreational locations suitable for walking and which is also along the train line is the only outlying area in the west which had similar levels of walking.

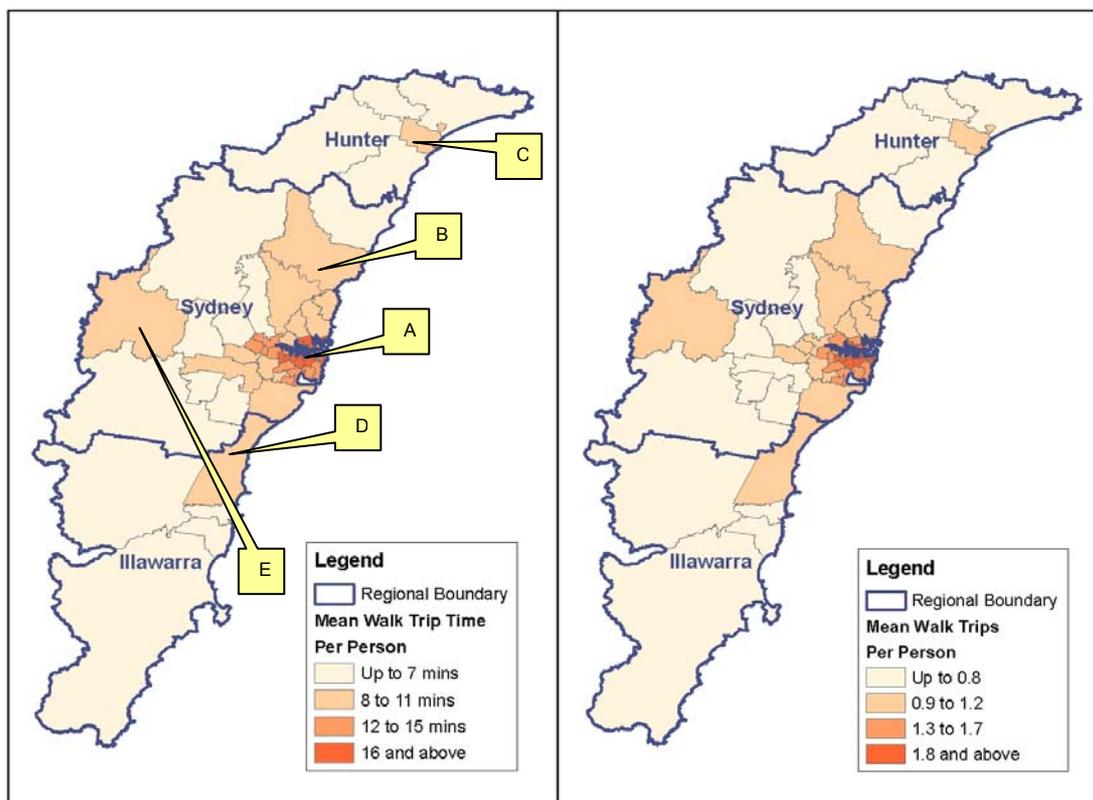


Figure 11 Mean walk trip time and mean walk trips per person per day by geography

5 Summary and Recommendations

The mean number of walking trips and trip time per person in the Sydney GMA declined between 1991 and 2001. The detailed analysis revealed some key patterns in the walking behaviour that are indicative of the likely factors impacting this trend. This information is applied to make a number of suggestions about some initiatives that may be implemented or enhanced to maximise the engagement of walking for transport and health.

Based on the socio-demographic analysis of walkers, the decline in walking was most prominent for the following groups:

- Persons aged 5 to 14
- Primary / secondary students
- Persons in couple with children households

The biggest decreases were among the 5 to 14 year olds, and similarly the primary and secondary students. These are the groups which have already been identified as exhibiting increasing levels of inactivity and incidence of weight-related problems in recent years. This requires attention considering the tendency for early behaviours to be carried into adulthood.

The comparison of walking patterns between socio-demographic groups also shows clear differences across all levels whether by gender, age, labour force status, licence-holding, household type or number of household vehicles. These variations between groups and the fact that there are particular groups that had significant declines in walking imply that group-targeted campaigns may be needed to maximise gains. Since the results also indicated that age and accessibility to a private vehicle appeared to have a strong impact to the propensity to walk, it would be beneficial to understand the issues surrounding the preference for the car and apply this information when promoting walking as a viable alternative for particular

trips. Since a significant proportion of weekday car trips in the Sydney GMA (27% or about 3.6 million trips) was less than 5 minutes (about 4 or less kilometres), there is clearly some scope to extend the use of sustainable modes such as walking. Further detailed analysis of the trip purposes and modes of the various demographic groups especially of those that are being targeted for intervention is recommended.

The purpose analysis of walking indicated that among the different trip purposes, walking to 'change mode' accounted for the biggest share of all walking trips made on weekdays and was also among the fastest growing. The relative importance and significant growth of this type of walking trip demonstrates the potential for increasing walking by promoting it for this purpose through improved accessibility to public transport which was the most accessed by walking. The average walking trip time for this purpose was about 7 minutes and should be considered when planning for optimum accessibility to public transport by walking. Since this mean trip time is below the ten-minute per trip prescribed by health professionals, maximising the impact of this type of walking trip to gain health benefits may require further intervention and promotion. This strategy of encouraging walking for transport to improve health was supported in an epidemiological study where it was conceded that walking for transport is more common than walking for exercise on any given day. It was also found that although walking for transport are usually made in several short trips during the day, the accumulated walking time tends to meet public health guidelines for those who report any walking for transport. For this reason, walking for transport was considered an important source of healthy physical activity (Tudor-Locke et. al. 2005).

Walking for social and recreational purposes (which includes exercise) also grew significantly in the last decade which coincided with the period when various campaigns advocating regular moderate exercises such as walking were implemented. Although the direct correlation can not be established, the magnitude of the growth for this type of walking trip reinforces the positive impact of marketing on walking for this purpose. The average trip time for this type of walking trip also met the ten-minute per trip recommendation to accrue health benefits, therefore, its suitability for promotion for health reasons is further justified.

Walking trips for other purposes were largely static or declining in the last decade, most notable of which were walking trips for education and childcare, shopping and personal business. This indicates the need to initiate specialised campaigns and urban planning solutions to arrest this trend and promote more walking. For example, school travel planning has been implemented in many countries to promote sustainable travel behaviour. In Australia, Travelsmart Education is being implemented in Victoria using a School Travel Planning approach which uses a combination of information, promotion, events, programs and site specific solutions. Results from a pilot program of six primary schools in 2002-2003 indicated some behavioural change amongst the students as well as other members in the students' households. There was a reported 7.7% increase in walking, a 7.8% increase in cycling and a 158.9% increase in public transport use corresponding to a 12.9% reduction in the number of trips taken by car (Di Pietro and Hughes 2003). Consistent with a previous recommendation about understanding the travel behaviour of children, further detailed analysis of school travel specifically is also proposed to identify the influences and how these can be targeted to promote sustainable travel behaviour.

To facilitate walking for shopping and personal business, accessibility and urban design considerations must be catered to. The average trip time for these purposes is 8 to 9 minutes and this indicates the level of accessibility that is preferred. This may be applied along with design guidelines that maximise opportunities for people to walk or cycle to services and public transport to induce more walking (NSW Government 2004, Bauman et. al. 2002, Owen et. al 2004).

The analysis of walking by day of the week indicated that less are undertaken on weekends compared to weekdays. Considering that there is typically more discretionary activity-making on the weekends, there is probably a greater likelihood of realising increases in walking on

these days through the implementation of previously tested campaigns tailored for maximising walking on weekends, especially for typically sedentary individuals. Shopping trips in particular which are among the most prevalent during weekends and which are dominated by car use may be targeted for their walking potential particularly in areas where accessibility already promotes walking. Although shopping trips into and out of commercial centres may be captive to car use, trips between locations *within* these centres may be tapped for increased walking.

The regional analysis shows that there was a lower incidence of walking both in terms of trips and trip time among residents in the Illawarra and Hunter compared to Sydney. In addition, these two regions outside Sydney posted significant decreases between 1991 and 2001. These regional differences provide some indication into the factors that impact on mode choice. The Hunter and Illawarra regions have lower urban densities, limited access to public transport and less road congestion compared to Sydney. As a result, there is greater car use and less walking (TPDC 2004, TPDC 2005). Further investigation at the lower geographical levels (Statistical Local Area) confirmed that people located near or at employment centres and areas of high public transport and service accessibility tend to walk more.

6 Conclusion

Walking delivers both transport-related and health benefits. In this paper, particular areas and applications where gains in both areas can be achieved in the Sydney GMA have been identified through the analysis of the walking behaviour of residents. Consideration of this information when implementing or refining policies is recommended to maximise success and effectivity. Finally, support is given to the call for greater collaboration between the transport and health sectors to ensure the ongoing mutual understanding of aims and improve the alignment of initiatives.

Appendix

1991 Home Interview Survey and the Household Travel Survey

Up to 1991, large one-off household travel surveys were conducted in Sydney in ten-year intervals. The last of this was the 1991 Home Interview Survey (HIS) which had a sample of over 12,000 households. Beginning in 1997, a new data collection strategy was implemented that would provide personal travel data on a continuous basis in order to meet the need of transport data users for more timely data. This continuous survey was called the Household Travel Survey (HTS). The HTS sampling methodology was developed for TPDC by the Australian Bureau of Statistics (ABS) with an annual sample of about 3500 households which can be pooled to improve statistical validity. In this paper, five waves of HTS data from 1997/98 to 2001/2002 were pooled resulting in a total sample of 17,000 households.

The HTS uses a similar method to the 1991 HIS, allowing for comparison over time. Both use the face-to-face interview method which is carried out every day of the survey period. A travel diary is used by each householder to record the details of all travel undertaken for their nominated 24 hour period. For each trip, the interviewer records the mode of travel, trip purpose, start and end location, and time of departure and arrival. Vehicle occupancy, toll roads used and parking is recorded for car trips and fare type and cost for public transport trips. Detailed socio-demographic information is also collected on the household, including dwelling type, household structure and vehicle details, as well as age, gender, employment status, occupation and income of individual household members.

Geographical coverage

TPDC's travel surveys are conducted over an area which includes the Sydney Statistical Division, Newcastle Statistical Subdivision and the Illawarra Statistical Division as shown in Figure 11. This area extends from Port Stephens in the north to Shoalhaven in the south and the Blue Mountains in the west.

Survey sampling design

The HTS, as in the HIS, uses a stratified, three-stage cluster sampling method. The stratification is by Statistical Local Area. (The 57 SLAs in the Sydney GMA are defined in Figure 11 with mauve boundaries). Temporal allocation of the sample is also undertaken. This refers to the allocation of the sample to days of the week and weeks of the year as evenly as possible over the survey period. This design ensures the geographic and temporal representativeness of the dataset.

The survey data

The following table summarises the sample (n) in the HIS and HTS datasets that were used in the analysis of this paper:

	1991 HIS	2001 HTS
Households	12,192	17,054
Persons	34,578	44,513
Total trips	142,594	186,763
Walk trips	37,064	49,058

Cycling as a mode was not examined because of the limited data available. There were only 1,230 cycling trips in the HIS dataset and 1,302 in the HTS.

Methodology

The data used in the analysis of this paper is expanded (weighted) to represent the travel patterns of the total population in the survey area using a methodology developed by the ABS. This process uses ABS data on households and individuals from the latest Census of Population and Housing together with annual estimates of the resident population (ERP) in occupied private dwellings by Statistical Local Area, age and sex. This expansion method

ensures that the survey estimates of population matches the ABS population estimates of residents of private dwellings for the survey area. The 1991 HIS data has been weighted to derive 1991 population estimates of travel. The HTS five-year pooled data has been weighted to represent 2001 population estimates of travel.

In this paper, analysis involved the use of 95% confidence intervals. These were constructed using data that were weighted but *normalised* to execute proper statistical tests of significance particularly when comparing means. The estimates were normalised by using a normalising factor equal to the sample size divided by the population size or the sum of weights (n/N).

In the presentation of the various results, including confidence intervals and statistical tests, the authors opted for a graphical approach. The numeric sample counts (n), standard deviations and test statistics are not presented; however, to establish whether the differences in the means are statistically significant, the confidence intervals only need to be examined whether these overlap. This method facilitates the comparison of means between 1991 and 2001 while also comparing socio-demographic groups or geographical areas.

Analysis of walk trips

The analysis undertaken in this paper used *unlinked* trips. An unlinked trip is each component of a linked trip, including each mode used. For example: A person living in Parramatta and working in the Sydney CBD travels by train with a walk trip at either end of the train trip (see below). This would be two walk and one train unlinked trips. This approach facilitates the detailed analysis of walk trips for all purposes including to 'change mode' (or the access another mode) which is one of the most important purposes of walking.

Trip	Origin	Destination	Mode	Purpose
1	Home	Parramatta Station	Walk	Change mode
2	Parramatta Station	Central Station	Train	Change mode
3	Central Station	Workplace	Walk	Work

Walk trips were analysed in terms of number and duration. In the HIS and HTS, the trip duration or travel time is based on the difference between the depart and arrive times reported by respondents. The duration of a walk trip derived this way may, therefore, include some stopping time (eg waiting for red lights). In addition, since the survey data is based on the recall of travel for a particular day, the quality of reported times can vary depending on a number of factors such as the proximity of the travel day to the day of the interview or whether the paper travel diary was used to assist in the trip recall. To an extent, some rounding off to the nearest minute can also be expected to occur. This is a limitation in all travel surveys of this nature which can be partly addressed with the use of global positioning devices which allow the capability of reporting exact trip times to even fractions of a minute. Pedometers which count actual steps can also be much more precise depending on the application. Despite this limitation in the data used in this paper, there is minimal impact in the analysis of trends or in the comparison of groups because of the consistency in the definitions and methodologies used throughout.

In this paper, walk distances were not examined because of the high degree of measurement error for short trips. In computing the trip distances in the HIS and HTS, each trip origin and destination is coded to a *travel zone* which can vary in size depending on the employment numbers in the area. The distance of the trip is calculated based on the road network distance between the trip origin and destination zone centroids. For intra-zonal trips, that is both the origin and destination are in the same zone, the distance is estimated using a formula based on the area of the zone. This method has the effect of significantly overestimating distance for short trips. In 2006, TPDC will move to the *point* geocoding of trip origin and destinations which will result in more precise distance measurements.

References

Bauman A, Bellew B, Vita P, Brown W, Owen N. (2002) *Getting Australia active: towards better practice for the promotion of physical activity* Melbourne: National Public Health Partnership

Di Pietro G, Hughes I (2003) *TravelSMART Schools – there really is a better way to go! Papers of the 26th Australasian Transport Research Forum* Wellington: ATRF

Mason C (2000) *Healthy People, Places and Transport Health Promotion Journal of Australia* Vol 10 No 3 pp 190 - 196

Merom D., Bauman A, Phongsavan P. (2003) *Active Commuting to School: habits, level of physical activity and influences. NSW primary school children, 2002*. New South Wales Centre for Physical Activity and Health, Report No. CPAH03-0004

Merom D., Bauman A (2005) *Public Health Application of the Transport and Population Data Centre's Travel Data*. Report prepared for the Premier Council for Active Living (PCAL), unpublished results

National Public Health Partnership (NPHP) and the Strategic Inter-Governmental forum on Physical Activity and Health (SIGPAH) (2001) *Promoting active transport. An intervention portfolio to increase physical activity as a means of transport* National Public Health Partnership

New South Wales Government (2004) *Planning guidelines for walking and cycling*

Owen N, Humpel N, Leslie E, Bauman A and Sallis J (2004) *Understanding Environmental Influences on Walking American Journal of Preventive Medicine* Elsevier Vol 27 No 1 pp 67-76

Pate R, Pratt M, Blair S, Haskell W, Macera C, Bouchard C, Buchner D, Ettinger W, Heath G, King A, Kriska A, Leon A, Marcus B, Morris J, Pfaffenbarger R, Patrick K, Pollock M, Rippe J, Sallis J and Wilmore J (1995) *Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine Journal of the American Medical Association*; 273: 402-407.

Transport and Population Data Centre (2004) *2002 Household Travel Survey Summary Report*

Transport and Population Data Centre (2005) *Car Travel in Sydney: Changes in the Last Decade Transfigures*

Tudor-Locke C, Bittman M, Merom D, Bauman A(2005) *Patterns of walking for transport and exercise: a novel application of time use data International Journal of Behavioral Nutrition and Physical Activity* Vol 2 No 5

WHO Regional Office for Europe (1999) *Charter on Transport, Environment and Health* Copenhagen: World Health Organisation

http://www.euro.who.int/document/peh-ehp/charter_transporte.pdf
[accessed 20 May 2005]