Walking and cycling: improving combined use of physical activity/health and transport data

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Abbreviations and acronyms

ANZS	Active New Zealand Survey
BMI	body mass index
CI	confidence interval
GPS	global positioning system
IPAQ	International Physical Activity Questionnaire
MET	Metabolic equivalent (metabolic rate for the specific activity ÷the resting metabolic rate)
MUA	main urban area (main urban areas are centred on a city or major urban centre with a population of 30,000 or more)
NZHTS	New Zealand Household Travel Survey
NZPAQ	New Zealand Physical Activity Questionnaire
NZTA	New Zealand Transport Agency
OtA	Obstacles to Action (a 2003 SPARC survey of physical activity and motivations)
PA	physical activity
SPARC	Sport and Recreation New Zealand
SRPA	sport and recreational physical activity
TPA	transport-related physical activity

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Executive summary

Context and objectives

Over the last decade, the transport, physical activity and health sectors in New Zealand have all shown increasing interest in promoting active transport (eg walking and cycling for travel purposes) and in researching active transport. This joint interest means that active transport data collected by one sector may be usefully analysed by another sector and thus enable cost savings in research.

The Active New Zealand Survey (ANZS) is a high-quality nationwide survey of over 4000 adults (aged 16 years or more) collected through face-to-face interviews over 12 months in 2007/08. Although this survey was commissioned by Sport and Recreation New Zealand (SPARC) mainly to measure levels of sport/recreation activity and to quantify physical activity in general, it includes data of interest to the transport sector on walking and cycling. In particular, people reported the amount of walking and cycling they did each day during the previous week and this was recorded separately for sport/recreation and for transport purposes (defined as 'mainly to get from place to place').

Volumes of walking and cycling for transport compared with sport/recreation

Active transport is common: ANZS 2007/08 results show 38% of adults walking, jogging/running or cycling for transport purposes during the previous seven days. One limitation that must be kept in mind with such results about volume of activity from the ANZS trip diary is that it only recorded instances where people did at least 10 minutes of an activity at a time (a common focus for research relating to potential health benefits of physical activity).

The ANZS provides sound quantification (previously lacking in New Zealand) of the relative size of recreational walking and cycling compared with walking and cycling for transport purposes:

- Of the total time in the ANZS trip diary recorded as walking (370 million hours per year), 37% was spent walking for transport purposes and 63% for sport/recreation.
  - Two underlying components contribute to this total time: the proportion of adults doing the activity and time spent by such participants. The proportion of adults walking for sport/recreation (45%) in a week was slightly higher than the proportion walking for transport (35%). Those who reported any recreational walking typically reported about two hours per week, whereas those reporting walking for transport had a much lower median of about one hour (70 minutes) per week.
- Of the total time recorded cycling in the ANZS (34 million hours per year), 29% was spent cycling for transport purposes and 71% for sport/recreation (including mountain biking).
  - The difference is driven by the greater numbers cycling for sport/recreation in any given week: during the previous week, more adults reported cycling for sport/recreation (6%) than for transport (3%). The amounts of time such participants typically spent cycling in a week were similar (median of 105 minutes for sport/recreation, 90 minutes for transport).

Even excluding mountain biking, total time spent by adults cycling for sport/recreation (18 million hours per year) was still higher than cycling for transport (10 million hours per year). Hence, the results suggest that more of the cycling done (by adults) *on the road* was for sport/recreation than mainly for transport

purposes (64% compared with 36%). This suggests that the Ministry of Transport should change conventions such as reporting cycling behaviour covered by its New Zealand Household Travel Survey (NZHTS) as 'cycling for transport', because most on-road cycling by adults is probably for sport/recreation rather than for transport.

Demographic patterns about walking for transport are quite different from those for walking for sport/recreation. Walking for transport decreases with age rather than increasing; it also shows no particularly marked gender differences (whereas women aged 25–49 years average about twice as much time walking for sport/recreation as men in that age group). Furthermore, overseas evidence suggests that trends in active transport may differ from those for walking for sport/recreation (eg by active transport decreasing at times when walking for sport/recreation is increasing).

Active transport and health benefits

With the ANZS, adults were classified as meeting the Ministry of Health's '30 x 5' guideline for physical activity if they did at least 30 minutes of moderate intensity physical activity on five or more days of the week (where each minute of vigorous intensity activity was counted as the equivalent of two minutes of moderate intensity activity). For simplicity in referring to 'active transport', our analysis here included all recorded types of active transport (including skateboarding, roller-blading, wheelchair use, etc).

Relatively few adults meet the 30 x 5 guideline through active transport alone: 3.8%. But even this small percentage represents about 125,000 adults per week across the New Zealand population. Furthermore, active transport makes a contribution towards meeting the recommended guidelines for many more people. For example, 20% of adults reported 30 minutes or more of active transport at moderate intensity (or equivalent) during the previous week.

Overall, 57% of the time spent doing active transport was moderate or vigorous and hence relevant to meeting the 30 x 5 guideline. The remaining active transport was thus 'light' intensity (defined as 'Does not cause you to breathe harder than normal, eg slow walking, standing').

Other analyses suggest modifications to some results that may be used in health benefit calculations related to active transport:

- The average cycling speed of 13–14km/h from the NZHTS 2003–09 seems preferable to the 20km/h assumed in Genter et al (2008).
  - Such a lower cycling speed might result in a lower per km value for cycling benefits.
- ANZS results show that roller-skating/roller-blading and skateboarding for transport are both so rare that detailed consideration of them for calculating health benefits seems unnecessary.

Comparability with NZHTS results

Collection of closely related data by different government agencies provides both opportunities (eg for cost savings on data collection) and risks (eg conflicting data, misinterpretation of data). This project took advantage of the opportunity the ANZS data provides to meet the needs of the transport sector. It also aimed to reduce the related risks by clarifying how much results from the NZHTS and ANZS differ and explaining reasons for major differences.

The ANZS estimate of 2.3 hours per adult per week for walking and jogging/running (including that done for sport/recreation) is much higher than the NZHTS estimate of 57 minutes. Hence it is important for

users in the transport, physical activity and health sectors to be aware that these two surveys may report very different results for things with similar labels such as ‘total walking’ or ‘total walking/jogging’.

These total figures are not directly comparable because the NZHTS excludes walking/jogging away from public roads (eg in parks, farms) whereas the ANZS includes such walking/jogging, and the ANZS excludes activities done for less than 10 minutes at a time. Even taking this into account, there is probably an underlying gap between the surveys. We suggest that the gap may result from some over-reporting in physical activity surveys such as the ANZS and some under-reporting of roadside walking/jogging in transport surveys such as the NZHTS.

Recommendations

The focus of this report lies more in delivering useful descriptive results for the use of others rather than recommendations. That said, a few recommendations flow from the findings:

1 The Ministry of Transport should ignore our earlier recommendation that SPARC’s ANZS be used to monitor leisure walking and cycling. (This change of view is because of uncertainty around what aspects of the ANZS will be repeated in the future and how often ANZS will be repeated.)

2 Given recommendation 1, alternatives should be sought for monitoring trends in transport-related walking and cycling separately from recreational walking and cycling.

3 Those planning to promote walking should take account of the fact that current participation levels by age and gender follow a very different pattern for transport than for sport/recreation.

4 The transport sector should move away from labelling totals for cycling recorded in the NZHTS as ‘for transport’.

5 When per km health benefit values associated with cycling are next reviewed, assume a speed closer to 14km/h than the 20km/h used in a recent report to the NZ Transport Agency. (This may lower benefit values somewhat.)

6 In planning major future surveys covering walking and cycling, government agencies working on transport, physical activity or health should consult and collaborate with each other to maximise value delivered to all sectors.

Abstract

SPARC's Active New Zealand Survey (ANZS) is a high-quality nationwide survey of over 4000 adults collected through face-to-face interviews over 12 months in 2007/08. Although collected mainly to measure levels of sport/recreation activity and to quantify physical activity in general, it includes data of interest to the transport sector on walking and cycling.

This report uses the ANZS data to meet the following transport-related objectives:

- quantifying how much walking/cycling by New Zealand adults is done mainly for transport purposes compared with sport/recreation purposes
- quantifying the proportion of New Zealand adults meeting key health guideline for physical activity through active transport alone, and the proportion for whom active transport makes a clear contribution to them meeting such guidelines
- establishing whether SPARC's ANZS and the Ministry of Transport's NZ Household Travel Survey deliver broadly comparable estimates of transport-related walking and cycling
- recommending refinements to collection, analysis, and interpretation of transport and physical activity/health data for the benefit of both sectors.

1 Introduction and objectives

1.1 General introduction

This chapter introduces the general background and objectives of the report. More specific introductory material about comparing the volume of active transport activities with similar sport/recreational activities and about associated health benefits is placed at the start of chapters on those topics.

1.1.1 The joint interest of transport, physical activity and health agencies in walking and cycling

Those working in transport, physical activity and health have all shown increasing interest in promoting active transport (eg walking and cycling for travel purposes) over the last decade. Active transport research has also become a greater focus of interest for both public health and transport researchers (Badland and Schofield 2005).

For the transport sector, increasing walking and cycling is attractive as a means for people to reach their destinations while contributing less to traffic congestion and to greenhouse gas production than if they travelled by car. There is also a little overseas evidence that pedestrian friendly improvements to streets may be good for the economy, for example, by attracting new businesses or increasing residential property values (Ministry of Transport 2008a). Hence New Zealand has had a strategy to increase walking and cycling for some years (Ministry of Transport 2005) and many centres have aimed to facilitate change through programmes such as workplace travel plans and school travel plans. Auckland's TravelWise programme (Auckland Regional Transport Authority n.d.) would be the largest, but there are several others (eg Greater Wellington n.d.; Living Streets Aotearoa n.d.; Bike Wise n.d.). Similar programmes, albeit on a larger scale, have been developed in other countries including Australia (TravelSmart n.d.) and the United Kingdom (eg Sustrans n.d.). More recently, the NZ Transport Agency (NZTA) has started the Model Communities programme to develop urban environments where walking or cycling is offered to the community as the easiest transport choice (NZTA 2010a). Hastings and New Plymouth were chosen as the first two walking and cycling model communities in mid-2010.

For the health and physical activity sectors, active transport is attractive as a way for people to gain the health benefits from physical activity in a way that can often fit well with regular routines (eg travelling to work or school) and take up relatively little extra time. In this way, active transport can overcome some of the major barriers to physical activity engagement such as lack of time and finding it hard to keep to a routine (Sullivan et al 2003). Thus, transport-related physical activity (TPA) has become of greater interest to public health officials internationally and is quite explicitly recognised in the WHO *Global strategy on diet, physical activity and health* (World Health Organization 2004). Not least, this greater interest arises because encouraging 'active living' (ie incorporation of physical activity into everyday life such as transport) may be cost-effective (Shephard 2008). Furthermore, there is some evidence that promotion of 'lifestyle' physical activity such as walking and cycling is more cost-effective than structured exercise programs (Garrard 2009).

In New Zealand, the government's walking and cycling strategy (Ministry of Transport 2005) has a goal of 'More people choosing to walk and cycle, more often' and that document recognises that investment to implement the strategy 'could come from a number of sectors such as transport, health, sport and recreation, and the environment' (p54). Thus when the Ministry of Transport commissioned the development of a framework for monitoring walking and cycling to help review actions taken as part of the strategy and to inform future government investment (Pinnacle Research & Policy 2008), it included a wide

range of indicators covering relevant infrastructure, behaviour and safety for TPA, as well as for leisure-related walking/cycling. The NZTA also extensively reviewed how it values health benefits associated with use of active transport modes (Beca Infrastructure Ltd 2007; Genter et al 2008). As a result, the per km benefits it now assigns to walking and cycling in cost–benefit analysis of projects (NZTA 2010b) are much higher than previously.

The health and physical activity sectors have also collected markedly more transport-related data in recent years:

- Sport and Recreation New Zealand's (SPARC's) major segmentation research project in 2003, Obstacles to Action, collected sufficient data on walking and cycling for a separate transport-funded report (Sullivan and O'Fallon 2006).
- The Ministry of Health's 2006/07 New Zealand Health Survey (NZHS) included questions on brisk walking specifically including 'walking to travel from place to place' (Ministry of Health 2008). A decade earlier, the same survey (NZHS 1996/97) asked only about walking 'for enjoyment or exercise' (hence effectively excluding most active transport). Another new question in 2006/07 asked parents and caregivers of children aged 5 to 14 years about active transport to school by those children.
- The Ministry of Health's Nutrition and Physical Activity Survey, which runs from 2009 to 2012, includes the same question as the 2006/07 NZHS on brisk walking and another on use of active transport in the previous week.
- SPARC's Active New Zealand Survey (ANZS) measured active transport in considerable detail as part of a seven-day diary (SPARC 2008) in 2007/08. The parallel earlier surveys (1997, 1998, 2000) did not monitor active transport (SPARC 2010).

Earlier health-oriented research on physical activity (PA) here and internationally focused on leisure-time physical activity. In this report we have used the term 'sport and recreational physical activity' (SRPA) for consistency with existing ANZS reports. However, broadening questionnaire coverage to include active transport, or TPA, has been shown to not only increase total recorded physical activity but also to have marked effects on disparity (eg between ethnic groups, levels of education and income) in adherence to recommended levels of PA. For example, in a Californian survey of 55,000 adults (Berrigan et al 2006), only considering SRPA showed dramatic differences between income groups in adherence to recommended levels of PA: a disparity of **25** percentage points (52% adherence compared with 27% for the highest and lowest income groups respectively). However, also considering non-leisure time walking and cycling significantly reduced this disparity to only 11 percentage points (59% adherence compared with 48% for the highest and lowest income groups respectively).

This joint interest and collection of related data by more than one sector opens up the possibility of analysis useful to transport being done using data collected by health or physical activity agencies and vice versa (which promises large savings in data collection costs). For example, Sydney researchers recently used their household travel survey as a means to monitor health-related levels of active transport activity (Merom et al 2010). We took the opposite approach and focused on using the ANZS (collected by SPARC) for transport purposes.

1.1.2 Information gaps

Despite this growing interest, some major information gaps are still apparent. For example, although it is sometimes stated that recreational cycling has greatly increased over the last decade or so, there was no firm data available to quantify such a trend until the ANZS. The Ministry of Transport's New Zealand Household Travel Survey (NZHTS) dataset cannot provide the required evidence because it combines

recreational and cycling for transport together in unknown proportions. We recognised the potential for utilising the ANZS to clarify the relative amounts of recreational cycling compared with cycling for transport when developing the Ministry of Transport's framework for monitoring walking and cycling (Pinnacle Research & Policy 2008), before the ANZS 2007/08 dataset was available. As a result, we tentatively recommended developing separate performance indicators for recreational cycling and transport-related cycling based on findings from the ANZS. We also noted the potential for similar performance indicators for recreational walking and transport-related walking, if desired. This research project looked at clarifying whether or not our recommendation could be followed through.

1.2 Objectives

At a broad level, the overall objective of this project was to improve active transport measurement/ monitoring and collaboration over data collection/analysis between different agencies in New Zealand working in this area (eg in both the transport and health sectors).

More specific objectives were to use SPARC's ANZS to:

- quantify how much walking/cycling is done mainly for transport purposes compared with sport/recreation purposes, how many people walk/cycle for both purposes, and whether some demographic groups particularly tend to walk/cycle for one purpose but not the other
- quantify the proportion of adults meeting key health guidelines for physical activity through active transport alone, the proportion for whom active transport makes a clear contribution to their meeting key health guidelines, and demographic differences in these proportions
- establish whether the ANZS and the Ministry of Transport's NZHTS deliver broadly comparable estimates of transport-related walking and cycling (and if not, why not)
- recommend refinements to collection, analysis, and interpretation of transport and physical activity/health data for the benefit of both sectors.

2 Datasets and method

2.1 Overview of datasets

This report mainly presents the results of analysis of transport-related data from SPARC's 2007/08 ANZS. A secondary focus is comparing the overall volumes of walking and cycling shown in the ANZS with the Ministry of Transport's NZHTS. Table 2.1 briefly describes these two surveys along with some other major nationwide surveys that we refer to occasionally in the report. Later sections in this chapter provide detailed information about the ANZS and NZHTS.

Table 2.1 Major nationwide datasets with transport-related walking or cycling for adults

Survey	Organisation	Description
Active New Zealand Survey (ANZS)	SPARC	Face-to-face survey of over 4000 adults over 12 months (2007/08). Includes 7-day diary of activities (including separate collection of walking or cycling for transport and for sport/recreation) with durations and intensity levels (SPARC 2008).
Census	Statistics NZ	Self-completion survey of all New Zealanders every 5 years (most recently 2006). One question on main mode of travel to work.
NZ Household Travel Survey (NZHTS)	Ministry of Transport	Face-to-face survey of 2000 to 4600 households per year running continuously since 2003 (Ministry of Transport 2010a). Includes 2-day diary of trips made with information on travel mode, purpose, distance, duration.
New Zealand Health Survey (NZHS)	Ministry of Health	Face-to-face survey of over 17,000 in 2006/07 (Ministry of Health 2008). Included one question on brisk walking in the past 7 days (specifically including getting from place to place). The NZHS is now continuous with around 30 minutes of core questions and modules that vary over the years.
Nutrition and Physical Activity Survey	Ministry of Health	Face-to-face recruitment then computer-assisted telephone interviewing (CATI). Three-year cohort survey from 2009 to 2012 (ie the same people will be followed up in later years). Around 6000 respondents in its first year. Includes one question on use of active transport in the previous week and another on brisk walking in the past 7 days (specifically including getting from place to place).
Obstacles to Action	SPARC	Self-completion survey of over 8000 adults in 2003. Mainly about motivations relating to physical activity and nutrition, but a few questions on walking and cycling (Sullivan and O'Fallon 2006).

2.2 Active New Zealand Survey (ANZS)

2.2.1 Questionnaire

The ANZS has two main components:

- sport and recreation survey (sport and recreation activities done during previous 12 months, relevant club membership, related volunteering)
- seven-day physical activity recall diary (including active transport and work-related physical activity as well as sport and recreational activity).

The first component monitors sport and recreation participation in a way fairly comparable to earlier national surveys (SPARC 2003). The second component (seven-day diary) created a new benchmark for

monitoring physical activity in the New Zealand context (SPARC 2008). With sport/recreation and active transport, the diary collected the type of activity (eg swimming, jogging, cycling) and the duration. Activities were only recorded for things done 'for at least 10 minutes at one time' (because health benefits are less clear for activities done for shorter amounts of time).

In particular, to assess how many people met health guidelines for physical activity, the diary collected self-reports on the intensity (as defined in table 2.2) at which people did physical activities (Nielsen 2009).

Table 2.2 Intensity level descriptions for physical activity

Level	Description
Light	Does not cause you to breathe harder than normal, eg slow walking, standing
Moderate	Will cause a slight, but noticeable, increase in breathing and heart-rate, eg brisk walking, cycling on the flat
Vigorous	Makes you 'huff and puff', talking in full sentences between a breath is difficult, eg running, rugby

Note: Time spent doing 'light' intensity activity was not explicitly collected in the ANZS. But such durations can be estimated by subtracting the moderate and vigorous intensity durations from the total duration doing each activity.

Thus, the diary collected information relevant to all five key dimensions (McLean and Tobias 2004) of physical activity: duration, intensity, frequency (in terms of days per week but not number of sessions per day), type and (to some extent) context.

Recalling physical activity over the previous seven days is very demanding on memory. But this time frame has been agreed internationally as the best way to gather self-report data on physical activity in such population surveys, and provides internationally comparable data. The ANZS diary is a modified form of the New Zealand Physical Activity Questionnaire (NZPAQ)–Long Form (McLean and Tobias 2004) which was derived from the International Physical Activity Questionnaire (IPAQ)–Long Form (IPAQ core group n.d.). There is validation data from objective measures locally for the NZPAQ using heart rate monitoring (McLean and Tobias 2004) and internationally for the IPAQ using accelerometers (Craig et al 2003) Consistent with other validation studies, correlations were only moderate (eg median Spearman's rho of about 0.3 in Craig et al 2003).

In the diary part of the ANZS, active transport activity was introduced by a list of 'types of non-motorised or active transport' presented on a showcard (essentially the modes in table 2.3 on p17). Respondents were then asked if they had used any 'form of active transport to get from place to place' where the showcard illustrated this as 'eg to work, school, or shops' (Nielsen 2009). If there was a possibility of double counting (eg cycling also done for sport/recreation), the questionnaire prompted the interviewer to clarify 'how much of that time was mainly to get from place to place?'.

2.2.2 Data collection, analysis, and confidence interval estimates

ANZS data comes from face-to-face interviews with 4443 New Zealand adults aged 16 years and over (but we chose to omit 16 cases from analysis as explained in the next section). The interviews covered a 12-month period (beginning March 2007). The overall response rate was 61% (SPARC 2008).

All ANZS estimates in this report were weighted to correct for differences between the sample population and the general New Zealand adult population at the time (several areas and ethnic groups were oversampled by design). Population variables used in weighting were age, gender, ethnicity and area. The procedure for calculating weights included estimation of selection probabilities, adjustment for non-response (based on a logistic regression model), and 'raking' using 2007 population estimates (Nielsen 2009).

Sampling error estimates here take into account the sampling design (stratification, clustering and weighting) through use of replicate weights based on the grouped jack-knife method (Wolter 2009) . For the jack-knife, the Nielsen area units used to select clusters of households for interviewing were randomly grouped into six groups per regional sports trust (pers comm A Gray, 19 May 2010). With estimates of percentages, calculation of large numbers of confidence intervals was facilitated by the use of logarithmic variance function that closely approximates results from the replicate weights.[1]

We used SPSS version 17 for most analysis and R version 2.11 including Lumley's survey package version 3.22-2 (Lumley 2010) for estimating ANZS confidence intervals (for estimates other than percentages).

2.2.3 Treatment of unusually high durations of reported PA

Results from self-reports about PA can be affected by methods chosen for both data collection and data analysis. In particular, with analysis of self-reported physical activity, unusually high values are sometimes truncated or have their influence reduced by log transforms. For example, the IPAQ data processing guidelines (IPAQ core group 2005) recommend truncating to a maximum of three hours each of the three key totals (total walking, total moderate PA and total vigorous PA). We did not find sufficient reason to truncate the few unusually high reports of transport-related PA by some similar process throughout this report (see appendix A for more details).

This decision had minimal effect on most of the analysis here because key measures (eg proportion reporting any cycling at all, or whether people comply with the health guideline of 30 minutes moderate intensity PA five days a week) are largely unaffected by special treatment of high values. Truncation was applied for one or two analyses of mean or total durations related to health benefits; in those cases, this special treatment is clearly specified.

The IPAQ data processing guidelines (IPAQ core group 2005) also recommend deleting cases who reported more than 16 hours of physical activity in total in a single day as 'unreasonably high'. The current SPARC dataset has 16 respondents (0.4% of the weighted total) with a total of more than 16 hours physical activity recorded for a single day. The impact of deleting or retaining these cases on transport-related analysis is fairly minor (only 4 of these 16 cases had more than an hour of active transport in total over the week). Because these cases seemed likely to be invalid and reviewing the original hardcopy diaries was impractical this long after the survey, we chose to delete these 16 cases for analysis in this report. This reduced the total base sample size to 4427. We adjusted the few totals reported so they still correspond to the correct total population size (though estimates of total participant numbers might be slightly underestimated because the respondents deleted were probably more active than most New Zealand adults).

Further details about these issues are in appendix A.

2.2.4 Base subsample sizes and limitations for active transport analysis

The large total sample size (over 4000) resulted in plenty of respondents reporting walking in the seven-day diary (table 2.3). However, subsample sizes from the seven-day diary for other active transport modes

[1] Some care is necessary when using this approximation for comparing groups, particularly beyond the age/sex/ethnic comparisons that the underlying model was designed for. More specifically, any comparisons between regions should be checked by other methods. For example, the confidence interval for Wellington proportions in table 3.3 may well be underestimated somewhat, but has been allowed to stand (because of a surprisingly high design effect when replicate weights were tried as an alternative, and because of evidence from other sources such as 2006 Census journey-to-work data for more transport-related walking in Wellington cities than in Auckland).

limited analyses. In particular, running/jogging and cycling for active transport had limited numbers (49 and 121 respondents respectively). We rarely report on running/jogging separately in this report. Rather, we usually combine running/jogging with walking. Other active transport modes (eg skateboarding) are not reported on separately again in this report because they occurred so rarely.

Table 2.3 Seven-day diary: unweighted base numbers reporting at least 10 minutes of active transport or related sport/recreational activities

Activity	*n*		*n*
Active transport		**Sport and recreation**	
Walk	1495	Walking	2067
Run/jog	49	Running/jogging	303
Cycle – count riding a tandem, recumbent, road, unicycle or mountain bike	121	Mountain biking	41
		Cycling/biking	199
Roller-blading/roller-skate	3		
Skateboard	8		
Wheelchair – non-motorised	6		
Other	33		

Note: the labels for active transport were presented on a showcard during the diary part of the questionnaire and so are not identical with those for sport/recreation which were introduced right at the start as part of a long list of sports and recreational physical activities.

Where relevant, we have disaggregated the sample into four urban areas: 'Auckland' (defined as being the four cities of Auckland, Manukau, Waitakare, and North Shore as they were at the time of data collection before formation of the Auckland 'super city'); 'Wellington cities' (Wellington city, Lower Hutt, Upper Hutt, Porirua); district/city councils containing a main urban area (MUA)[2]; and other district/city councils (without MUAs). We have not routinely separated Christchurch in such comparisons because there were only 157 Christchurch respondents; in contrast, booster sampling in the four territorial local authorities comprising 'Wellington cities' increased respondents there to 383 making it more worthwhile to report the Wellington results separately.

The ANZS data was not collected with transport analysis as the main planned use. Hence, in contrast to many transport surveys, distances for active transport activity were not collected. Nor is it possible to determine the number of trips involved; rather the total duration for each type of activity within a single day was collected.

2.3 NZ Household Travel Survey (NZHTS)

2.3.1 Questionnaire

The NZHTS aims to improve understanding of how and where people travel (Ministry of Transport 2010a) by recording every journey taken by an individual in a two-day period, the travel mode used, the distance

[2] Main urban areas are centred on a city or major urban centre with a population of 30,000 or more.

travelled, and the purpose of the journey. Among other purposes, this enables estimation of crash risk for different groups of road users.

Every member normally resident in a participating household is visited and invited to use a 'memory jogger' to record all their travel over two consecutive days. The interviewer later returns and interviews each individual face-to-face. Day 1 begins at 4am and Day 2 ends at 3.59am.

Of course, not all walking is relevant (eg within a shopping mall). Hence, in the interviewer briefing notes, walking is defined within the trip definition as follows:

> *Any movement on a public street - footpath, railway line, etc, more than 100 metres. Walking trips less than 100 metres are included if a road is crossed or if there is a change of purpose from last trip. This only excludes trips when you walk from one shop to another (same purpose) for less than 100 metres.*

The NZHTS not only records walking and cycling done 'for transport purposes'; recreational walking and cycling along public streets is firmly within its scope too.

2.3.2 Data collection, weighting, and confidence interval estimates

The NZHTS was established by the Ministry of Transport as a continuous survey in 2003. Between July 2003 and June 2008, people in over 2000 households in 280 meshblocks throughout New Zealand were sampled each year. The sample size increased to around 4600 households per year from July 2008.[3] Sample size is generally not sufficient for robust national estimates from a single year. In this report, we have generally used the three years of data from July 2006 to June 2009, the 'NZHTS 2006–2009', because that period is (roughly) centred on the same period of time as the ANZS (the year beginning March 2007) and so enhances comparability of estimates from these two surveys. For some analyses about cycling we have added two or three years of data to increase the sample size of respondents who cycled during the two-day period of the diary.

The response rate remains high for this survey: full responses for the NZHTS 2006–2009 were collected from 66% of eligible households (ie occupied households with at least one eligible household member); partial responses were received from a further 5%.

Statistical weighting was used to make the results representative of the New Zealand adult population at the time as shown by the census.

For the NZHTS confidence interval estimates we have used the 'random groups' method of estimation (Wolter 2009) as documented in the report on the 1997/98 NZHTS (Land Transport Safety Authority 2000). In summary, the estimate of interest was calculated for five random groups whose structure matched that of the parent sample, and then the variance was calculated. This procedure was repeated for 10 independent random groupings and the median of these 10 variances was taken as the best variance estimate.

[3] Further detailed information about the continuous survey can be obtained from the Ministry of Transport website www.transport.govt.nz/ongoing-travel-survey-index/.

3 Sport/recreation vs active transport

3.1 Introduction

The Ministry of Transport's 2005 walking and cycling strategy (*Getting there – on foot by cycle)* focuses on promoting active transport, as well as supporting walking and cycling for leisure. Indeed, the vision it promotes is 'A New Zealand where people from all sectors of the community walk and cycle for transport and enjoyment' (p10). More specifically, it states:

> *Because the road environment is a common setting for leisure-oriented walking and cycling, improving the on-road environment for pedestrians and cyclists is expected to benefit those who walk and cycle for leisure. Getting there — on foot, by cycle also recognises that off-road facilities for walking and cycling that serve transport as well as leisure functions can make an important contribution to a multi-modal transport system.* (Ministry of Transport 2005, p5)

For the transport sector, taking some account of leisure walking and cycling seems sensible. For example, UK research (Gardner 1998) suggests that leisure cycling has an important part to play in preserving the cycling habit (eg the mountain bike has played an important part in getting adults back onto a bicycle). The UK research also found that many current 'utility' cyclists claimed leisure cycling did encourage them to try cycling to work.

Examination of New Zealand documents about active transport reveals information gaps. For example, a recent profile designed to assist decision-makers to encourage and increase walking and cycling (Ministry of Transport 2008a) documented the declining trends for walking and cycling as transport, but could only offer the following under the heading 'recreational cycling':

> *The NZHTS suggests that the distance cycled per person has decreased since 1989/90. However, it should be noted that over one-third of New Zealanders own a bike... 750,000 of whom ride at least once a month. Over 10 percent of cyclists use their bike every day (approximately 140,000 people) and about 38,000 (or 2.5 percent of commuters) ride to work.* (p12)

However, none of the results quoted are specifically about recreational cycling. For example, although it is true that the NZHTS documents a decline in the distance cycled per person (strictly speaking, for those aged under 18 years only), this decline may have been in cycling for transport-related reasons, rather than recreational cycling.

An older document had related speculations:

> *While walking and cycling for leisure are growing in popularity, the fitness gains are marginal because of the decrease in walking and cycling for day-to-day transport.* (Ministry of Transport 2007, p44)

In both documents, the authors seemed constrained by lack of data. There is some evidence of such trends (increase in leisure/recreation cycling; decline in cycling for transport) in the UK (Cavill and Davis 2007). Surveys using the ANZS methodology, if repeated over time, can quantify the extent to which suspected trends in behaviour like that quoted above are or are not occurring in New Zealand.

One of the goals of this project was to more accurately quantify and compare the amount of walking and cycling done for sport/recreation versus that done for transport in New Zealand. Not least this was because we had recommended the Ministry of Transport track separate indicators for transport and 'non-transport' cycling using the ANZS as a suitable data source (Pinnacle Research & Policy 2008). Our

recommendation recognised that transport-related walking/cycling could easily follow very different trends from recreational walking/cycling and hence without clear measurement of either we would not have good core performance indicators for the volume of active transport. To our knowledge, ANZS is the first detailed source of information about both recreational walking/cycling and active transport activity available in New Zealand from a high-quality nationwide survey suitable as an indicator for the Ministry of Transport.

This project provided two key opportunities related to the above issues. These were to:

- quantify the amounts of transport-related cycling and walking versus sport/recreational cycling and walking (eg is more walking done for transport or for sport/recreation?)
- improve monitoring because 'non-transport' walking and cycling trips may distort transport monitoring results or cause misinterpretation.

For example, imagine that attention to preventing obesity and promoting physical activity led to a dramatic increase in people walking for recreation/health (without any transport purpose) over the next decade. This would increase walking trips as recorded in the NZHTS (which needs to record such walks for safety monitoring, to the extent they cross roads, etc). Such an increase in NZHTS-recorded walking could easily be misinterpreted as an increase in active transport choices (because it was recorded in a transport survey) even though the recreational/health-related walks had not substituted for transport trips using other modes, nor were they done for transport purposes. Making good use of non-transport datasets (eg any using the ANZS methodology) promises to be a cost-effective way for the transport sector to prevent such a mistake in interpretation.

Overseas evidence shows some clear differences between transport-related and recreational walking/cycling. For example, in contrast to recreational cycling, commuter cycling in Melbourne declines by only a small amount in winter (Garrard 2009).

3.2 Numbers active and time spent (total sample)

Total volume of walking and cycling is of interest to the transport sector, quite apart from potential health benefits. This is reflected in the inclusion of six walking and cycling indicators in the transport volume part of New Zealand's Transport Monitoring Indicator Framework (Ministry of Transport 2010b).

One objective for this project was to quantify how much walking and cycling was done mainly for transport and how much for sport/recreation. The ANZS can quantify this in two main ways: *numbers* of people doing walking and cycling of each kind in the previous week, and *amount of time* spent on these activities during the previous week. As our interest was in the total volume of transport-related physical activity we have ignored other dimensions relevant to health such as frequency (days per week) and intensity.

In terms of numbers of adults walking, counting only where they do at least 10 minutes at one time, walking mainly for transport purposes (done by 1.2 million in the previous week) is nearly as common as walking for sport/recreation (table 3.1). As expected, jogging/running is more common for sport/recreation (four to five times as common) than for transport. Sport/recreational cycling (totalling road cycling and mountain biking) is about twice as common as cycling for transport.

Table 3.1 Adults (16+ years) who walk/jog/cycle in a week (at least 10 minutes at one time), ANZS 2007/08

Activity	Purpose	% of total adults [95% confidence interval]	000 adults
Walk	Transport	35.3% [33.3, 37.2]	1156
	Sport/rec	44.8% [42.8, 46.7]	1466
	All	64.2% [62.2, 66.1]	2102
Jog/run	Transport	1.7% [1.1, 2.2]	54
	Sport/rec	8.2% [6.8, 9.5]	267
	All	9.5% [8.1, 11.0]	313
Cycle	Transport	3.3% [2.5, 4.2]	109
	Sport/rec*	6.0% [4.8, 7.2]	197
	All	8.0% [6.7, 9.3]	262
Walk, jog/run, or cycle	Transport	37.6% [35.6, 39.5]	1231
	Sport/rec	51.8% [49.8, 53.8]	1697
	All	69.3% [67.4, 71.3]	2271

* Includes mountain-biking

Analysis in terms of duration gives a slightly different picture (remembering that we do not have ANZS data on occasions when people might have done the activity for less than 10 minutes at a time). Those who do walk for transport (labelled 'participants' in table 3.2) spend significantly[4] less time on this (136 minutes on average) compared with those who walk for sport/recreation (mean of 184 minutes). Hence the total time for transport walking (136 million hours per year nationwide) is clearly less than for sport/recreational walking (234 million hours per year). That is, walking for transport was 37% of the total walking recorded in the ANZS.

Of course, mean time spent by participants is affected by the small number of very high durations reported; thus we have reported median durations per participant in table 3.2. Using medians, the typical person who walks for sport/recreation does so for two hours a week compared with about one hour a week for those who walk for transport.

Activities done by relatively small proportions of people (eg cycling for transport) naturally have a relatively large difference between the overall mean time per week and the mean minutes *per participant.* For example, with cycling for transport, the per week means are 3.4 minutes overall (low, because most respondents recorded 0 minutes) and 104 minutes per participant (much higher, because by definition participants all have non-zero minutes of cycling).

Small numbers of minutes per week in table 3.2 should not obscure the fact that overall these results show large amounts of behaviour relevant to transport and health. For example, the mean of 3.4 minutes per week for transport-related cycling is equivalent to 10 million hours as a nationwide annual total. Cycling for sport/recreation has a significantly higher mean of 8.5 minutes per week. Thus, cycling for transport contributes 29% of total time spent cycling recorded in the ANZS.

[4] The statistical significance is shown in table 3.2 by the 95% confidence intervals for the relevant means not overlapping.

If mountain biking is excluded, the mean for sport/recreational cycling drops to 6.2 minutes per week, 95% confidence interval (CI) [4.4, 7.9], compared with a mean of 3.4 minutes per week for transport cycling, 95% CI [2.4, 4.4]. Even with this drop, the results suggest that more of the cycling done (by adults) *on the road* is for sport/recreation than mainly for transport purposes (64% compared with 36%). Such a result may well surprise many in the transport sector, and suggests it may be time to change conventions such as reporting cycling behaviour covered by the NZHTS as 'cycling for transport' (Ministry of Transport 2009a).

Table 3.2 Time per week spent by adults (16+ years) who walk/jog/cycle in a week (only counting sessions of at least 10 minutes at one time), ANZS 2007/08

Activity	Purpose	Million hours per year	Mean mins per week [95% CI]	Participants (unweighted count)	Mean mins per week (*per participant*) [95% CI]	Median mins per week (*per participant*)
Walk	Transport	136	48 [40, 55]	*1495*	136 [116, 156]	70
	Sport/rec	234	82 [77, 88]	*2067*	184 [173, 195]	120
	All	370	130 [121, 140]	*2867*	203 [190, 217]	135
Jog/run	Transport	4	1.6 [0.8, 2.3]	*49*	94 [59, 128]	50
	Sport/rec	25	8.9 [7.2, 10.6]	*303*	109 [94, 124]	75
	All	30	10.4 [8.5, 12.4]	*344*	109 [94, 125]	70
Cycle	Transport	10	3.4 [2.4, 4.4]	*121*	104 [90, 117]	90
	Sport/rec*	24	8.5 [6.6, 10.4]	*232*	141 [118, 165]	105
	All	34	11.9 [9.4, 14.5]	*309*	149 [126, 173]	105
All of the above	Transport	150	53 [45, 61]	*1578*	141 [122, 160]	80
	Sport/rec	283	100 [94, 106]	*2301*	193 [183, 202]	130
	All	434	153 [143, 162]	*3037*	220 [207, 234]	150

* Sport/recreational cycling includes mountain-biking. Excluding mountain-biking, sport/recreational cycling totalled 18 million hours per year.

3.3 Trends

There is widespread interest in whether walking and cycling for sport and recreation is increasing or decreasing, similar to those trends reported elsewhere for the NZHTS (Ministry of Transport 2009b). The 2007/08 ANZS establishes a new and more detailed baseline for physical activity measurement in New Zealand which, if the survey methodology is repeated, makes possible good quantification of such trends in the future. However, identical measurements from earlier years are not available for direct comparisons with figures in table 3.2.

For sport/recreation but not transport, other questions in the ANZS do provide some indications of trends in participation by comparison with the earlier NZ Sport and Physical Activity Surveys (1997, 1998, 2000). As indicated in appendix B (p63), changes in wording mean that the differences between years may reflect the effect of changes in method or wording rather than in actual activity.

In particular, the listing of walking only once on the 2007/08 ANZS showcard rather than twice as in 1997 and the specific exclusion of active transport from the first part of the questionnaire might have reduced mentions of walking in 2007/08. Mentions of walking may also have reduced in 2007/08 because 'exercise'

was no longer explicitly mentioned on the showcard. This led us to ignore the slight decrease, estimated between 1997 and 2007/08, in the percentage of New Zealand adults (aged 18 years and above) who reported walking for sport/recreation during the previous 12 months (the exact results are in appendix B).

On the other hand, the ANZS suggests a real increase in adults (aged 18 years and above) road cycling for sport/recreation (ie excluding mountain-biking) during the previous 12 months. This increase in participation was around 6.0 percentage points (from 13.4% in 1997 to 19.4% in 2007/08). Changes in wording mean we cannot rule out the possibility that changes in method have influenced the observed differences and there is more uncertainty about the size of the increase than reflected simply by the confidence intervals in appendix B. Nevertheless, we find it difficult to see how the changes in method could have caused an increase this large:

- The reduction from two listings of cycling on the 1997 showcard to only one listing in 2007/08 is more likely to cause a decrease in reports rather than an increase.
- Similarly, the explicit mention of asking about active transport later in 2007/08 seems more likely to have decreased not increased mentions of cycling in the initial sport/recreation part of the ANZS.
- It is perhaps possible that more ANZS respondents incorrectly reported mountain-biking in the cycling/biking category than in the earlier surveys. Although the ANZS showcard listed mountain-biking separately and placed mountain-biking together with cycling/biking on screen to help interviewers distinguish between the two, it did not explicitly state 'not mountain-biking' in the cycling/biking option on the show card that respondents saw (whereas the earlier surveys did explicitly state 'not mountain biking').

Unfortunately, we could not check whether the current NZHTS question about cycling in the previous 12 months shows a parallel increase because the 1997/98 NZHTS (Land Transport Safety Authority 2000) had a different question sequence and data entry procedure. Hence the current results are not directly comparable with the 1997/98 NZHTS for that question. Although the NZHTS 2006–2009 shows a slightly higher proportion of adults recording some cycling in the two-day travel diary than the NZHTS 1997/98 (2.7% compared with 2.3%), such a small difference could easily result from random sampling fluctuations. Observational studies in Auckland and Wellington have shown a recent growth in cycling: observations at 61 sites in Auckland recorded 27% more cyclist movements in March 2010 than in 2009 (Gravitas Research and Strategy 2010); in Wellington, annual counts of cyclists crossing a screenline into the central city and in five suburbs were markedly higher in 2007 through 2009 than in earlier years (Greater Wellington 2009).

Of course, there is evidence from other sources that walking and cycling *for transport* in New Zealand is lower now than during the 1980s. For example, census data shows that 14.2% of work commute trips had walking or cycling as their main mode in 1981, but only 8.9% in 2006 (Badland et al 2009). More generally, the NZHTS (Ministry of Transport 2009b) also reported that walking had reduced (from an average duration per week for those aged five years or older of 72 minutes in 1989/90 to 58 minutes in 2005–2008). Because the NZHTS results also include recreational walking along streets to an unknown degree, it is possible that transport-related walking has decreased even more than shown by NZHTS trends.

Overseas data shows that trends in recreational walking/cycling can differ from those for related active transport. UK data suggests that walking/cycling for sport/recreation may increase at the same time as walking/cycling for transport is decreasing (Cavill and Davis 2007; Gardner 1998). Related US data (Brownson et al 2005) about broad trends over the 50 years to 2000 shows: relatively stable or slightly increasing levels of leisure-time physical activity, declining work-related physical activity, declining active transport, declining activity in the home and increasing sedentary activity (eg TV watching). Recent Australian data shows increases both in cycling to work in cities and in cycling for leisure. For example,

cycling to work in capital cities increased by 22% between the 2001 and 2006 censuses (Bauman et al 2008). The increase in cycling participation for exercise, recreation or sport of 34% between 2001 and 2009 by those aged 15 years or more (Australian Sports Commission 2010) also clearly outstripped population growth over the same period.

3.4 Overlaps: do the same people cycle for both sport/ recreation and transport?

Particularly with cycling, the extent to which those who do this activity for sport/recreation as well as for transport reasons is of interest. From a transport perspective, those who already cycle for sport/recreation are an obvious target to increase their cycling for travel purposes. But anecdotally it seems many of those who cycle for sport/recreation rarely consider cycling for transport reasons and UK research suggests negative perceptions of cycling for transport among many leisure cyclists (Davies et al 1997; Gardner 1998). The ANZS provides an opportunity to quantify such overlaps between purposes.

Walking for transport is independent of walking for sport/recreation: walking for transport (for at least 10 minutes) during the previous seven days was reported by 35% of those who had walked for sport/recreation and also by 35% of those who had not walked for sport/recreation. The phi correlation coefficient of only .004 is an alternative way of quantifying the lack of association (phi can range from –1 to +1, with 0 showing a lack of association).

In contrast, there is a clear association between cycling for sport/recreation and cycling for transport: cycling for transport was recorded by 22% of those who had cycled for sport/recreation in the previous seven days but by only 2% of those who had not. The phi coefficient for the association is .27 ($p < .001$). This association is no surprise given that cycling, whatever the purpose, requires access to a cycle plus ability and willingness to cycle. Of those who had cycled for transport in the previous seven days, 40% had also cycled (for at least 10 minutes) for sport/recreation during the same time period.

There are also some relevant ANZS results concerning sport/recreational cycling over a broader time-frame (the previous 12 months). These show that many of those who cycled for transport did not cycle for sport/recreation, despite the surface similarity of the behaviour. Fully one quarter (25.3%, 95% CI [17.0, 33.5]) of those cycling for transport in the previous week did not report any cycling for sport/recreation over the previous 12 months.[5]

3.5 Demographic differences

3.5.1 Walking and jogging/running for transport: main demographic comparisons

From here onwards in the report we will usually combine walking with jogging/running, because of the small numbers doing the latter mainly for transport purposes. Table 3.3 shows four major demographic comparisons: gender, age, urban area and household vehicle availability. Means in table 3.3 are for all respondents rather than participants only; in this way, the means help to show demographic differences as sharply as possibly by combining together the effect of differences in the proportion participating in the activity as well as the duration by participants. These means are complemented by medians for

[5] We do not have comparable results for those cycling for sport/recreation in the previous week but not transport in the previous 12 months because the ANZS only collected 12-month data about sport/recreation activities.

participants only (overall medians, including non-participants, would generally be zero and hence uninformative because only a minority do any walking for transport in a week).

More women than men reported having done at least 10 minutes of walking/jogging for transport in the previous week (39% compared with 32%). But the means for minutes of walking/jogging for transport in a week do not differ significantly (45 minutes for women, 54 minutes for men).

Walking/jogging for transport drops sharply with age: 55% for those aged 16–24 years, 30% for those aged 50–64 years, and 25% for those aged 65 years or more. The gender difference noted above remains fairly constant across the age groups. Thus, for these age groups, participation ranges from a high of 60% for women aged 16–24 years to a low of 19% for men aged 65 years plus. The mean time spent walking/jogging for transport in a week also drops strongly with age, from 91 minutes for the 16–24 year age group to 35 minutes for those aged 50–64 (and 22 minutes for those aged 65 years or more). Consistent with these patterns, results from the 2006 Census show the youngest age groups as those most commonly walking to work (Tin et al 2009) and preliminary results from the Nutrition and Physical Activity Survey 2009/10 show a sharp drop with age for people reporting using active transport in the previous seven days (64% for those aged 15–24 years compared with 35% for those aged 55–64 years; H Carr, pers comm, 13 Oct 2010).

There are sharp differences between urban areas. Significantly more people in Wellington cities (ie Wellington City, Lower Hutt, Upper Hutt and Porirua) reported walking/jogging for transport than in Auckland (53% compared with 44%). Walking/jogging for transport is even less common (32%) in other main urban areas (MUAs) and places outside MUAs (27%). Furthermore, people from these areas who did report walking/jogging typically reported doing significantly less than those in Wellington cities (median minutes of 60 for these other areas compared with 110 for Wellington)[6].

Household vehicle availability is also strongly associated with walking for transport. Nearly twice as many people (59%) in households with no vehicles (including motorcycles) reported walking/jogging for transport in the previous week compared with households where there is one vehicle available for every usual resident aged 16 or more (31%). Those with one vehicle for two adults are clearly in the middle (44%), significantly different from both the other groups just mentioned. In terms of duration, those with one vehicle for two adults average about twice as much walking/jogging for transport (60 minutes per week) as those with one vehicle per adult resident (32 minutes). These results are consistent with similar decreases in active transport associated with greater vehicle availability found by others both in New Zealand (Badland and Schofield 2008) and overseas (eg Cervero and Duncan 2003). In particular, Badland and Schofield's study with North Shore City adults found, after adjusting for potential confounders including income and age, that respondents who did not have a private automobile available were over six times more likely to walk or cycle to their place of work/study, and almost 10 times more likely to walk or cycle to the convenience shop, when compared with those who reported unrestricted private automobile availability.

[6] The 95% confidence interval for the Wellington median [91.7, 126.5] is much higher than those for 'other TLAs in MUAs' or 'TLAs outside MUAs' (both being [50.1, 69.9]).

Table 3.3 Demographic comparisons (ANZS 2007/08): Adults (16+ years) who walk or jog/run for active transport (at least 10 minutes at one time during the previous week)

	Subgroup	Unweighted count*	Do 10+ minutes [95% CI]	Mean minutes [95% CI]	Median minutes (participants only)
Total		*4427*	36% [33.9, 37.8]	49 [41.8, 57.1]	70
Gender	Male	*1847*	32% [29.3, 34.8]	54 [40.0, 68.5]	85
	Female	*2580*	39% [36.9, 41.9]	45 [39.5, 50.6]	65
Age	16–24	*519*	55% [50.3, 59.9]	91 [71.4, 110.9]	90
	25–34	*708*	40% [36.3, 44.7]	64 [46.3, 82.5]	90
	35–49	*1283*	33% [29.8, 36.3]	43 [34.8, 50.7]	60
	50–64	*946*	30% [26.0, 33.3]	35 [23.8, 47.0]	60
	65 plus	*971*	25% [21.1, 28.1]	22 [17.7, 26.2]	60
Urban area	Auckland	*1068*	44% [40.2, 47.3]	78 [53.3, 101.9]	80
	Wellington cities	*383*	53% [47.4, 58.3]	78 [52.8, 102.9]	110
	Other TLAs in MUAs	*1686*	32% [29.5, 35.3]	33 [26.0, 40.1]	60
	TLAs outside MUAs	*1290*	27% [23.9, 30.2]	33 [24.1, 41.3]	60
Vehicle: adult ratio in household	0	*298*	59% [52.9, 65.0]	102 [70.9, 133.8]	100
	0.01–0.49	*153*	50% [42.2, 58.1]	128 [13.2, 243.1]	120
	0.5	*743*	44% [40.1, 48.4]	60 [49.1, 70.8]	90
	0.51–0.99	*331*	38% [32.6, 44.1]	66 [46.2, 85.3]	100
	1	*2192*	31% [28.0, 33.1]	32 [26.8, 37.8]	60
	>1	*706*	28% [24.3, 32.4]	34 [23.2, 44.4]	60

* The 'unweighted count' is the total number of relevant respondents for the line. The medians in the last column are based on the smaller number of 'participants only', ie excluding respondents reporting 0 minutes of walking/jogging for transport.

3.5.2 Walking and jogging/running for transport: secondary demographic comparisons

Other demographic comparisons are listed for reference in appendix C, p67. We have not tried to identify all demographic differences that might reach statistical significance here; rather we have aimed to highlight the largest differences for large groups of practical interest (which would be statistically significant beyond the conventional 5% level). Our focus was on differences between proportions for pragmatic reasons: confidence intervals could quickly be estimated for large numbers of proportions but not the means and medians.

Most of the demographic comparisons in table C.1 in appendix C add little or no clear value beyond the differences described in table 3.3. The exceptions are economic deprivation and presence of a child under five years in the household.

The New Zealand Index of Socioeconomic Deprivation for Individuals (NZiDep) shows a significantly higher proportion of those with at least one 'deprivation characteristics'[7] to be walking or jogging for transport (42% compared with 32% for those without any deprivation characteristics). This difference remained clearly significant even when differences for age, gender and urban area were controlled for statistically.

Associations with economic measures (ie income) more commonly reported than NZiDep are patchy. This warns that conclusions drawn about the association of active transport with income or economic deprivation can depend a lot on exactly how these are measured and analysed. With respect to walking/jogging for transport, there is no significant direct association with household income, and associations with personal income become relatively weak once gender, age and urban area are controlled for. However, when household income is adjusted for household size[8] and split into seven different income categories, there are statistically significant differences that remain after controlling for gender, age and urban area; F (6, 87)= 4.03, p= 0.001. Highest reporting of walking/jogging for transport comes from a middle-income group (40% for $30,000 to $40,000) and the lowest comes from the highest income group (26% for adjusted income of $100,000 or more) [9]. Surprisingly however, these differences are not at all apparent if the adjusted household incomes are split into five categories rather than seven as also shown in the detailed table in appendix C on p68 (the proportions reporting walking/jogging for transport range only between 32% and 36% for the five categories).

Given reduced active transport by children (Ministry of Transport 2008a), in considering policy responses the sector is interested in other data that may relate to such changes. The ANZS does not cover children's travel behaviour directly (because the sampling covered only people aged 16 years or more). But the presence of at least one child aged under five years in the household is associated with the adult respondent being more likely to walk/jog for transport in the previous week: 46% compared with 34% for those without such a child, with 95% CIs [41.8, 50.0] and [31.7, 35.8]. This difference remains statistically significant when analysis controls for gender, age and urban area; adjusted odds ratio =1.44, 95% CI [1.12, 1.85]. The arrival of young children typically causes many changes in household behaviour, and the difference could easily relate to things such as taking young children for a walk on errands.

There are various reasons why the remaining demographic comparisons are of little interest.

First, some comparisons are listed for convenient reference but are otherwise ignored because it is more worthwhile to focus on closely related variables:

- Number of vehicles available in the household is listed. But because the practical impacts of such numbers are very different for a household with five adults than for a single occupant household, the analysis in table 2.1 on p27 by 'vehicle: adult ratio' seems clearly preferable.
- Number of household residents aged 15 years or younger is less specific and informative than the difference discussed above concerning the presence of a child aged under five years.

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[7] Deprivation characteristics measured (for the previous 12 months) were: being forced to buy cheaper food (so that they could pay for other things); being out of paid work for more than a month at one time (for those in the labour force); putting up with feeling cold to save heating costs; making use of special food grants or food banks; wearing shoes with holes because they could not afford to replace them; going without fresh fruit and vegetables often so that they could pay for other things; and getting help in the form of food, clothes or money from a community organisation like the Salvation Army. Further information about the NZiDep and its development is available from the developers (Salmond et al 2004).

[8] The adjustments for household size follow the equivalence scale approach outlined by Easton (2004)

[9] These groups remain the most sharply contrasted when gender, age and urban area are controlled for statistically.

- Personal income continues to show significant differences (p=.02 from logistic regression) after controlling for gender, age and urban area (and excluding the 'don't know' and 'refused' responses). But the NZiDep analysis and household income (adjusted for household size) analyses discussed above reveal sharper distinctions and are better indicators of socio-economic deprivation.

Second, many show no differences between percentages large enough to be of both practical and statistical significance:

- Māori ethnicity, child aged 5–12 years in household, child aged 13–15 in household, household income, hours of computer use (excluding work/school), total 'screen time' (combining TV/DVD/video and computer use outside of work or school).

Third, although the following show some differences which may appear large enough to be of interest (as shown by confidence intervals in table C.1, appendix C), the differences are not statistically significant when the analysis controls for age, gender and/or urban area (ie the four urban areas listed in table 3.3). Hence we see little practical point in drawing attention to differences such as:

- Asian and Pacific ethnicities are both associated with more walking or jogging/running for transport (44% and 48% respectively reporting some during the previous week compared with 36% for the full sample). However, these populations have a very different age structure, with many more young people. These ethnic differences in percentages walking or jogging for transport are no longer significant when the age differences are controlled for statistically (by logistic regression).
- Higher educational qualifications are associated with significantly more walking or jogging/running for transport (eg 41% of those with a postgraduate degree/certificate/diploma reported at least one session of 10 minutes during the previous week compared with only 30% of those with no secondary school qualifications. However, these differences are no longer significant when differences in age, sex and urban area are controlled for statistically.
- A significantly higher proportion (43%) of those in part-time work (less than 30 hours) reported walking or jogging for transport in the previous week compared with those not working (35%) or working full-time (34%). Again this difference is no longer significant once differences in the age distribution for part-time workers are controlled for statistically.
- Similarly, although there are differences associated with main working environment (eg in a shop, outside), these are not strong enough to be of interest once age, gender and urban area are controlled for statistically.
- Occupation as recorded in this survey does show some clear differences in table C.1, appendix C. For example, 60% of students recorded some walking/jogging for transport compared with only 21% of farm owners/managers. But if the scope of the analysis is reduced to those in paid work (ie excluding students, home duties, the retired, beneficiaries), then there are no significant differences when analysis controls for gender, age and urban area.
- TV/DVD/video hours during the previous seven days show some differences between percentages, but these disappear when age, sex, urban area controlled for.

Note that if the ANZS survey had not included the extra detail of the NZiDep scale, we might have reached a conclusion similar to that for Victoria where 'there is no social gradient (based on education, occupation and income) for walking and cycling to work' (Garrard 2009, p1). Some of the differences we have found using the NZiDep scale parallel those in other places where low socio-economic status is associated with higher levels of active transport: California (Berrigan et al 2006), Denmark, Canada and the Netherlands (Garrard 2009), and Israel (Plaut 2004). One of the reasons this is of particular interest to public health

officials wishing to increase physical activity levels and reduce health inequalities is that the reverse pattern is often found with SRPA, for example, in Australia (Garrard 2009). It is possible for this pattern to change, as shown in recent New South Wales data (both their Health Survey and the Sydney Household Travel Survey) where socio-economic differences in walking, clearly demonstrated in the 1990s, had reduced to non-significant levels by 2006 (Merom et al 2010).

3.5.3 Cycling for transport: main demographic comparisons

Table 3.4 shows the main demographic comparisons for cycling. With only 3.3% reporting cycling for transport in the previous week, even the large ANZS sample yields only 121 respondents reporting it in the activity diary. Hence we have not presented means and medians for demographic splits other than the two-way gender split (the medians by gender are based on responses from 78 men and 43 women). Splitting these 121 respondents into more groups would result in means and medians based on durations from very small sample sizes and hence with relatively large margins of error.

Clearly more men than women cycle for transport purposes in the previous seven days (5.1% compared with 1.6%). Similarly, more men than women cycle for sport/recreation in the previous seven days: 8.2% of men compared with 3.9% of women, 95% CIs [6.6, 9.9] and [2.8, 5.1] respectively. Cycling data from the NZHTS and from several other countries shows a similar gender difference (eg Australia; Bauman et al 2008). The exceptions are countries like the Netherlands where cycling is very common and women cycle more than men (Bauman et al 2008).

Table 3.4 Demographic comparisons (ANZS 2007/08): Adults (16+ years) who cycle for active transport (at least 10 minutes at one time during the previous week)

Ty6		Unweighted count	Do 10+ minutes [95% CI]0	Mean minutes [95% CI]	Median minutes (participants only)
Total		*4427*	3.3% [2.5, 4.2]	3.4 [2.4, 4.4]	90
Gender	Male	*1847*	5.1% [3.6, 6.7]	5.6 [3.7, 7.5]	100
	Female	*2580*	1.6% [1.0, 2.3]	1.4 [0.6, 2.3]	60
Age	16–24	*519*	4.2% [1.8, 6.5]		
	25–34	*708*	3.3% [1.5, 5.1]		
	35–49	*1283*	4.6% [2.9, 6.3]		
	50–64	*946*	3.1% [1.6, 4.6]		
	65 plus	*971*	0.5% [0.2, 0.8]		
Urban area	Auckland	*1068*	1.6% [0.7, 2.5]		
	Wellington cities	*383*	4.2% [1.5, 6.8]		
	Other TLAs in MUAs	*1686*	4.0% [2.6, 5.4]		
	TLAs outside MUAs	*1290*	3.9% [2.4, 5.5]		
Vehicle: adult ratio in household	0	*298*	3.7% [0.9, 6.4]		

Ty6		Unweighted count	Do 10+ minutes [95% CI]0	Mean minutes [95% CI]	Median minutes (participants only)
	0.01–0.49	*153*	2.0% [0.0, 4.3]		
	0.5	*743*	4.1% [2.1, 6.1]		
	0.51–0.99	*331*	5.5% [2.2, 8.7]		
	1	*2192*	2.8% [1.7, 3.8]		
	>1	*706*	3.0% [1.3, 4.7]		

The only clear age difference in table 3.4 is that cycling for transport is particularly rare among those aged 65 years or more (only 0.5% reported cycling for transport in the previous week).

Table 3.4 does not show significant differences between the four urban areas selected for comparison. This reminds us of the difficulty of clearly showing differences between such small percentages, where even a result twice as large as another may not be significantly different. Census journey-to-work results have shown consistent differences between cities over the years. In the 2006 Census, Christchurch, Nelson and Palmerston North had relatively high proportions cycling to work (6%–7%), whereas Auckland had clearly lower proportions (around 1%)[10].

Nor does table 3.4 show clear differences in cycling related to car availability. In contrast, an international literature review about commuting by bicycle provides 11 references stating car ownership is associated with less cycling compared with only one study finding that the two seem unrelated (Heinen et al 2010).

3.5.4 Cycling for transport: secondary demographic comparisons

We skimmed other demographic comparisons for cycling, similar to those reported in section 3.5.2 for walking. However, because of the difficulty of reliably detecting differences of both statistical and practical significance among such small percentages, we did not find any worth presenting in more detail.

3.5.5 Do some demographic groups particularly tend to walk for one purpose but not the other?

Given that the ANZS is one of the very few data sources to distinguish walking done for transport purposes as opposed to sport/recreation, it provides a rare opportunity to check for any striking differences between major demographic groups in the balance of similar activity for transport and sport/recreation.

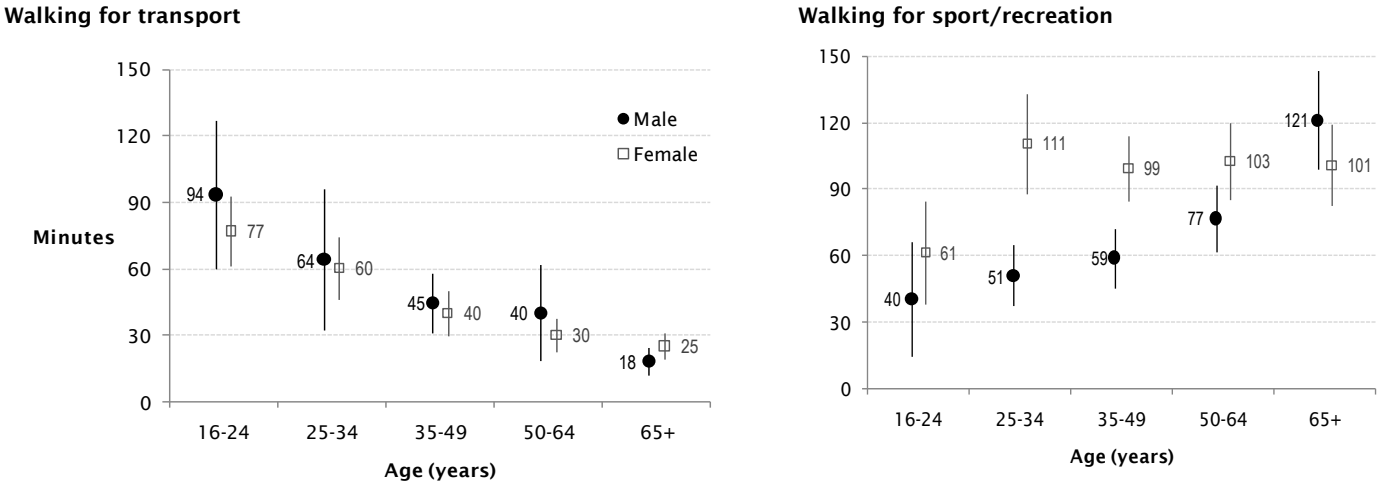
There are some important differences between walking for transport and walking for sport/recreation in terms of the core demographics of age and gender. Figure 3.1 shows that mean time spent walking for transport falls steadily with age (for both men and women). In sharp contrast, walking for sport/recreation shows the youngest age group does the least and there are clear gender differences for the 25–34 and 35–49 year age groups.

This contrast between the transport and sport/recreation results suggests potential target markets for policy- and decision-makers wanting to encourage walking for transport. These large differences would be obscured if walking for both purposes is combined. Such obscuring is unavoidable with the short form of the NZPAQ because it asks about brisk walking done for recreation or transport (combined in a single

[10] Analysis from census data downloaded 11 March 2009 from www.stats.govt.nz

answer). Hence preliminary results from the Nutrition and Physical Activity Survey 2009/10 (H Carr, pers comm, 27 October 2010) show no sharp differences for age groups between 15 and 65 years; for example, those aged 15–24 and 55–64 years both averaged 3.3 days in the previous week on which they walked briskly (for at least 10 minutes at a time). Also, an earlier NZTA report with results from a 2003 sample of over 8000 New Zealand adults using the short form of the NZPAQ showed few clear age/gender differences apart from a decline for those aged over 80 years (Sullivan and O'Fallon 2006).

Figure 3.1 Time spent walking during previous seven days: mean minutes and 95% confidence intervals (ANZS 2007/08)



Note: The lines extending above and below each plotted point show margins of error (95% confidence intervals).

In general, as reported in section 3.2, walking and jogging for transport is less commonly reported for the previous week than walking and jogging for sport/recreation: 36% reported at least one instance of doing 10 minutes or more walking/jogging for transport (compared with 49% for sport/recreation). Walking/jogging for transport has a mean of 49 minutes in the previous week compared with 91 minutes for sport/recreation. The disparity is particularly strong for the demographic groups shown in table 3.1 (table C.1 on p34 provides complete sets of results for demographic groups, eg all age groups, and confidence intervals for the percentages). Strength of the disparity was judged by highlighting groups with largest differences between percentages and most extreme ratios between the mean minutes.

Table 3.5 Major demographic groups whose walking/jogging for transport is notably *low* compared with walking/jogging for sport/recreation (ANZS 2007/08)

Group	% reporting 10+ minutes in previous week		Mean minutes	
	Transport	Sport/ recreation	Transport	Sport/ recreation
Age 65+	25%	56%	22	111
Occupation: retired	26%	57%	23	108
Occupation: business manager/executive	30%	56%	35	98
Occupation: business proprietor or self employed	30%	54%	34	104
Household income adjusted for	26%	52%	28	98

Group	% reporting 10+ minutes in previous week		Mean minutes	
	Transport	Sport/ recreation	Transport	Sport/ recreation
household size >$100,000				
Main working environment: in a house	28%	49%	23	94
Main working environment: in a vehicle	28%	50%	21	95

However, some groups tend to reverse this pattern with a higher proportion walking/jogging for sport/recreation. The most noteworthy reversals are summarised in table 3.6 (although even with these groups the mean time spent walking/jogging for sport/recreation sometimes exceeds that for transport).

Table 3.6 Major demographic groups whose reporting of some walking/jogging for transport is relatively high compared with walking/jogging for sport/recreation (ANZS 2007/08)

Group	% reporting 10+ minutes in previous week		Mean minutes	
	Transport	Sport/ recreation	Transport	Sport/ recreation
Ethnicity: Pacific people	48%	39%	144	80
No car available in household	59%	48%	102	127
Occupation: student	60%	39%	94	77

4 Active transport and health benefits

4.1 Introduction

The main objectives for this chapter are to quantify the proportion of adults meeting key health guidelines for physical activity through active transport alone, the proportion for whom active transport makes a clear contribution to their meeting key health guidelines, and demographic differences in these proportions. While doing this, wherever possible we also show how the ANZS analysis might contribute to improving the economic evaluation of health benefits relating to active transport as reported on recently for the NZTA (Genter et al 2008).

By way of introduction, we first briefly summarise evidence of health benefits from transport and the current New Zealand guidelines for physical activity. Then we consider how health benefits affect transport sector decisions through benefit–cost analysis for project evaluation.

Overall, there is clear agreement that active transport does have health benefits.

> *The health benefits of walking and cycling for transport are well-established, and comparable to those traditionally associated with more structured sport and exercise programs.* (Garrard 2009, p2)
>
> *There is a body of research demonstrating that physical activity reduces the risk of numerous chronic health conditions. Specific evidence exists for the protective effect of active transport engagement on CVD [cardiovascular disease], certain cancers and obesity, all of which are serious health concerns in New Zealand*. (Genter et al 2008, p34)

More specifically, a recent meta-analysis of eight studies shows an 11% overall reduction in cardiovascular risk associated with active commuting and a meta-analysis of 18 studies of walking shows reductions of 31% for cardiovascular disease and 32% for all-cause mortality (Hamer and Chida 2008). Associated economic impacts may be considerable. For example, recent research from Australia estimated that health benefits from recreational and commuter cycling totalled around A$150 million per year (Bauman et al 2008). Given that such material on health benefits of physical activity has been recently summarised thoroughly by others in New Zealand (Beca Infrastructure Ltd 2007; Genter et al 2008), we have not repeated the evidence in this report.

Since 2001, the New Zealand adult guidelines for physical activity (Ministry of Health 2010) have stated:

1 View movement as an opportunity, not an inconvenience.

2 Be active every day in as many ways as possible.

3 Put together at least 30 minutes of moderate-intensity physical activity on most if not all days of the week.

4 If possible, add some vigorous exercise for extra health benefit and fitness.

Guideline 3 is the focus of measurements assessing compliance with the national physical activity guidelines, ie adults are classified as meeting the '30 x 5' guideline if they do at least 30 minutes of moderate intensity physical activity on five or more days of the week (where each minute of vigorous intensity activity is counted as the equivalent of two minutes of moderate intensity activity). The ANZS shows 48.2% of adults (44% of women, 52% of men) meet this guideline. The ANZS result (based on the detailed seven-day activity diary, NZPAQ–Long Form) is similar to that from the most recent NZHS (which

used the NZPAQ-Short Form). The 2006/07 NZHS found that half of all adults (50.5%) met the definition of being regularly physically active.

The focus on the health guidelines should not be misinterpreted as suggesting that lesser amounts or intensities of physical activity are entirely irrelevant to health. On the contrary, increases in physical activity that move someone away from being totally sedentary may be particularly beneficial (Blair et al 2004; Bauman et al 2008). But the guidelines do provide a useful focus for analysis which complements the broader results concerning all transport-related walking and cycling in the previous chapter.

Health benefits are also recognised in transport project cost-benefit analysis, including NZTA's *Economic evaluation manual* (NZTA 2010b). Where new infrastructure (eg a cycle lane, walkway or other facility) or another initiative (eg travel planning; advertising campaign) are proposed, it is assumed that some people prompted to walk or cycle as a result will shift from being 'inactive' to being 'active' or from 'sedentary' to 'inactive' or 'active'. The emphasis is on assigning benefits to walking and cycling as forms of active transport, not for recreational purposes. Total health benefits of cycling for transport are currently assessed as $1.30/km and of walking for transport as $2.60/km). Yet, the ability to determine how much of the resultant walking and cycling is for transport-related reasons rather than recreational or leisure purposes has, until the ANZS, been severely limited.

4.2 What proportion of active transport contributes to meeting health guidelines?

As preparation for dealing with the main objectives of this chapter, we first briefly describe how different types of active transport differ with respect to the proportion of time relevant to meeting health guidelines (ie at moderate or vigorous intensity). The survey definitions for light, moderate, and vigorous activity are in table 2.2 on p15.

Of the total hours spent doing all forms of active transport (for 10 minutes or more at one time) recorded in the survey, 57% was reported to be at the moderate or vigorous intensity levels relevant to the health guidelines.

Variation by mode is to be expected (and is relevant to transport evaluation of health benefits). For example, 85% of time spent cycling as transport was reported as moderate or vigorous compared with 54% of walking (table 4.1).

Table 4.1 Proportion of total time at moderate or vigorous intensity by mode of active transport (ANZS 2007/08)

Mode	Unweighted participants	% of time moderate/vigorous
All active transport	*1620*	57%
Walk	*1495*	54%
Jog/run	*49*	84%
Cycle	*121*	85%

Note that health benefits for very large amounts of moderate or vigorous activity are far from clear. But how to truncate active transport activity durations to reflect this is even less clear. As outlined in section 2.2.3, there are established truncation procedures in the IPAQ data processing guidelines. But these truncation rules (involving truncation to a maximum of three hours) concern the totals for each of walking, total moderate intensity and total vigorous intensity. Given that moderate or vigorous physical activity

other than active transport may be done on the same day, and in the interests of checking the maximum relevant impact of such truncation rules, we briefly explored the sensitivity of result to truncating total moderate or vigorous intensity active transport to a maximum of two hours. This is clearly less than the IPAQ limit of three hours for all moderate and vigorous intensity activity, but more than the one hour for which health benefits are firmly claimed (eg Blair et al 2004).

This truncation affects only a small number of participants (fewer than 1%, whether on an unweighted or weighted basis). Nevertheless, it has a clear effect on the reported results: for example, the percentage of activity 'relevant' to the health guidelines drops from 57% to only 48%. This provides a clear warning that such analyses are sensitive to the treatment of a small number of high values (particularly if the high values happen to coincide with high statistical weights). Fortunately, this is not relevant to much of the health-related analysis in this report because the health guidelines we based it on effectively ignore any amounts of moderate or vigorous activity beyond the recommended 30 minutes per day.

4.3 What proportion of people meet health guidelines for physical activity through active transport alone?

Focusing on the key 30 x 5 guideline shows that relatively few adults (ie aged 16 years or more) meet this guideline through active transport alone: 3.8%, 95% CI [2.9, 4.8]. While small, this percentage nevertheless represents about 125,000 adults per week across New Zealand.

By way of comparison, 20.3% meet the guideline from sport and recreation activity alone and 15.8% through their occupational activity alone. Of course, it is possible that these comparisons are somewhat biased if self-report of physical activity is more complete or even over-reported for some of these domains (eg sport and recreation) than for others. For example, participating in a game of rugby may well be more memorable than a routine walk to shops.

4.4 Are people who use active transport more or less active overall than those who don't?

One related question of interest is whether those who incorporate active transport in their lifestyle are more or less active overall than those who do not engage in active transport. Those recording at least 10 minutes of walking for transport (at one time) in the previous week were no more likely to meet the health guidelines than those recording no such walking for transport.

However, there was a clear difference for those recording at least 10 minutes cycling for transport in the previous week: 66% doing such cycling met the 30 x 5 health guideline compared with only 48% of those who did not (with non-overlapping 95% CIs [57.0, 74.4] and [45.5, 49.5] respectively).

Of course, a point-in-time survey like the ANZS cannot answer more complex questions such as whether those doing active transport are increasing their physical activity levels above what they would be achieving otherwise or whether they are substituting active transport for other types of physical activity.

4.5 Proportion of people for whom active transport contributes to meeting health guidelines

Taking a broader approach to the health guidelines, one can see a contribution of active transport to overall physical activity levels for many more people. About 25% of the adult population, 95% CI [23.0, 26.8], recorded at least one instance of 10 minutes or more of moderate or vigorous active transport

during the previous seven days (excluding occasions when they did an activity for less than 10 minutes at a time).

As there are no particularly strong conventions, other than the 30 x 5 guideline, for describing how different activities such as active transport contribute to meeting health guidelines in New Zealand, we considered several options (see table 4.2).

Table 4.2 Various levels of contribution by active transport to meeting health guidelines (ANZS 2007/08)

Level of contribution by active transport	% of total adults [95% CI]
'30 x 5' – 30 minutes of active transport at moderate intensity (or equivalent*) on 5 or more days of the week	3.8% [2.9, 4.8]
'30 x 3'	6.5% [5.3, 7.7]
'30 x 2'	9.8% [8.3, 11.2]
'30 x 1'	15.5% [13.9, 17.2]
1 ¼ hours of active transport at moderate intensity (or equivalent*) during week (≈one-half of a weekly guideline of 2.5 hours)	11.6% [10.1, 13.2]
30 minutes of active transport at moderate intensity (or equivalent*) during week	20.0% [18.2, 21.8]
Any active transport at moderate or vigorous intensity recorded during week	24.9% [23.0, 26.8]

* 'or equivalent' indicates that each minute of vigorous activity is counted as 2 minutes of moderate activity.

This analysis provides a somewhat different picture from that suggested by Genter et al (2008 p39):

> *The travel survey data [ie NZHTS] on walking and cycling leads to two well-founded conclusions:*
>
> - *A very small proportion of the population currently walk or cycle for transport reasons (less than 10 percent), and this proportion has been decreasing steadily for well over a decade (MoT 2008).*
> - *When people do walk and cycle for transport they are, on average, active enough (or nearly), to meet the recommended daily minimum of 30 minutes of activity.*

Genter et al (2008) seem simply mistaken in their interpretation of the Ministry of Transport's NZHTS data (in their first bullet point above). They cite a Ministry of Transport document with an analysis of NZHTS data (Ministry of Transport 2008b) which does suggest an overall decline in the mode share of walking and cycling compared with the previous decade. This document also shows a statistically significant drop in average time spent walking or cycling for the 5–14 year age group since 1989/90. But the Ministry of Transport's documents do not provide evidence to support the claim that less than 10% of the population walk or cycle for transport reasons, nor do any of the NZHTS results summarised earlier in the report by Genter et al (2008). Our analysis of the NZHTS 2006–2009 shows that even if one limits the time frame to a single day, then 27% reported some walking or cycling (26% for those aged 16 years or older). The ANZS dataset can provide a more specific figure for the proportion of the (adult) population who 'walk or cycle *for transport reasons'*: table 3.1 on p21 shows that 38% of adults walk, jog/run or cycle for transport

purposes during a week. Despite this only counting occasions when they do so for at least 10 minutes at one time, it is again far above the 10% mentioned in the quote above and is clearly not 'a very small proportion of the population'.

Furthermore, the detailed ANZS data indicates that much of the walking and cycling within the scope of the NZHTS is not mainly 'for transport reasons'. For example, excluding mountain biking, the ANZS shows 18 million hours of road cycling for sport/recreation compared with 10 million hours cycling for transport. Comparisons between ANZS and NZHTS results are discussed further in section 5.2.

4.6 Demographic comparisons

4.6.1 Active transport contributing to meeting health guidelines: main demographic comparisons

For examination of demographic differences, we decided to focus on those doing 30 minutes of moderate activity (or equivalently 15 minutes of vigorous) per week through active transport. The proportion of adults doing this amount of active transport, 20%, is large enough to allow for demographic differences of interest to emerge. Also, this level parallels SPARC's category of 'Some activity' for adults not meeting the 30 x 5 recommendation but achieving at least 30 minutes of moderately intensity physical activity over seven days (done by 39% of adults; SPARC 2008, p15). A final reason for the choice is that it seems a reasonably clear contribution to meeting the health guidelines; for example, it may reflect meeting the full requirement for one day, or contributing to meeting the requirements for several days of the week.

Table 4.3 shows major demographic comparisons similar to those done for walking and cycling earlier (then ignoring intensity level of activity). With respect to doing at least 30 minutes of active transport at a moderate level (or equivalent) in the previous week:

- Men and women are similar.
- Older adults report clearly less moderate/vigorous active transport (11 minutes per week on average by those aged 65 or more years compared with 56 minutes for those aged 16–24).
- Wellington cities stand out as having a significantly higher proportion of adults (33%) doing this (compared with only 16% for respondents resident outside MUAs).
  - This is consistent with Wellington's relatively high use of active transport and public transport (remembering that public transport also typically involves some walking). For example, 2006 Census journey to work results for Wellington cities show bicycle or walked/jogged as the main mode for 13% (compared with 9% nationwide) and public bus or train for 17% (compared with 5% nationwide).
- Those without a vehicle usually available in the household are also more likely to do this (32% compared with only 16% for those with one vehicle available for each adult); this difference remained clearly significant statistically even when age and urban area were controlled for.

Table 4.3 Demographic comparisons (ANZS 2007/08): Adults (16+ years) who did active transport at moderate or vigorous intensity during the previous week

		Unweighted count	Did 30+ minutes (or equivalent*) [95% CI]	Mean minutes* [95% CI]	Median minutes* (participants only)
Total		*4427*	20% [18.2, 21.8]	33 [25.3, 41.6]	60
Gender	Male	*1847*	19% [16, 21.1]	39 [23.2, 55]	80
	Female	*2580*	21% [19.1, 23.6]	28 [23.3, 33.1]	60
Age	16–24	*519*	30% [25.2, 34.5]	56 [35.6, 75.5]	70
	25–34	*708*	23% [19.3, 27.2]	44 [26.4, 61.7]	80
	35–49	*1283*	19% [16.5, 22.4]	34 [26.1, 41.2]	80
	50–64	*946*	17% [13.9, 20.4]	25 [11.7, 38.8]	50
	65 plus	*971*	11% [8.5, 14.2]	11 [7.8, 13.2]	40
Urban area	Auckland	*1068*	22% [18.8, 25.3]	50 [21.9, 78.7]	60
	Wellington cities	*383*	33% [27.9, 38.5]	45 [26.4, 63.2]	90
	Other TLAs in MUAs	*1686*	19% [15.9, 21.2]	24 [18.2, 29.3]	60
	TLAs outside MUAs	*1290*	16% [12.8, 18.4]	25 [16.6, 33.4]	60
Vehicle: adult ratio in household	0	*298*	32% [26.2, 37.9]	62 [39.4, 85.2]	80
	0.01–0.49	*153*	30% [22.4, 37.8]	101** [0, 222.7]	90
	0.5	*743*	25% [21.5, 29.3]	35 [28.1, 42.7]	80
	0.51–0.99	*331*	26% [20.2, 31.1]	47 [30.1, 64]	90
	1	*2192*	16% [13.4, 17.9]	21 [15.9, 25.9]	60
	>1	*706*	16% [12.2, 19.5]	26 [16.7, 36.3]	60

* Vigorous minutes counted as equivalent to 2 minutes of moderate activity

** This high mean and unusually wide confidence interval reflects one or two extremely high durations of moderate/vigorous active transport in this relatively small subgroup.

4.6.2 Active transport contributing to meeting health guidelines: secondary demographic comparisons

Other demographic comparisons are appended for reference in table C.2 on p70. Again, we did not try to identify all demographic differences that might reach statistical significance here; rather we aimed to highlight the few largest differences for groups of practical interest. Our focus was on differences between proportions for pragmatic reasons: confidence intervals could quickly be presented for large numbers of proportions but not the means and medians. Most of these secondary comparisons add little or no clear value beyond to the differences described in table 4.3. The most noteworthy exceptions relate to work:

- Significantly more part-time workers (less than 30 hours a week) reported 30 minutes or more of active transport at a moderate or vigorous level in the previous week (27% compared with 19% for full-time workers and 18% for non-workers). This difference remained clear even after controlling for age, sex, and urban area.
- Those whose main working environment was in a vehicle reported such active transport less often. Only 6% reported 30 minutes or more in the previous week, much lower than the 20% of adults in general. This difference remained clear even after controlling for age, sex and urban centre.

There are various reasons why the remaining demographic comparisons are of little interest.

First, some comparisons are listed purely for reference but are otherwise ignored because it is more worthwhile to focus on closely related variables:

- Number of vehicles available in the household is listed. But because practical impacts of such numbers are very different for a household with five adults than for a single occupant household, the analysis in section 4.6.1 by vehicle: adult ratio seems clearly preferable.

Second, many show no differences large enough to be of both practical and statistical significance:

- ethnicity, presence of children in the household (separately for aged under 5, 5–12, 13–15), whether they have an educational qualification beyond school taking three months or more to complete, BMI[11], household income, household income adjusted for household size, NZiDep, hours of computer use (excluding work/school), computer hours, and TV/DVD/video and computer hours combined.

Third, although the following show differences between percentages that appear large enough to be of some interest (as shown by the confidence intervals in table C.2 on p70), the differences are not statistically significant when the analysis controls for age, gender and/or urban area. For that reason, we see little practical point in drawing much attention to them:

- number of children aged 15 years or younger, whether have any secondary school qualifications, highest education qualification, TV/DVD/video hours.

Also related, occupation as recorded in this survey does show some clear differences in table C.2. For example, 37% of students recorded 30 minutes or more of active transport at a moderate or vigorous intensity compared with only 12% of 'retired' people. But if scope of the analysis is reduced to those in paid work (ie excluding students, home duties, the retired, beneficiaries), then there are no significant differences when analysis controls for gender, age and urban area.

4.6.3 Comparison with other related analyses

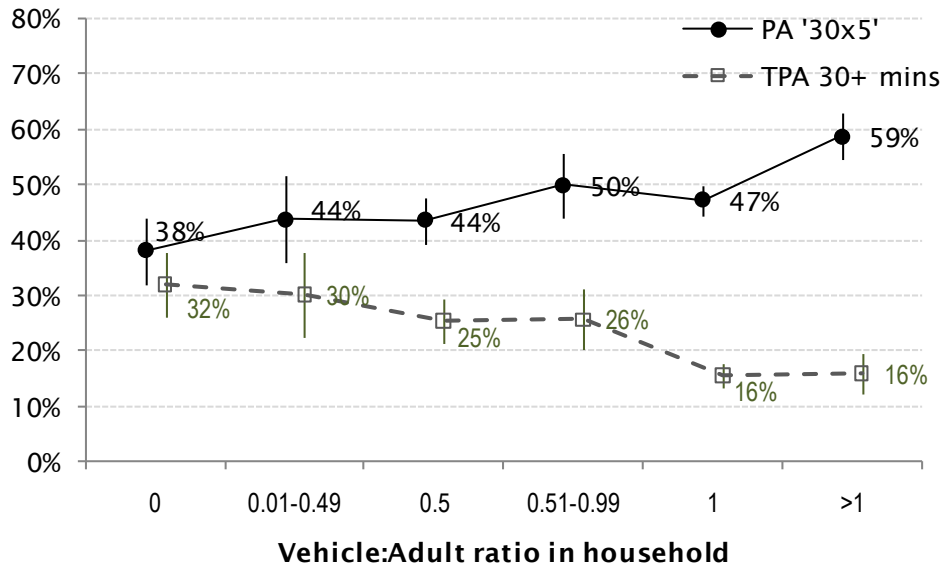
The rich detail available in the ANZS can clarify questions raised by other analyses.

For example, a survey of 2000 adults in North Shore in 2005 (Badland and Schofield 2008) also found that limited vehicle availability increased active transport (as measured by usual mode of travel to work/study or to 'convenience store'). However, they found a surprising pattern of results in that the increased level of activity accumulated through travel for this group was not reflected in overall physical activity level accumulation (as assessed by the NZPAQ–Short Form). Indeed, those with no private car available (an

[11] Nor are differences by BMI categories such as obese or overweight statistically significant when we also control for education and household income as done in a telephone survey of 1989 North Shore City adults. They found that respondents who used cars to get to their place of work/study were about half as likely to be classified with normal BMI as those who walked or cycled (for the whole trip).

admittedly small group) were significantly *less* likely to meet health guidelines for PA. Despite measuring vehicle availability and physical activity in somewhat different ways, the ANZS replicates this finding with a nationwide sample (figure 4.1).

Figure 4.1 Contrasting physical activity patterns with vehicle availability (ANZS 2007/08)



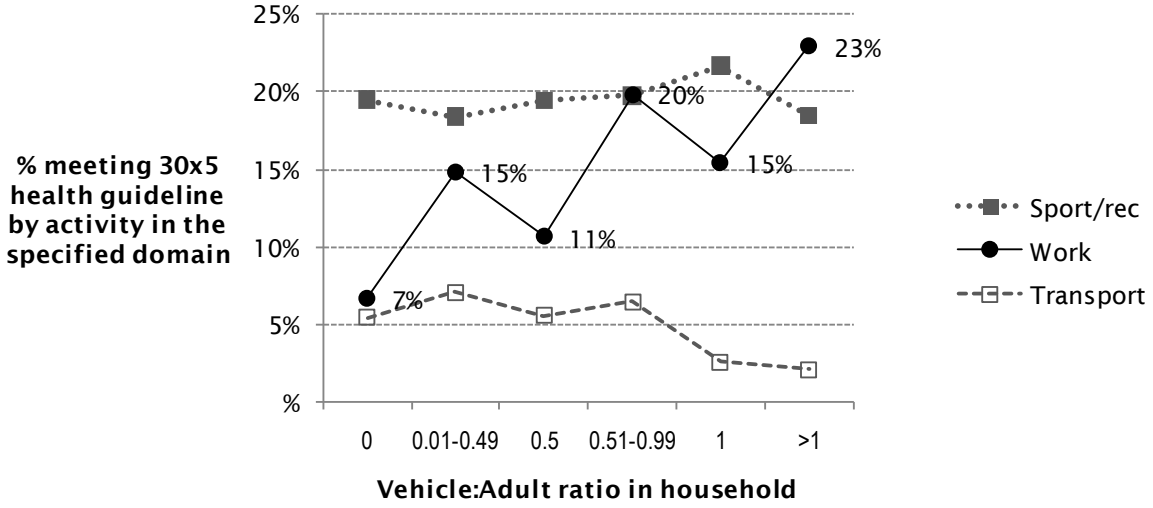
Notes: PA '30x5'=proportion recording at least 30 minutes of moderate PA (or equivalent) for at least 5 days in previous week; TPA 30+ mins=proportion reporting at least 30 minutes or moderate activity (or equivalent) for transport purposes in previous week

However, because of the less detailed measurements of physical activity in the NZPAQ-Short Form (which combines together SRPA and TPA), it was not possible to explain more fully the underlying causes of this unusual pattern of results using the North Shore survey data. The authors (Badland and Schofield 2008) proposed that it might have occurred because more economically advantaged people have access to cars but also do more SRPA (which is major contributor to meeting health recommendations), or even because of limitations of self-report physical activity measures, specifically that SRPA is more readily recalled.

The ANZS provides more detailed data to help clarify this surprising pattern. The explanation seems to lie with participating in physical activity while at work. Figure 4.2 shows that the proportion doing sufficient physical activity at work to meet health guidelines increases with vehicle availability (from 7% for those with no vehicle available in the household to 23% for those with more than one vehicle per adult)[12], whereas the proportion doing sufficient sport/recreational PA to meet health guidelines seems unrelated to vehicle availability. Another way of illustrating the same point is to consider the average number of days where respondents reported 30 minutes or more of moderate/vigorous physical activity at work. Those with no household vehicles available averaged only half a day a week, 95% CI [0.3, 0.8]; those in households with more than one vehicle available per adult averaged two such days, 95% CI [1.7, 2.2].

[12] Despite these being relatively small groups, (298 respondents without any household vehicle, 706 with vehicle:adult ratio above 1), this difference is clearly significant. The 95% confidence intervals are: [2.9, 10.4] and [19.0, 26.8].

Figure 4.2 Physical activity at work sufficient to meet health guidelines increases with higher vehicle availability (ANZS 2007/08)



4.7 Relevance of such results to health benefits calculations in transport

A recent NZTA report on evaluating health benefits associated with active transport noted that 'the valuation in this report is limited by a poverty of data' (Genter et al 2008, p15). They also recommended updating the benefit values they had estimated as new data sets became available (Genter et al 2008, p58). The ANZS and NZHTS datasets provide data to alleviate the apparent dearth of information a little as well as providing the opportunity to update benefit values.

For example, the datasets can be used to check assumptions made while estimating health benefits. As an illustration, the average speed of 20km/h assumed for cycling (Genter et al 2008, p12) seems surprisingly high when a major WHO report on economic appraisal of health effects of active transport uses 14km/h (WHO 2008). Shepherd (2008) proposed an average of 16km/h based on American College of Sports Medicine guidelines, while another source, published since Genter et al (2008), gives an average of 15km/h for cyclists in Dutch cities, including stops while waiting for traffic lights (Zuurbier et al 2009).

Locally, our analysis of the NZHTS 2003–09 gives an average cycling speed just over 13km/h (based on 1999 cycling trip legs by respondents aged 15 years or more). If we limit the analysis to commuting (defined as cycling to work or education) by those aged 15 years or more, the NZHTS gives a similar average cycling speed (13.1km/h). Admittedly, speed estimates in the NZHTS could suffer inaccuracy as they rely on duration calculations derived from respondent-provided start and finish times which are often rounded to the nearest five minutes. But given the consistency with international estimates and lack of source for the assumption of 20km/h, assuming an average of around 13 or 14km/h seems preferable to 20km/h. Adopting a value of 13 to 14km/h for cycling has implications for the metabolic equivalent (MET) value (the ratio of the associated metabolic rate for the specific activity divided by the resting metabolic

rate) for cycling. If Ainsworth et al (1993)[13] is adhered to, 13 to 14km/h is the equivalent of 4 METs, rather than 7 METs as proposed by Genter et al (2008). Adopting the value of 4 METs, and a speed of 14km/h for cycling, means cyclists would need to be active for slightly less time than walkers to receive the same benefits. This could have the effect of reducing the proposed per km values for cycling in (Genter et al 2008) by around 20%. The effect on per km values for cycling actually in use in the NZTA's *Economic evaluation manual* is less clear: the 'health' benefit value of $1.30 per km there for cycling for new facilities (NZTA 2010b, pp8–11) is markedly less than the $2.14 (medium scenario) in Genter et al. Various reasons for the difference are documented (S Fong, pers comm, 3 November 2010), but not done in a formal analytical report that would enable us to readily quantify the impact on benefit values of a lower assumed speed for cycling.

In reporting on the average cycling trip length/distance and average number of trips per day by cyclists, it is unclear why Genter et al (2008) derived these figures from an assumed speed (refer p37 'Assuming an average speed of 20km/hour, the average cycle trip distance and frequency would be 5–6km for 2 trips, or 3–3.5km for 3 trips'). It seems clearly better to use the accurate geocoded distances travelled for cycling provided in the NZHTS datasets. For example, for those aged 15 years or more (the age groups reported by Genter et al), the NZHTS 2003–09 shows an average of 7.5km per day for those who did any cycling over the two-day survey period. This is a distinctly lower average distance than the 9–12km implied by the distances and trip numbers in Genter et al.

The ANZS data is useful to quantify the amount of less common modes of active transport. Only 0.1% reported any roller-skating/roller-blading for transport during the previous week, and 0.2% skateboarding for transport. Hence these modes at this time do not seem to warrant detailed treatment when valuing health benefits of active transport modes in future reports like Genter et al (2008).

[13] Ainsworth et al (1993) is the source cited by Genter et al (2008). The *Compendium of physical activities* was updated, with explanations, by (Ainsworth et al 2000) The full *Compendium* is available from http://prevention.sph.sc.edu/tools/docs/documents_compendium.pdf

5 Comparability of active transport levels with other datasets

5.1 Introduction

In recent years, an increasing amount of data on active transport has been collected by different government agencies (Ministry of Transport, SPARC, Ministry of Health). This provides both opportunities and risks. The opportunities include:

- Potential for cost savings by reducing data collection costs through shared studies or re-use of data from other sectors:
  - Data collection costs are very high for high-quality face-to-face nationwide surveys like the ANZS and NZHTS.

Risks include:

- Conflicts between multiple data sources on related issues:
  - Although several major surveys now collect data on walking and cycling, differences in the data collection methods and survey purposes may lead to substantial differences in results. Such differences may cause users to become confused about or mistrustful of the results.
- Misinterpretation of data:
  - Users from one sector may misinterpret results by wrongly assuming that walking/cycling data collected in another sector uses methods comparable to their sector. For example, transport users might not realise that ANZS and NZHS data on walking and cycling only count times when 10 minutes or more is done (let alone that health analysts may routinely truncate or transform to reduce the impact of extremely high durations).
  - Reaching consensus about wording/terminologies/classifications because different agencies might have different monitoring guidelines that need to be taken into account.

This project aimed to maximise benefits from the opportunities above and reduce the risks. Risks are reduced by:

- clarifying how much results from the NZHTS and ANZS datasets differ
- explaining reasons for major differences
- involving representatives from transport, health and physical activity agencies in the project.

5.2 Comparability with the NZHTS

5.2.1 Walking/running

The NZHTS 2006–09 estimates 57 minutes of walking/running per adult per week by those aged 16 years or more (where running is collected together with walking and not separable from it). This is equivalent to 163 million hours per year nationwide. Although collected as part of a transport survey and hence affected by the purposes of such a survey, this does not only consider walking/running done for transport purposes as opposed to recreation. Rather the NZHTS aims to include any movement on a public street, footpath, railway line and so on of more than 100 metres. Walking/running trips less than 100 metres are

to be included if a road is crossed or if there is a change of purpose from last trip. In contrast to the ANZS, walking/running away from public streets and footpaths (eg in parks or farmland) is out of scope as it is not relevant to road safety measurement or use of the transport system.

As a starting point for considering broad comparability between surveys, we used the ANZS to estimate total hours per year walking and jogging/running (both for transport and sport/recreation): 2.3 hours per adult per week (400 million hours per year in total nationwide). This is clearly different from the NZHTS estimate of 57 minutes and warns that dramatically different figures for 'total walking' or 'average walking/running' per adult may be reported depending on the source.

Are these figures contradictory or merely measuring different things? Major underlying sources of difference include:

- The NZHTS walking/running figures include walking/running that ANZS respondents would not record because the activity was for less than 10 minutes 'at one time':
  - We can improve comparability due to this by excluding NZHTS trip legs that are less than 10 minutes long. This reduces the NZHTS walking/running from 57 to 45 minutes per week[14] (and so increases the gap between NZHTS and ANZS estimates).
- The ANZS estimate includes walking/running away from roads (eg in a park or on farmland) that NZHTS respondents do not report because it is out of the NZHTS scope (ie not on a public street or footpath, and does not involve crossing a road):
  - We have no easy solution from either survey to quantify this difference. The ANZS seven-day activity diary does not record where the walking/running occurred, so we do not have a simple way of excluding this to improve comparability with the NZHTS.

We saw no feasible way to produce walking/running results from each survey that would be exactly comparable. So we also checked whether other results roughly seemed the right size relative to each other. For example, if we switched to considering the ANZS total of walking/running *for transport purposes*, it seems reasonable to expect this to be clearly *less* than the NZHTS total for walking/running (excluding trip legs less than 10 minutes) of 45 minutes per week because the NZHTS total should still include a substantial amount of walking/jogging along public footpaths and roads that the ANZS has classified separately as sport/recreation. However, the ANZS total of walking/jogging for transport purposes is 49 minutes, 95% CI [42, 57].

Major reasons for the difference between ANZS estimates of walking/jogging for transport and NZHTS estimates of roadside walking/jogging (which we assume should include a substantial amount of walking/jogging for sport/recreation) are:

- Probable under-reporting in the NZHTS of walking/jogging:

[14] But note that the exclusion of trip legs recorded as being less than 10 minutes long may not be consistent with how the ANZS excluded activities lasting less than 10 minutes at a time. First, because short durations in the NZHTS are often inaccurately recorded because these are derived from starting and ending times which respondents often round to the nearest 5 minutes or so. Second, because a trip leg in the NZHTS ends if a person stops even briefly for a purpose such as briefly dropping off or picking up something (whereas in the ANZS, if the stop was only brief, respondents might well have treated the walking/running as effectively continuous).

  - Comparing objective global positioning system (GPS) data with trip diaries both in the US and Australia has shown that traditional trip diaries like the NZHTS generally under-report trips (Stopher and Greaves 2009).
  - Respondent fatigue, that is, respondents quickly realise that every trip they mention will result in several follow-up questions.
  - We suggest that NZHTS respondents may sometimes not report walking/jogging for sport/recreation even when it is along roads because they do not see such 'non-transport' activity as relevant to a transport survey (despite it being formally within the scope of the NZHTS). In contrast, such walking/running may come to mind more easily (and not suffer from any doubts about relevance) for a survey like the ANZS about sport/recreation and physical activity.
  - Possibly the 'memory jogger' that NZHTS respondents may use to record travel before the interview contributes a little to underreporting. It prompts recording trips with 'I went to'; if a person simply leaves their home to walk/jog around several blocks and then return home, they may not think of this as going to anywhere and so may not think of recording this in the memory jogger. However, the actual effect of this detail of the memory jogger may be minor given that the prompted travel recall during the NZHTS interview aims to be more comprehensive by prompting with 'What did you do next?'

- Possible over-reporting in the ANZS of walking/jogging:
  - As explained in more detail in appendix A, self-report physical activity surveys like the ANZS have often shown over-reporting when compared with objective measures.
  - Possible rounding up to the 10-minute threshold for activity 'at one time' in the ANZS trip diary. That is, whereas an eight-minute walk might be recorded as such in the NZHTS (and hence excluded from our comparisons of trips 10 minutes of more), some respondents may have included such walks in the ANZS if they felt the duration was close enough to the 10 minute threshold to justify reporting that physical activity.
- Different treatment of work-related active transport in the two surveys:
  - Some respondents with substantial amounts of work-related active transport (eg posties, cycle couriers) may have completed the ANZS and reported that activity as active transport[15]. The NZHTS now excludes such activity (just as it does similar activity by professional drivers such as taxi drivers or courier drivers).

ANZS results show that around 1 in 3 (33%) of adults do some walking, running or road cycling for sport/recreation over two days (with very similar results for two weekdays or the weekend). Given that the New Zealand population is highly urbanised, we would expect much of this to be counted in the NZHTS (because it occurs on the road or footpath). But we could not find an easy way to detect such behaviour in

[15] Future users of the ANZS questionnaire may wish to review whether double-counting of work-related active transport is a problem for the purposes of their study. The main check on double-counting in the activity diary is prompted before the work activity is recorded, and no specific instructions were given about how to record active transport done in the course of work (eg by a postie).

the NZHTS two-day diary so as to further improve comparability of the results from the two different datasets for transport-related walking/running[16].

5.2.2 Cycling

Cycling figures from the ANZS and NZHTS should match more closely because the separate mountain-biking category in the ANZS enables us to better separate off-road activity. We would expect the NZHTS result to be a little higher given that it includes activity of less than 10 minutes.

Counting cycling for transport and road cycling for sport/recreation but not mountain biking, the ANZS shows 9.6 minutes per week per adult from the ANZS in the 2007–08 year for those aged 16 years or more, 95% CI [7.4, 11.8]. This is equivalent to 27 million hours per year nationwide. The NZHTS 2006–09 estimates 6.6 minutes per week for those aged 16 years or more; this drops to 6.4 minutes if trip legs less than 10 minutes are excluded to improve comparability with the ANZS results, 95% CI [4.8, 7.9]. Given the relatively large margins of error around such cycling estimates because relatively few adults record any cycling, we see these ANZS and NZHTS estimates as in the same ballpark.

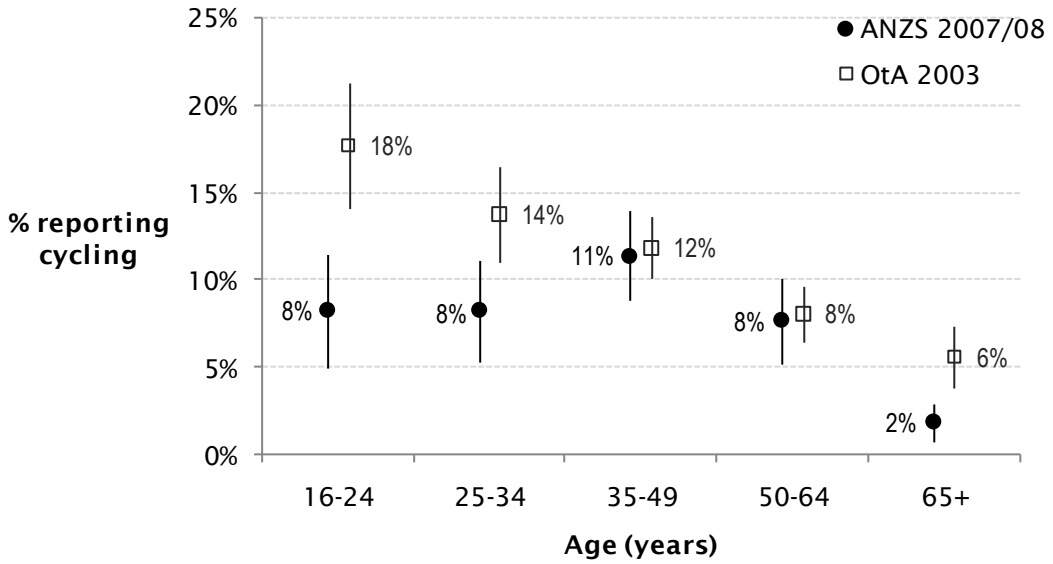
As expected, the NZHTS records more cycling than the ANZS records specifically as active transport (rather than sport/recreation); the ANZS shows 3.4 minutes per week per adult cycling for transport (compared with the 6.4 minutes average from the NZHTS excluding trip legs lasting less than 10 minutes).

5.3 Contrasts with cycling results from the Obstacles to Action survey

It is also worth comparing some cycling results from the ANZS with SPARC's earlier 2003 Obstacles to Action (OtA) survey (Sullivan and O'Fallon 2006). In particular, OtA showed sharp age differences: the proportion self-reporting as 'regular' cyclists (ie, once a week or more often) steadily halved from the 16–24 year age group to the 50–64 year age group for both genders. This is quite a different pattern from the ANZS results about cycling for transport in table 3.4 and from the ANZS results for all cycling as shown in figure 5.1.

[16] For example, we considered approximating this by estimating round trips (ie trip legs in the NZHTS with the same address for the start and the end of a trip leg) where the purpose was Recreation. But there were surprisingly few such trip legs. Many recreational walks have been separately recorded as more than one trip leg, for example, to the park/beach and then back again (L Povey [Ministry of Transport], pers comm, 2 August 2010).

Figure 5.1 Contrasting age differences for cycling between surveys (ANZS 2007/08)



Notes: ANZS 2007/08=proportion reporting any cycling (sport/recreational or for transport) in 7-day diary; OtA 2003=proportion reporting cycling about once a week or more often during previous 3 months

We see the ANZS trip diary as more reliable than the OtA data because the ANZS survey:

- shows a relationship with age more consistent with other data sources
  - NZHTS 2004–2009 results for reporting any cycling during the last four weeks similarly show no decline before age 50 years (percentages of 17%, 16% and 16% for the 16–24, 25–34 and 35–49 year age groups respectively).
  - 2006 Census journey-to-work data does not show a decline in cycling with age from the age of 25 years is reached (eg 2.5% and 2.4% cycling to work for the 20–24 and 40–44 year age groups respectively) (Statistics New Zealand 2010)
- asked for specific reports day by day for the previous week, a shorter and more recent time frame (OtA required only a single response about regularity of cycling during the previous three months)
- the ANZS data was collected over a full year and thus has no major seasonal bias (whereas the OtA data was collected over a couple of months (29 May –31 July)
- for planning or decisions now, ANZS data is more current (collected in 2007/08 compared with 2003 for OtA).

6 Conclusions and recommendations

6.1 Conclusions

6.1.1 Volumes of walking and cycling for transport compared with sport/recreation

Active transport is common: ANZS 2007/08 results show 38% of adults (ie aged 16 years or more) reporting that they walk, jog/run or cycle for transport purposes (for at least 10 minutes at one time) during a week; NZHTS results record 25% of people doing some walking on roads or footpaths on any given day (Ministry of Transport 2009b).

The ANZS provides sound quantification (previously lacking in New Zealand) of the relative size of recreational walking and cycling compared with walking and cycling for transport purposes:

- Of the total time recorded walking in the ANZS trip diary (370 million hours per year), 37% was spent walking for transport purposes and 63% for sport/recreation. Two underlying components contribute to this total time: proportion of adults doing the activity and time spent by such participants. The proportion of adults walking for sport/recreation (45%) in a week (for at least 10 minutes at one time) is slightly higher than the proportion walking for transport (35%). Those who reported any recreational walking typically reported about two hours per week, whereas those reporting walking for transport had a much lower median of about one hour (70 minutes).
- Jogging for transport is relatively rare (reported by only 1.7% of adults in the previous week)
- It has been widely suspected that recreational cycling is more common than cycling for transport in recent years, but clear figures quantifying this have been lacking until now. Time-recorded cycling (including mountain-biking) in the ANZS totals 34 million hours per year. Of this, 29% is cycling for transport purposes and 71% for sport/recreation. Hence adults cycle for sport/recreation about 2.5 times as often as they do for transport. The difference is driven by the greater numbers cycling for sport/recreation in any given week: a significantly higher proportion of adults reported cycling for sport/recreation (6%) during the previous week than for transport (3%). The amounts of time such participants typically spend cycling in a week are similar (median of 90 minutes for transport, 105 minutes for sport/recreation).

Even if mountain biking is excluded, total time spent by adults cycling for sport/recreation (18 million hours per year) is more than cycling for transport (10 million hours per year). This suggests that it may be time to change conventions such as reporting cycling behaviour covered by the NZHTS as 'cycling for transport' (Ministry of Transport 2009a), because most on-road cycling (by adults at least) is probably for sport/recreation rather than for transport.

Many people cycle for sport/recreation but not transport and vice versa, despite the surface similarity of the behaviour. Fully one quarter (25.3%, 95% CI [17.0, 33.5]) of those cycling for transport in the previous week did not report any cycling for sport/recreation over the previous 12 months.

Even with the large sample size of a major survey like ANZS, the relatively low numbers cycling for transport makes it difficult to detect differences between subgroups for cycling. The only large and clear differences were those familiar from previous research covering all cycling: more men than women cycle for transport (5.1% in the previous week compared with 1.6%, respectively), and cycling for transport is particularly infrequent among those aged 65 years or more (only 0.5% in the previous week).

In contrast, there are several large differences in walking/jogging for transport purposes between demographic groups. Walking/jogging for transport:

- decreases with age (eg mean of 91 minutes per week for the 16–24 year age group compared with 35 minutes for the 50–64 year age group and 22 minutes for those aged 65 years or more)
- is much more common in Wellington cities and Auckland (mean of 78 minutes for both) than other areas (other MUAs and areas outside MUAs average 33 minutes)
- is strongly related to vehicle availability in the household – those with one vehicle for two adults averaged about twice as much walking/jogging for transport (60 minutes per week) as those with one vehicle per adult resident (32 minutes).

These patterns are quite different from those for walking for sport/recreation. (Here we temporarily keep jogging separate because jogging for sport/recreation is relatively common and some other major surveys record walking separately but not jogging.) Compared with walking for sport/recreation, walking for transport decreases with age rather than increasing; it also shows no particularly marked gender differences (whereas women aged 25–49 spend about twice as much time walking for sport/recreation as men in that age group). Although large, these differences can be hidden if the measurement of walking done for both purposes is combined as is done in the NZPAQ–Short Form used in the NZHS, the Nutrition and Physical Activity Survey, and several other surveys of physical activity (Badland and Schofield 2008; Sullivan and O'Fallon 2006).

Differences simply in terms of personal or household income groups are not apparent. But some differences of moderate size emerge with more focused measures of socioeconomic deprivation such as the NZiDep (a higher proportion of walking/jogging for transport among those with at least one 'deprivation characteristic'). Such patterns suggest that facilitating active transport (through relevant infrastructure improvements and promotion) may be part of a reasonable strategy for increasing physical activity among lower income groups.

Such results show that a dataset collected for analysis of physical activity rather than for transport analysis can deliver results about volume of transport activity useful to the transport sector. The reverse can also apply: recent analysis of the Sydney Household Travel Survey has shown that transport data can be useful to detect changes over time in active travel sufficient to meet various health-enhancing thresholds (Merom et al 2010).

Apart from possible cost savings in data collection to both sectors, there may be other advantages to using data collected mainly for another sector. Data collected for transport purposes rather than physical activity or health purposes will be less prone to social desirability bias (Merom et al 2010) and this may reduce the over-reporting that is a major concern with physical activity surveys.

6.1.2 Active transport and health benefits

The evidence for health benefits associated with active transport is widely accepted. Analysis of the ANZS active transport results focused on the extent to which this activity contributed towards adults meeting the Ministry of Health's guidelines for physical activity, in particular, the '30 x 5' guideline (that they should 'Put together at least 30 minutes of moderate-intensity physical activity on most if not all days of the week'). With the ANZS, adults were classified as meeting the 30 x 5 guideline if they did at least 30 minutes of moderate intensity physical activity on five or more days of the week (where each minute of vigorous intensity activity was counted as the equivalent of two minutes of moderate intensity activity). This analysis complements the earlier results concerning total volume of walking/jogging and cycling by being restricted to activity reported as being of moderate or vigorous intensity only.

Overall 57% of the time spent using active transport modes was reported as being moderate or vigorous (and hence relevant to meeting health guidelines).

Relatively few adults meet the 30 x 5 guideline through active transport alone: 3.8%, 95% CI [2.9, 4.8]. But even this small percentage represents about 125,000 adults per week, and active transport makes a contribution towards meeting the guideline for many more. For example, 20% of adults reported 30 minutes or more of active transport at moderate intensity (or equivalent) during the previous week.

With respect to doing at least 30 minutes of active transport at a moderate level (or equivalent) in the previous week, there were four major demographic differences:

- A steady reduction in active transport with age is apparent:
  - 30% of those aged 16–24 years do at least 30 minutes in the previous week compared with only 11% of those aged 65 years or more
- Wellington cities (ie Wellington City, Lower Hutt, Upper Hutt and Porirua) stand out as having a significantly higher proportion of adults (33%) doing at least 30 minutes (compared with only 16% for respondents resident outside MUAs)
- Those without a vehicle usually available in the household are also more likely to do at least 30 minutes (32% compared with only 16% for those with one vehicle available for each adult); these differences remained clearly significant statistically even when age and urban area were controlled for.
- Those whose main working environment was in a vehicle reported such active transport less often. Only 6% reported 30 minutes or more in the previous week, much lower than the 20% of adults in general. This difference remained clear even after controlling for age, sex and urban centre (ie Auckland v Wellington cities v other MUAs v outside MUAs).

Although those in households with no vehicles do *more* active transport, they are significantly *less* likely to meet the 30 x 5 physical activity guideline. Admittedly the differences between groups are not large and the group with no vehicles in the household is not large, nevertheless this pattern of results is notable because it is surprising and replicates the pattern originally found with a North Shore sample (Badland and Schofield 2008).

Other analyses suggest modifications to some results that may be used in health benefit calculations related to active transport:

- The average cycling speed of 13–14km/h from the NZHTS 2003–09 seems preferable to the 20km/h assumed in Genter et al (2008). A value of 14km/h would be consistent with international practice (WHO 2008).
- A lower cycling speed might result in a reduced per km value for cycling benefits[17].
- ANZS results show that roller-skating/roller-blading and skateboarding for transport are both so rare that detailed consideration of them for calculating health benefits seems unnecessary.

6.1.3 Comparison with other datasets (especially the NZHTS)

The ANZS estimate of 2.3 hours per adult per week for walking and jogging/running (including that done for sport/recreation) is much higher than the NZHTS estimate of 57 minutes. Hence it is important for users in the

[17] Though note that the per km benefit values adopted by the NZTA (2010b) are lower than those proposed by Genter et al (2008).

transport, physical activity and health sectors to be aware that these two surveys may report very different results for things with similar labels such as 'total walking' or 'total walking/jogging' in New Zealand.

These total figures are not particularly comparable because the NZHTS excludes walking/jogging away from public roads (eg in parks, farms) and the ANZS excludes activities done for less than 10 minutes at a time. Even taking this into account, there is probably some underlying inconsistency between the surveys (because the ANZS shows 49 minutes on average for walking/jogging for transport purposes whereas the NZHTS has a mean of only 45 minutes per week when trip legs less than 10 minutes are removed while still including recreational walking/jogging along roads). We suggest that the inconsistency may result from some over-reporting in physical activity surveys such as ANZS and some under-reporting of roadside walking/jogging for sport/recreation in transport surveys such as the NZHTS.

Such issues are likely to become resolved with more widespread use for such surveys of objective measures, for example using GPS and/or accelerometers. Small-scale use of GPS in transport research has been done for some years. But only recently has there been a serious trial of replacing travel diaries by GPS in large scale fieldwork comparable to the NZHTS (Stopher and Prasad 2010). At the same time, use of objective measurement in physical activity research has also been increasingly going beyond the relatively small scale use of heart rate monitors or accelerometers in validation exercises such as those done with the NZPAQ (McLean and Tobias 2004; Mackay et al 2007). For example, a 2008/09 survey of 2500 children and young people in New Zealand used accelerometers (Clinical Trials Research Unit – University of Auckland and Synovate 2010). A recent study of physical activity by 1307 UK children used both accelerometers and GPS (Wheeler et al 2010); such a combination enabled precise measurement of duration, location and intensity of activity.

Over time, as objective measurement devices become both cheaper as well as increasing in capability, research use will only increase. Greater convergence of physical activity and travel behaviour research is to be anticipated through a common interest in GPS data (both for its core measurement of movement and also because the detailed information it provides about location can be informative about the influence of the built environment). This convergence in data collection will make it increasingly important for the health and transport sectors to overcome the 'language barrier' noted in a report to NZTA as reducing constructive communication (Ball et al 2009).

Despite the uncertainty arising from self-report survey weaknesses, we suggest that the volume of walking/jogging for sport/recreation reported in the ANZS is sufficiently large to be of interest to the transport sector. Assuming much of this walking/jogging happens along roads, then it suggests that materially more walking/jogging where people are exposed to risks from traffic may be occurring than the NZHTS records (not least, perhaps because people might often fail to report such walking because they do not see it as relevant to a 'transport' survey). If true, this would imply that walking (eg as commonly measured in terms of pedestrian injuries or fatalities in motor vehicle crashes per million hours travelling) may be materially safer per hour walked than is currently reported.

Cycling figures from the ANZS and NZHTS may match more closely than walking figures. This conclusion is expressed somewhat uncertainly because the relatively small base numbers of cyclists in such surveys providing estimates of cycling durations result in relatively largely margins of error.

One pattern of results from the ANZS contrasts sharply with a major previous survey of physical activity. The Obstacles to Action segmentation study showed a clear pattern of reducing cycling with age. In contrast, ANZS results show that cycling by adults might even peak in the 35–49 year age group, with a sharp drop-off only by about 65 years of age. The ANZS pattern of results seems more credible, because it is more consistent with NZHTS and census journey-to-work results.

6.1.4 Suggestions for changes/improvements to surveys

We are wary of suggesting changes or additions to major surveys such as the ANZS and NZHTS because maintaining consistency over time is central to their value and there are many claims on the limited space within them.

If the ANZS method is repeated and adding one short extra question related to transport were possible in addition to the trip diary, we would suggest a one-off[18] question about the extent to which recreational walking uses public streets/roads. Even a question with relatively imprecise response options would be helpful in clarifying the extent to which the NZHTS may be underreporting such walking. For example:

> *About how much of that walking for recreation in the past week was along public streets or roads?*
>
> *All/nearly all; Most; About half; Less than half; None/almost none.*

With the NZHTS, the most desirable change may well be more in processing and reporting than in data collection. The NZHTS trip diary cannot easily be extended to cover walking and cycling away from roads. But given the results here about the extent to which recreational walking or cycling may be trending differently from active transport and may have sharply different demographics, an investigation into the extent to which extra results can be reported that exclude walking, jogging and cycling for sport/recreation is highly desirable. Discussions with the Ministry of Transport suggest that some of the extra text information they hold about places travelled to may be useful to guide such decisions (eg the place was sometimes recorded as 'walk' or 'run'). Note that 'recreation' as the current reason for a trip has at least two major meanings: either the walk or cycle was done for recreation, or the person walked or cycled to a place (eg gym) to do recreation there.

Alternatively, an extra question might be advisable to help monitor walking and cycling done for sport/recreation separately (even if in an approximate manner because modifying current trip reason codes would threaten comparability). For example, relatively short and simple questions something like the following might be sufficient:

> [Skip if no walking recorded] *We've recorded xx [software to supply automatically] minutes of relevant walking during your two travel days. About how much of that travel was mainly to get from place to place rather than for sport, recreation or exercise?*
>
> *All/nearly all; Most; About half; Less than half; None/almost none.*
>
> [Skip if no cycling recorded] *We've recorded xx [software to supply automatically] minutes of cycling during your two travel days. About how much of that travel was mainly to get from place to place rather than for sport, recreation or exercise?*
>
> *All/nearly all; Most; About half; Less than half; None/almost none.*

Logically, answering such questions can become difficult where a person feels both reasons were strong (eg where the reason for their trip was getting to work, but their reason for walking rather than driving was a desire for exercise). How people split the activity between sport/recreation and active transport in the ANZS when both reasons for walking/cycling were strong is not known. Hence the slightly unusual wording proposed above, with the main question asking about the reason for the 'travel' rather than for the walking or cycling

[18] ie not intended for repetition if the ANZS method is repeated subsequently.

activity. In practice, such overlapping reasons were not found to be a major problem for smooth flow of the interview in the ANZS pre-testing or piloting (over 200 interviews).

Finally, the focus on cross-sectional surveys like the ANZS and NZHTS should not obscure the value of different kinds of survey. In particular, longitudinal surveys delivering comparable data from the same people over time could be very useful to all sectors by quantifying factors associated with actual change in active transport use. The Ministry of Health's Nutrition and Physical Activity Survey is one such longitudinal study.

6.2 Recommendations

The focus of this report lies more in delivering useful descriptive results for the use of others rather than recommendations. That said, a few recommendations flow from the findings (see table 6.1).

Table 6.1 Recommendations

Recommendation	Clarifying notes
1 The Ministry of Transport should ignore our earlier recommendation (Pinnacle Research & Policy 2008) that SPARC's ANZS be used to monitor leisure walking and cycling.	This change of view is because of uncertainty around what aspects of the ANZS will be repeated in the future and how often ANZS will be repeated. Hence its value for transport-related monitoring may be greatly reduced.
2 Given recommendation 1, the Ministry of Transport should seek alternative ways of monitoring trends in transport-related walking and cycling separately from recreational walking and cycling.	This report has shown that demographic patterns differ greatly between recreational walking and walking for transport, and trends for recreational walking or cycling may well be moving in the opposite direction to active transport. Even if imperfect, removing recreational travel as far as possible from some NZHTS walking/cycling estimates or adding two additional NZHTS questions about recreational walking/cycling may provide a useful starting point.
3 Those planning to promote walking should take account of the fact that current participation levels by age and gender follow a very different pattern for transport than for sport/recreation.	Mean time spent walking for transport falls steadily with age (for both men and women). In sharp contrast, walking for sport/recreation shows the youngest age group to do the least and clear gender differences for the 25–34 and 35–49 age groups.
4 The transport sector should move away from labelling totals for cycling recorded in the NZHTS as 'for transport'.	ANZS results suggest that most on-road cycling by adults is probably for sport/recreation, not for transport.
5 When per km health benefit values associated with cycling are next revised by the NZTA, use a speed more like 14km/h than the 20km/h used in a recent report prepared for the NZTA (Genter et al 2008).	A figure of 14km/h is consistent both with NZHTS data on actual distances and times and with World Health Organization practice (WHO 2008). Relatedly, it would be appropriate to revise the MET value from 7 to 4. These lower values could have lowered the per km benefit values in (Genter et al 2008) by around 20%, but their impact on benefit values subsequently chosen for use by NZTA is less clear (for other reasons, the NZTA adopted more conservative health benefit values in its 2009 update of the *Economic evaluation manual* volume 2 than those suggested by Genter et al).
6 In planning major future surveys covering walking and cycling, government agencies working on transport, physical activity or health should consult with each other to maximise value delivered to all sectors..	Walking and cycling data collected by one sector may be useful to another sector with minimal added cost. Increasing collection of GPS data is likely to increase data useful to more than one sector.

7 References

Ainsworth, BE, WL Haskell, AS Leon, DR Jacobs, HJ Montoye, JF Sallis and RSJ Paffenbarger (1993) Compendium of physical activities: classification of energy costs of human physical activities. *Medicine & Science in Sports & Exercise 25*, no.1: 71–80.

Ainsworth, BE, WL Haskell, MC Whitt, ML Irwin, AM Swartz, SJ Strath and WL O'Brien (2000) Compendium of physical activities: an update of activity codes and MET intensities. *Medicine & Science in Sports & Exercise 32,* no.9: S498–S516.

Auckland Regional Transport Authority (n.d.) TravelWise – home. Accessed 18 August 2010. *www.travelwise.org.nz/*

Australian Sports Commission (2010) Participation in exercise, recreation and sport: Annual report 2009. Australian Sports Commission. Accessed from: *www.ausport.gov.au/information/scors/ERASS/exercise,_recreation_and_sport_survey_past_reports/erass_2009*

Badland, HM, MJ Duncan and GM Schofield (2009) Using census data to travel through time in New Zealand: patterns in journey to work data 1981–2006. *Journal of the New Zealand Medical Association 122,* no.1296: 15–20.

Badland, HM and GM Schofield (2005) The built environment and transport-related physical activity: What we do and do not know. *Journal of Physical Activity & Health 2,* no.4: 433–442.

Badland, HM and GM Schofield (2008) Understanding the relationships between private automobile availability, overall physical activity, and travel behavior in adults. *Transportation 35,* no.3: 363–374.

Ball, J, M Ward, L Thornley and R Quigley (2009) Applying health impact assessment to land transport planning. *NZ Transport Agency research report no.375*.

Bauman, A, C Rissel, J Garrard, I Ker, R Speidel and E Fishman (2008) Cycling: Getting Australia moving: barriers, facilitators and interventions to get more Australians physically active through cycling. Melbourne: Cycling Promotion Fund. Accessed from: *www.cyclingpromotion.com.au/content/view/329/9/*

Beca Infrastructure Ltd (2007) *Health benefits of walking and cycling*. Wellington: Land Transport NZ.

Berrigan, D, R Troiano, T Mcneel, C Disogra and R Ballardbarbash (2006) Active transportation increases adherence to activity recommendations. *American Journal of Preventive Medicine 31,* no.3: 210–216.

Bike Wise (n.d.) New Zealand Bike Wise. Accessed 18 August 2010. *www.bikewise.org.nz/*

Blair, SN, MJ LaMonte and MZ Nichaman (2004) The evolution of physical activity recommendations: how much is enough? *Am J Clin Nut 79,* no.5: 913S–920.

Boon, RM, MJ Hamlin, GD Steel and JJ Ross (2008) Validation of the New Zealand physical activity questionnaire (NZPAQ LF) and the International physical activity questionnaire (IPAQ LF) with accelerometry. *British Journal of Sports Medicine*.

Brownson, RC, TK Boehmer and DA Luke (2005) Declining rates of physical activity in the United States: What are the contributors? *Annual Review of Public Health 26,* no.1: 421–443.

Cavill, N and A Davis (2007) Cycling and health: what's the evidence. London: Cycling England. Accessed from *www.dft.gov.uk/cyclingengland/health-fitness/health-benefits-of-cycling/*

Cervero, R and M Duncan (2003) Walking, bicycling, and urban landscapes: evidence from the San Francisco Bay area. *American Journal of Public Health 93,* no.9: 1478–1483.

Clinical Trials Research Unit – University of Auckland and Synovate (2010) A national survey of children and young people's physical activity and dietary behaviours in New Zealand: 2008/09 – key findings. Accessed from *www.moh.govt.nz/moh.nsf/indexmh/national-survey-cyp-physical-activity-dietary-behaviours-08-09-sept2010?Open*

Craig, CL, AL Marshall, M Sjöström, A Bauman, ML Booth, BE Ainsworth and M Pratt. (2003) International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise 35,* no.8.

Davies, DG, ME Halliday, M Mayes and RL Pocock (1997). *Attitudes to cycling: a qualitative study and conceptual framework* (no.266). Crowthorne, UK: TRL Limited.

De Bourdeaudhuij, I, JF Sallis and BE Saelens (2003) Environmental correlates of physical activity in a sample of Belgian adults. *American Journal of Health Promotion 18,* no.1: 83–92.

Easton, B (2004) The econometrics of household equivalence scales. Accessed 13 October 2004. *www.eastonbh.ac.nz/?p=516*

Gardner, G (1998) *Transport implications of leisure cycling*. Crowthorne, UK: TRL Limited.

Garrard, J (2009) Active transport: adults (an overview of recent evidence). Melbourne: VicHealth. Accessed from *www.vichealth.vic.gov.au/en/Resource-Centre/Publications-and-Resources/Physical-Activity/Active-transport.aspx*

Genter, J, S Donovan, B Petrenas and H Badland (2008) Valuing the health benefits of active transport modes. *NZ Transport Agency research report no.359.*

Gravitas Research and Strategy (2010) *Manual cycle monitoring in the Auckland region: March 2010 (regional summary).* Auckland: Auckland Regional Transport Authority.

Greater Wellington (2009) *2008/2009* Annual monitoring report on the regional land transport strategy. Wellington: Greater Wellington. Accessed from *www.gw.govt.nz/assets/Transport/Regional-transport/RLTS/AMR-08-09-final-lowres.pdf*

Greater Wellington (n.d.) Walking and cycling. Accessed 18 August 2010. *www.gw.govt.nz/walking-and-cycling/*

Hamer, M and Y Chida (2008) Walking and primary prevention: a meta-analysis of prospective cohort studies. *British Journal of Sports Medicine 42,* no.4: 238--243.

Heinen, E, B van Wee and K Maat (2010) Commuting by bicycle: an overview of the literature. *Transport Reviews: A Transnational Transdisciplinary Journal 30,* no.1: 59.

IPAQ core group (2005) Guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ). Accessed 18 March 2010 from *www.ipaq.ki.se/scoring.pdf*

IPAQ core group (n.d.) International physical activity questionnaire. Accessed 2 March 2010. *www.ipaq.ki.se/ipaq.htm*

Land Transport Safety Authority (2000) *Travel survey report 1997/98: increasing our understanding of New Zealanders' travel behaviour*. Wellington: LTSA.

Living Streets Aotearoa (n.d.) Welcome | Living Streets Aotearoa Inc. Accessed 18 August 2010. *www.livingstreets.org.nz/*

Lumley, T (2010) Survey analysis in R. University of Washington faculty. Accessed 22 June 2010. *http://faculty.washington.edu/tlumley/survey/*

Mackay, LM, GM Schofield and P Schluter (2007) Validation of self-report measures of physical activity: a case study using the New Zealand physical activity questionnaire. *Research Quarterly for Exercise and Sport 78*: 189–196.

McLean, G and M Tobias (2004) *The New Zealand physical activity questionnaires: report on the validation and use of the NZPAQ-LF and NZPAQ-SF self-report physical activity survey instruments*. Wellington: SPARC.

Merom, D, HP van der Ploeg, G Corpuz and AE Bauman (2010) Public health perspectives on household travel surveys: active travel between 1997 and 2007. *American Journal of Preventive Medicine 39,* no.2: 113–121.

Ministry of Health (2008) 2006/07 New Zealand health survey adult and child questionnaires. Accessed 1 March 2010 from *www.moh.govt.nz/moh.nsf/indexmh/2006-07-nzhs-adult-and-child-questionnaires*

Ministry of Health 2010 How much activity should I do? - physical activity. Accessed 4 March 201. *www.moh.govt.nz/moh.nsf/indexmh/physicalactivity-howmuch*

Ministry of Transport (2005) *Getting there – on foot, by cycle; a strategy to advance walking and cycling in New Zealand*. Wellington: Ministry of Transport.

Ministry of Transport (2007) *Sustainable transport (discussion paper): update of the New Zealand transport strategy*. Wellington: Ministry of Transport.

Ministry of Transport (2008a) Raising the profile of walking and cycling in New Zealand. Accessed from *www.transport.govt.nz/ourwork/Land/Raisingtheprofileofwalkingandcycling/*

Ministry of Transport (2008b) Comparing travel modes (v1.4). Accessed from *www.transport.govt.nz/assets/NewPDFs/Comparing-travel-modesv1.4.pdf*

Ministry of Transport (2009a) Cycling for transport (v2.0). Accessed from *www.transport.govt.nz/research/Documents/Cycling_for_transport_2009.pdf*

Ministry of Transport (2009b) *How New Zealanders travel: trends in New Zealand household travel 1989–2008*. Wellington: Ministry of Transport.

Ministry of Transport (2010a) New Zealand household travel survey. Accessed 19 August 2010. *www.transport.govt.nz/research/travelsurvey/*

Ministry of Transport (2010b) Transport Monitoring Indicator Framework (TMIF). Accessed 18 August 2010. *www.transport.govt.nz/ourwork/tmif/*

New Zealand Transport Agency (NZTA) (2010a) Model communities. Accessed 19 August 2010. *www.nzta.govt.nz/planning/process/model-communities.html*

New Zealand Transport Agency (NZTA) (2010b) Economic evaluation manual (volume 2). Accessed from *www.nzta.govt.nz/resources/economic-evaluation-manual/volume-2/docs/eem2-july-2010.pdf*

Nielsen (2009) *2007/2008 Active New Zealand technical report*. Auckland: Nielsen.

Pinnacle Research & Policy (2008) *Multi-sector monitoring framework for walking and cycling*. Wellington: Ministry of Transport.

Plaut, PO (2004) Non-commuters: the people who walk to work or work at home. *Transportation 31,* no.2: 229–255.

Rzewnicki, R, YV Auweele and ID Bourdeaudhuij (2003) Addressing overreporting on the international physical activity questionnaire (IPAQ) telephone survey with a population sample. *Public Health Nutrition 6,* no.3: 299–305.

Sallis, JF (1997) Seven-day physical activity recall. *Medicine and Science in Sports and Exercise 29,* no.6: S89–S103.

Salmond, C, P Crampton, P King and C Waldegrave (2004) *NZiDep: An index of relative socioeconomic deprivation for individuals*. Accessed from *www.wnmeds.ac.nz/academic/dph/research/NZidepflyer.pdf*

Shephard, RJ (2003) Limits to the measurement of habitual physical activity by questionnaires. *British Journal of Sports Medicine 37,* no.3: 197–206.

Shephard, RJ (2008) Is active commuting the answer to population health? *Sports Medicine 38,* no.9: 751–758.

Sport and Recreation New Zealand (SPARC) (2003) *SPARC facts: results of the New Zealand sport and physical activity surveys (1997–2001)*. Wellington: SPARC.

Sport and Recreation New Zealand (SPARC) (2008) *Sport, recreation and physical activity participation among New Zealand adults: Key results of the 2007/08 active New Zealand survey*. Wellington: SPARC.

Sport and Recreation New Zealand (SPARC) (2010. Measurement tools – SPARC. Active NZ Survey. Accessed 18 August 2010. *www.activenzsurvey.org.nz/About-the-Survey/Active-NZ-Survey-200708/Measurement-Tools/*

Statistics New Zealand (2010) Table builder – Statistics New Zealand. Accessed 2 August 2010. *www.stats.govt.nz/methods_and_services/access-data/tablebuilder.aspx*

Stopher, P and S Greaves (2009) Missing and inaccurate information from travel surveys – pilot results. Presented at the Australasian Transport Research Forum, Auckland. Accessed from *www.patrec.org/web_docs/atrf/papers/2009/1757_paper109-Stopher.pdf*

Stopher, P and C Prasad (2010) Can GPS replace conventional travel surveys? Some findings. Presented at the Australasian Transport Research Forum, Canberra. Accessed from *www.patrec.org/web_docs/atrf/papers/2010/1940_034 - Stopher Prasad Zhang.pdf*

Sullivan, C, J Oakden, J Young, H Butcher and R Lawson (2003) Overview report. Accessed from *www.sparc.org.nz/research-policy/research-/obstacles-to-action*

Sullivan, C and C O'Fallon (2006) *Increasing cycling and walking: an analysis of readiness to change*. Wellington: Land Transport NZ.

Sustrans (n.d.) Sustrans | Join the movement. Accessed 18 August 2010. *www.sustrans.org.uk/*

Tin, S, A Woodward, S Thornley and S Ameratunga (2009) Cycling and walking to work in New Zealand, 1991–2006: regional and individual differences, and pointers to effective interventions. *International Journal of Behavioral Nutrition and Physical Activity 6,* no.1: 64.

TravelSmart (n.d.) TravelSmart Australia – home page. TravelSmart Australia. Accessed 18 August 2010. *www.travelsmart.gov.au/index.html*

US Department of Health and Human Services (2008) 2008 Physical activity guidelines for Americans. Accessed from *www.health.gov/paguidelines/guidelines/default.aspx*

Westerterp, KR (2009) Assessment of physical activity: a critical appraisal. *European Journal of Applied Physiology 105,* no.6: 823–828.

Wheeler, BW, AR Cooper, AS Page and R Jago (2010) Greenspace and children's physical activity: A GPS/GIS analysis of the PEACH project. *Preventive Medicine 51,* no.2: 148–152.

Wolter, KM (2009) *Introduction to variance estimation* (2nd ed.) New York: Springer.

World Health Organization (WHO) (2004) *Global strategy on diet, physical activity and health*. Geneva: World Health Organization.

World Health Organization (WHO) (2008) Health economic assessment tool for cycling (HEAT for cycling): User guide (version 2). Accessed from *www.euro.who.int/__data/assets/pdf_file/0011/87482/E90948.pdf*

Zuurbier, M, G Hoek, P van den Hazel and B Brunekreef (2009) Minute ventilation of cyclists, car and bus passengers: an experimental study. *Environmental Health 8,* no.48: 8–48.

Appendix A: Over-reporting of physical activity and truncation of high values

Details: data collection

It is prudent to suspect that ANZS data may be affected by the 'perennial problem of overestimation of self-reported physical activity' (McLean and Tobias 2004, p8). For example, the validation study comparing the NZPAQ–Long Form (on which the ANZS activity diary is based) with an objective measure (heart rate recording) found self-reported minutes of moderate/vigorous activity to be roughly double those recorded objectively (McLean and Tobias 2004, p9). A later study with 70 Christchurch adults assessing the validity of the NZPAQ–Long Form against accelerometers found clear overestimation (Boon et al 2008). Note that accelerometers are now seen as a superior criterion measurement to heart rate monitors (Westerterp 2009). A smaller study involving only 20 participants using accelerometers found substantial *under-reporting* of moderate activity including walking for the NZPAQ-T (telephone version, short form) compared with accelerometers (Mackay et al 2007).

Given the over-reporting found in the earlier validation study (McLean and Tobias 2004), we[19] took particular care to try to maximise accuracy of recall (with particular attention to potential over-reporting) during the modifications of the NZPAQ activity diary for large-scale nationwide fieldwork in 2006. General interviewer procedures were particularly influenced by the protocol for the 7-Day Physical Activity Recall (Sallis 1997). Prevention of over-reporting was particularly influenced by Belgian evidence that probes during interviewing (eg 'What was the time at start and finish?' and 'How was your breathing affected?') could result in large and significant reductions in reported PA (Rzewnicki et al 2003); specifically they found that numbers meeting health recommendations were reduced by 50% compared with the standard IPAQ (using telephone).

To minimise memory problems and incorrect reporting of time durations, the electronic questionnaire led interviewers to:

- list all sport and recreation activities recorded earlier in the questionnaire as having been done in the previous seven days
- take respondents backwards through the week starting with the easiest day to recall (yesterday)
- note memory prompts for each day at the top of the diary sheet (eg where they went that day, what the weather was like, what happened that day)
- probe using 'Any more activity that day?', 'How was your breathing affected?', 'What time did you start and finish?', and 'Did you have some breaks during that time?'
- give the completed diary form to the respondent to check (while also checking that the figures appeared realistic).

Given the many decades of research showing weaknesses of self-report questionnaires about physical activity (Shephard 2003), we did not expect that these methods would completely eliminate inaccuracy due to over-reporting. But we had good reason, based on previous research and our own pre-testing during

[19] At the time, the first author of this report was part of the ACNielsen team designing the ANZS.

questionnaire development, to believe that these modifications would improve validity of the measurements.

Details: data processing and analysis

How data is treated after collection also affects how much effect over-reporting has on reported results. For example, IPAQ data processing and analysis guidelines (IPAQ core group 2005) advise to create three totals (total walking, total moderate intensity, total vigorous-intensity activity) and then, for each of these summed behaviours, to truncate the total value to three hours (180 minutes). This truncation is in addition excluding as 'unreasonably high' all cases in which the sum total of all walking, moderate and vigorous time variables is greater than 960 minutes (16 hours) on the assumption that eight hours in a day is normally spent sleeping.

Truncation to three hours per day by activity type?

Should truncation similar to the IPAQ rules be applied to ANZS data in this report? Simply applying the IPAQ guidelines for truncation exactly as specified for the IPAQ is not an option particularly relevant to this report. That is because this report focuses on specific behaviours such as walking for transport purposes whereas the IPAQ guidelines concern total walking, total moderate PA and total vigorous PA.

Initial data analysis of the ANZS data exposed a few suspiciously high values. In particular, one respondent reported 60 hours of walking for transport purposes during the previous week (10 hours on each of 6 days, all at moderate intensity) in addition to three hours a day of moderate or vigorous activity at work. However, it seemed justifiable to include this value in analysis given that durations this high were individually checked during data processing by the fieldwork company (Nielsen 2009, p17), that the diary sheet provided space for the interviewers to explain such irregularities, and that there were a few other walk durations nearly as high (the next four highest numbers of hours reported were 45, 40, 40, and 35). Only 2% of respondents (unweighted) reported six hours or more of walking for transport purposes during the week.

Furthermore, validation studies comparing self-reported PA using the NZPAQ with objective measures (McLean and Tobias 2004; Mackay et al 2007), n=186 and 80 respectively, have not yet been large enough to reliably establish whether or not such small percentages of high durations usually reflect marked over-reporting. Nor have we been able to find overseas evidence clearly relevant to this issue. Hence we did not have sufficient evidence to justify overriding the decisions made during data collection and data editing.

Consideration of the ANZS data and also IPAQ processing/analysis guidelines prompted us to think in more detail about underlying principles for truncating such data. The IPAQ guidelines themselves are little help with this. The only justification for their rules for truncation section is: 'This rule attempts to normalize the distribution of levels of activity which are usually skewed in national or large population data sets' (IPAQ core group 2005, p11). Even with truncation, the data remain strongly skewed and far from normally distributed. For example, the total number of minutes of active transport recorded at a moderate or vigorous intensity during the previous week (with truncation to a maximum of two hours per day) stretched out to a maximum of 840 minutes (14 hours) but had a mean of only 26 minutes and median of 0 minutes. Without truncation, the maximum was 3600 minutes and the mean 31 minutes.

We see at least three reasons for considering truncation:

- to reduce the effect of over-reporting in self-report measures
- because health benefits from extremely high durations of PA in a single day may be negligible or even negative and hence best not included in estimates aiming to approximate size of health benefits

- to improve clarity of statistical analysis or to increase statistical power (eg similar to the advantages trimmed means may provide in detecting differences or change by eliminating the very highest and lowest values, without prejudging their validity).

Hence, given that we have not found clear evidence to truncate purely to reduce the effect of over-reporting (the first reason above), whether or not one should truncate depends on the purposes of the analysis (the second and third reasons above). In this report, there are two major types of analysis: those concerning health benefits and those not. In principle, we consider truncation more justified for analysis in relation to health benefits, which may be an underlying reason for the truncation recommended in the IPAQ analysis guidelines). Although researchers have not identified an upper limit of activity above which there are no additional health benefits, daily durations as high as the longest values found in the ANZS are not seen as delivering substantial health benefits comparable to durations around the level of health recommendations (US Department of Health and Human Services 2008).

In practice, truncation of high durations was irrelevant for the main analyses relating to health benefits here: the key measures (eg the health benefits recommendation standard of 30 x 5) used mean that truncation would have little or no effect (because extra activity beyond 30 minutes in a day does not affect whether one meets the guideline). For the other analyses not concerning health benefits, there was even less reason to consider truncation, particularly once the means proved sufficiently stable statistically to reveal useful patterns of difference between demographic groups. In addition, where we present means, we consistently complement them by other analyses minimally affected by the skewed distribution (eg percentages doing any active transport, medians).

A common alternative that may more effectively 'normalise' the data is transforming by logarithms (De Bourdeaudhuij et al 2003). This was considered for some analyses of means in this report; but for the expected readership the complication of explaining the transformation was not judged worthwhile.

Deletion of cases reporting more than 16 hours activity?

There are stronger reasons to apply the IPAQ rule of deleting as 'unreasonably high' cases reporting more than 16 hours physical activity in a day. There are 16 such cases in the current ANZS dataset[20]. These cases show impact of work PA more than active transport: only 4 of these 16 cases had more than an hour of active transport in total over the week. Hence whether or not they are included will not often make much difference to the analysis in this report. For example, deleting these 16 cases reduces the mean time spent on active transport (all types) over the week from 54.8 to 53.7 minutes, a decrease of 2%. Less difference will occur with analyses based on proportions or medians (the majority).

[20] Although the IPAQ data processing guidelines base this rule on moderate and vigorous activity only (plus walking), we have added the time spent at light intensity on sport/recreational activities or active transport. This seems reasonable given that the rule was designed for the IPAQ which simply does not record such light intensity activities and that the justification for the rule was: 'This assumes that on average an individual of [sic] 8 hours per day is spent sleeping' (IPAQ core group 2005, p10). Admittedly, the IPAQ rule was designed for amounts of activity reported as done 'usually' on days where they did activity of a particular type (because the IPAQ does not record durations separately for each day of the week as done in the NZPAQ-LF). Hence extremely long exertions on just one or two days might not get recorded in the IPAQ. But the problem cases found in ANZS data were not all just for isolated days (reflecting perhaps some extreme events or accidental misrecording of durations in the wrong day); rather 5 of the 16 cases reported more than 16 hours physical activity on three or more days of the week.

On the other hand, two of the cases do have very high levels of active transport (31.5 and 40 hours total for the week). Such cases are inherently of questionable validity given the total of over 16 hours activity recorded for the day and may bias mean durations for some subgroups noticeably upwards.

Hence we decided to delete the 16 outliers from analysis (and correspondingly to set weights to 0 in the R dataset used to estimate confidence intervals). We adjusted the few reported totals (as opposed to means or percentages) upwards slightly (by 0.4%) to reduce bias from this deletion.

Those analysing the dataset for other purposes might choose alternative approaches (eg either leaving the 16 outliers in the dataset or replacing the problematic physical activity durations with imputed values derived from similar respondents).

Appendix B: Differences between NZSPAS and Active NZ Survey

Note: We are grateful to SPARC for supplying most but not all of this appendix (M. Hohepa, pers comm, 27 August 2010).

Differences in method

Before the 2007/08 ANZS, SPARC (formerly known as the Hillary Commission) ran the NZ Sport and Physical Activity Survey (NZSPAS) in 1997, 1998 and 2000. The NZSPAS did not have an activity diary like the ANZS, and data from the diary is the focus of the current report. But the start of the ANZS did collect information on leisure physical activity in a way more similar to the NZSPAS.

There are two key differences in the survey methodology relevant to judging trends in participation levels of walking and cycling:

1 the wording of the questions is slightly different

2 the response options in the activity list are different for walking and cycling.

The question: participation in sport and recreation activities at least once in the past year

NZSPAS 'On this card is a list of sport and physical activities. Would you please tell me whether you have taken part in any of them during the last 12 months, that is since, <Today's date> 2000? Please don't count any teaching, coaching, refereeing, or sports administration that you many have done – I'll ask you about this later.'

Active NZ Survey 'Showcard 1 shows different areas that people can be active in. I'll ask about them one at a time. First there is sport and recreation activities, then there is active transport, then work and then other activities. So first I'll ask about sport and recreational activities. On Showcard 3 are some types of sports and physical activities that people do in their spare time. During the last 12 months, that is, since <Date>, what sports and recreation physical activity have you taken part in?'

Differences in response options

The table below shows the differences in the listed activities for each survey. For the NZSPAS, the response options were combined to represent the sport and recreation activity category of walking or cycling. Mountain biking is ignored here because the focus is on road cycling; in both surveys, mountain-biking was listed separately on the activity list showcard.

Table B.1 Details of response options for walking and cycling in NZSPAS and ANZS

Activity category	Survey	Response options in the activity list (definition)
Walking	NZSPAS	1 Walking for enjoyment and/or exercise: 10-30 minutes 2 Walking for enjoyment and/or exercise: over 30 minutes
	Active NZ	1 Walking for sport or leisure
Cycling	NZSPAS	1 Competitive cycling 2 Recreational cycling (**not** mountain biking)
	Active NZ	1 Cycling/ biking

Findings

The data presented refer to the percentage of New Zealand adults (aged 18 years and above) who participated in a specific sport and recreation activity (walking, cycling) at least once in the past year. Using the confidence intervals, it appears that between 1997 and 2007/08 participation levels:

- for cycling (as a sport or recreation activity) increased by 6.0 percentage points
- for walking (as a sport or recreation activity) declined by 4.6 percentage points.

Table B.2 Sport/recreational participation rates for cycling and walking

Activity	Survey year	N	Weighted %	95% CI
Cycling	NZSPAS 1997	*5471*	13.4	12.1 –14.8
	NZSPAS 1998	*4046*	14.2	12.7 –15.7
	NZSPAS 2000	*3052*	14.1	12.5–15.7
	Active NZ 2007	*4297*	19.4	17.9–21.0
Walking	NZSPAS 1997	*5471*	70.2	68.2–72.1
	NZSPAS 1998	*4046*	70.9	68.4–73.3
	NZSPAS 2000	*3052*	72.1	69.5–74.7
	Active NZ 2007	*4297*	65.6	63.6–67.6

Caution: The changes in method described at the start of this appendix mean that the differences between NZSPAS and ANZS estimates may reflect the effect of changes in method or wording rather than in actual activity.

Appendix C: Additional demographic comparisons

These comparisons are additional to those in the body of the report (which cover gender, age, urban area and vehicle:adult ratio in a household).

Table C.1 Walk or jog/run for transport during previous 7 days (10+ minutes)

(Walk or jog/run for transport during previous 7 days)		Unweighted count	% [95% CI]	Mean mins	Median mins (participants)
Total		*4427*	36% [33.9, 37.8]	49	70
Q311, 312 Ethnicity – Māori	No	*3648*	35% [33.0, 37.3]	49	75
	Yes	*779*	41% [36.9, 45.0]	52	60
Q311, 312 Ethnicity – Asian	No	*4069*	35% [33.0, 37.0]	47	65
	Yes	*358*	44% [38.1, 49.2]	75	120
Q311, 312 Ethnicity – New Zealand European	No	*1381*	42% [38.6, 45.0]	76	90
	Yes	*3046*	33% [31.0, 35.6]	38	60
Q311, 312 Ethnicity – Pacific people	No	*4154*	35% [33.1, 37.1]	44	70
	Yes	*273*	48% [41.3, 53.8]	144	110
Q311, 312 Ethnicity – other Ethnicity	No	*4133*	35% [33.3, 37.3]	48	70
	Yes	*294*	42% [36.3, 48.4]	62	80
Q317 Vehicle number – How many motor vehicles do the people who live here have available for their use?	0	*298*	59% [52.9, 65.0]	102	100
	1	*1549*	41% [37.9, 43.9]	62	90
	2	*1613*	32% [29.1, 35.0]	39	60
	3	*577*	34% [29.3, 38.3]	51	70
	4 +	*388*	30% [25.2, 35.7]	33	60
	Refused	*2*			
1=at least 1 under 5 in household	0	*3678*	34% [31.7, 35.8]	45	70
	1	*745*	46% [41.8, 50.0]	71	70
1=at least 1 aged 5-12 in household	0	*3428*	35% [32.6, 36.9]	46	75
	1	*997*	40% [36.1, 43.4]	60	60
1=at least 1 13-15 in household	0	*3902*	35% [33.4, 37.5]	48	70
	1	*521*	38% [33.6, 43.1]	56	70
Q304, 304b How many people living in house/flat are aged 15 or younger?	0	*2758*	32% [29.9, 34.6]	42	75
	1	*664*	42% [37.6, 46.3]	69	80
	2	*637*	39% [34.7, 43.4]	38	60
	3+	*364*	44% [38.7, 49.8]	80	70
Q330 Education – have any secondary school qualifications	Yes	*2879*	38% [35.4, 40.1]	51	70
	No	*1548*	31% [28.4, 34.4]	45	75
Q331 Education – any other qualification that takes 3 months+ full time study	Yes	*2239*	36% [33.8, 38.9]	48	70
	No	*2188*	35% [32.7, 37.9]	51	75

(Walk or jog/run for transport during previous 7 days)		**Unweighted count**	**% [95% CI]**	**Mean mins**	**Median mins (participants)**
Q332, 333 Highest educational qualification	No secondary school qualifications	*1120*	30% [26.4, 33.1]	43	75
	Highest qual - NZ School Certificate in 1+ subjects (or equivalent)	*458*	36% [31.4, 41.3]	62	90
	Secondary school qual higher than Sch Cert, but no tertiary (3+ months)	*610*	42% [37.8, 46.7]	56	75
	Other tertiary qualification taking 3+ months full-time study	*1574*	35% [31.9, 37.8]	50	70
	Bachelors degree	*422*	38% [33.2, 43.6]	43	60
	Postgraduate degree, certificate or diploma	*243*	41% [34.9, 48.0]	45	90
Body mass index thresholds	Underweight	*95*	38% [28.6, 47.7]	47	60
	Normal weight	*1657*	39% [36.0, 41.9]	48	65
	Overweight	*1386*	31% [27.7, 33.9]	42	75
	Obese	*896*	34% [30.1, 37.6]	62	65
Body mass index thresholds	Underweight	*95*	38% [28.6, 47.7]	47	60
	Normal weight	*1657*	39% [36.0, 41.9]	48	65
	Overweight	*1386*	31% [27.7, 33.9]	42	75
	Obese	*580*	34% [29.2, 38.2]	66	70
	Severely obese	*316*	34% [28.5, 40.0]	52	60
Q336 Income – personal income in the past 1 year	No Income	*189*	47% [39.4, 53.9]	65	60
	$1 – $5,000	*229*	52% [45.1, 58.6]	70	90
	$5,001 – $10,000	*269*	38% [31.4, 43.8]	53	90
	$10,001 – $15,000	*565*	37% [32.5, 41.7]	44	60
	$15,001 – $20,000	*416*	39% [33.6, 44.0]	45	70
	$20,001 – $25,000	*366*	31% [25.5, 36.2]	37	65
	$25,001 – $30,000	*302*	40% [34.5, 46.4]	85	95
	$30,001 – $40,000	*477*	33% [27.7, 37.4]	41	60
	$40,001 – $50,000	*387*	38% [33.0, 43.7]	54	70
	$50,001 – $70,000	*448*	28% [22.6, 32.4]	46	75
	$70,001 – $100,000	*197*	28% [21.4, 35.1]	42	60
	$100,001 or more	*140*	36% [27.7, 43.9]	37	80
	Don't know	*272*	25% [18.7, 30.4]	23	60
	Refused	*170*	33% [25.6, 40.5]	52	60

(Walk or jog/run for transport during previous 7 days)		**Unweighted count**	**% [95% CI]**	**Mean mins**	**Median mins (participants)**
Q337 Income – household income in the past 1 year [adj using p336 instead of Live alone]	Up to $15,000	*328*	34% [28.2, 39.6]	37	60
	$15001 – $25,000	*527*	32% [27.7, 37.0]	46	90
	$25,001 – $40,000	*587*	33% [28.5, 37.4]	52	90
	$40,001 – $50,000	*351*	37% [31.3, 42.4]	52	60
	$50,001 – $70,000	*591*	36% [31.9, 40.9]	44	75
	$70,001 – $100,000	*564*	35% [30.0, 39.1]	48	65
	$100,001 or more	*617*	34% [29.6, 38.4]	47	60
	Don't know	*663*	41% [37.1, 45.7]	61	80
	Refused	*199*	38% [30.7, 44.8]	44	60
Household income adjusted for household size	Less than $22.5k	*574*	34% [29.4, 38.4]	56	80
	$22.5k up to $35k	*637*	35% [30.7, 39.3]	51	90
	$35k up to $50k	*677*	33% [28.5, 36.9]	34	60
	$50k up to $80k	*620*	36% [31.9, 40.7]	52	60
	$80k or more	*832*	32% [28.0, 35.7]	40	60
Household income adjusted for household size	Less than $20k	*334*	35% [28.9, 40.2]	66	90
	$20k up to $30k	*645*	32% [27.6, 36.1]	46	80
	$30k up to $40k	*523*	40% [35.0, 44.5]	43	60
	$40k up to $50k	*386*	30% [24.4, 34.8]	32	50
	$50k up to $70k	*470*	37% [31.9, 41.8]	48	65
	$70k up to $100k	*568*	35% [30.9, 40.0]	52	60
	$100k or more	*414*	26% [21.3, 31.3]	28	65
NZiDEP score	No deprivation characteristics	*2736*	32% [29.7, 34.4]	39	65
	1 deprivation characteristic	*822*	42% [38.3, 46.2]	61	75
	2 deprivation characteristics	*382*	41% [35.3, 46.1]	92	90
	3–4 deprivation characteristics	*338*	47% [40.9, 52.3]	59	80
	5+ deprivation characteristics	*149*	37% [29.3, 45.1]	62	90
Q32 Work – time spent working per week – working for more or less than 30 hours a week	Does not work in a job, business or farm	*1663*	35% [32.3, 38.1]	46	70
	Less than 30 hours	*735*	43% [38.9, 47.2]	53	60
	More than (or equal to) 30 hours	*2029*	34% [31.1, 36.4]	51	75
Q33 Work – main working environment	Don't work	*1663*	35% [32.3, 38.1]	46	70
	Mostly in an office (include home office)	*916*	39% [35.6, 43.1]	41	70
	Mostly in a shop	*264*	46% [39.4, 52.1]	76	70

(Walk or jog/run for transport during previous 7 days)		**Unweighted count**	**% [95% CI]**	**Mean mins**	**Median mins (participants)**
	Mostly in a factory or workshop	*378*	37% [32.0, 42.8]	55	100
	Mostly outside	*503*	26% [21.8, 31.0]	68	100
	Mostly inside a house	*229*	28% [21.4, 34.3]	23	60
	Mostly in a vehicle	*93*	28% [19.0, 37.7]	21	30
	None of the above	*381*	38% [32.4, 43.2]	51	70
Q334 Occupation – type of occupation	Student	*333*	60% [53.7, 65.3]	94	120
	Home duties (not otherwise employed)	*397*	37% [31.8, 42.4]	44	60
	Retired	*872*	26% [22.3, 29.6]	23	60
	Beneficiary/Unemployed	*254*	42% [35.3, 48.2]	82	90
	Clerical or sales employee	*384*	40% [35.1, 45.9]	48	75
	Semi-skilled worker	*210*	35% [28.3, 42.0]	65	80
	Technical or skilled worker	*461*	30% [25.4, 35.1]	48	60
	Business manager/executive	*210*	30% [23.5, 37.0]	35	70
	Business proprietor or self employed	*362*	30% [24.8, 35.6]	34	60
	Teacher/Nurse/Police/ Other trained service worker	*392*	35% [29.8, 40.4]	46	60
	Professional or senior government official	*134*	45% [36.2, 52.9]	64	120
	Labourer, manual, agricultural or domestic worker	*229*	32% [25.3, 38.4]	44	90
	Farm owner or farm manager	*97*	21% [12.0, 29.4]	53	180*
	Other	*90*	33% [23.5, 42.8]	47	75
	Don't know	*2*			
TV/DVD/video: hours in past 7 days	0	*168*	45% [37.0, 52.3]	61	100
	Up to 3.5	*429*	40% [34.8, 45.1]	51	70
	>3.5 – 7	*769*	41% [37.2, 45.3]	55	75
	>7 – 14	*1428*	35% [31.4, 37.6]	49	70
	>14 – 21	*852*	33% [28.8, 36.4]	43	80
	>21	*781*	31% [27.6, 35.4]	48	60
Computer (excl.	0	*2067*	32% [29.5, 34.8]	48	70

(Walk or jog/run for transport during previous 7 days)		Unweighted count	% [95% CI]	Mean mins	Median mins (participants)
work/school): hours in past 7 days	Up to 3.5	*1309*	36% [32.4, 38.9]	44	65
	>3.5 – 7	*508*	43% [38.1, 47.8]	49	70
	>7 – 14	*320*	40% [34.2, 45.8]	58	60
	>14 – 21	*134*	43% [35.1, 51.8]	83	60
	>21	*89*	46% [36.2, 56.0]	74	120
TV/DVD/video + computer (excl. work/school): hours in past 7 days	Up to 7	*901*	38% [34.2, 41.8]	51	70
	>7 – 14	*1297*	36% [32.6, 39.1]	48	60
	>14 – 21	*1027*	35% [31.7, 38.8]	47	90
	>21	*1202*	35% [31.4, 38.0]	53	60

* Too much attention should not be paid to the unusually high median of 180 minutes for farm owner or manager. The weighted median is unusually unstable in this relatively small group of respondents (the margin of error is 116 minutes; the 45th percentile is only 85 minutes). It can even change substantially depending on different conventions for calculating weighted medians, and these conventions differ between software packages (eg with default conventions, R software gives a weighted median of 126 minutes rather than 180 for this group). The unweighted median is 120 minutes.

Table C.2 Active transport at moderate or vigorous intensity during previous 7 days (vigorous minutes counted as equivalent to 2 moderate minutes)

(Active transport at moderate or vigorous intensity)		Unweighted count	% 30+ mins [95% CI]	Mean mins	Median mins (participants)
All		*4427*	20% [18.2, 21.8]	33	60
Q311, 312 Ethnicity – Māori	No	*3648*	20% [18.3, 22.2]	34	60
	Yes	*779*	18% [14.8, 22.0]	33	65
Q311, 312 Ethnicity – Asian	No	*4069*	20% [17.9, 21.6]	33	60
	Yes	*358*	23% [17.7, 28.1]	37	60
Q311, 312 Ethnicity – New Zealand European	No	*1381*	21% [18.0, 23.8]	47	70
	Yes	*3046*	20% [17.6, 21.7]	27	60
Q311, 312 Ethnicity – Pacific people	No	*4154*	19% [17.6, 21.3]	28	60
	Yes	*273*	29% [22.9, 35.0]	116	90
Q31, 312 Ethnicity – other ethnicity	No	*4133*	20% [18.2, 21.9]	34	60
	Yes	*294*	20% [14.5, 25.4]	29	70
Q317 Vehicle number – How many motor vehicles do the people who live here have available for their use?	0	*298*	32% [26.2, 37.9]	62	80
	1	*1549*	22% [19.4, 25.1]	43	80
	2	*1613*	19% [16.6, 22.0]	25	60
	3	*577*	16% [12.2, 20.1]	36	60
	4+	*388*	18% [13.3, 22.8]	25	70
	Refused	*2*		7	10
1=at least 1 under 5 in household	0	*3678*	19% [17.4, 21.2]	30	60
	1	*745*	23% [19.6, 27.2]	48	70
1=at least 1 aged 5-	0	*3428*	19% [17.5, 21.4]	30	60

(Active transport at moderate or vigorous intensity)		**Unweighted count**	**% 30+ mins [95% CI]**	**Mean mins**	**Median mins (participants)**
12 in household	1	*997*	22% [18.7, 25.4]	45	60
1=at least 1 13-15 in household	0	*3902*	20% [17.9, 21.6]	32	60
	1	*521*	22% [17.5, 26.3]	45	70
Q304, 304b How many people living in house/flat are aged 15 or younger?	0	*2758*	19% [16.4, 20.7]	27	60
	1	*664*	22% [18.1, 26.1]	45	90
	2	*637*	19% [15.3, 23.2]	24	45
	3+	*364*	28% [22.4, 33.0]	70	80
Q330 Education – have any secondary school qualifications	Yes	*2879*	22% [19.3, 23.7]	35	60
	No	*1548*	17% [14.0, 19.2]	31	70
Q331 Education – any other qualification that takes 3 months+ full time study	Yes	*2239*	20% [17.7, 22.5]	31	60
	No	*2188*	20% [17.5, 22.3]	36	60
Highest educational qualification	No secondary school qualifications	*1120*	16% [12.9, 18.8]	31	70
	Highest qual - NZ School Certificate in 1+ subjects (or equivalent)	*458*	19% [14.9, 24.0]	47	60
	Secondary school qual higher than Sch Cert, but no tertiary (3+ months)	*610*	26% [21.5, 30.0]	36	70
	Other tertiary qualification taking 3+ months full-time study	*1574*	19% [16.3, 21.7]	32	60
	Bachelors degree	*422*	20% [15.1, 24.6]	25	60
	Postgraduate degree, certificate or diploma	*243*	27% [20.9, 33.4]	33	70
Body mass index thresholds	Underweight	*95*	16% [7.9, 24.5]	34	60
	Normal weight	*1657*	22% [19.4, 24.8]	33	60
	Overweight	*1386*	18% [15.4, 21.1]	26	75
	Obese	*896*	18% [14.7, 21.5]	48	60
Body mass index thresholds	Underweight	*95*	16% [7.9, 24.5]	34	60
	Normal weight	*1657*	22% [19.4, 24.8]	33	60
	Overweight	*1386*	18% [15.4, 21.1]	26	75
	Obese	*580*	19% [15.0, 23.2]	55	60
	Severely obese	*316*	16% [11.0, 21.0]	32	50
Q336 Income – personal income in the past 1 year	No income	*189*	24% [17.0, 30.5]	30	60
	$1 – $5,000	*229*	29% [22.9, 35.9]	47	60

(Active transport at moderate or vigorous intensity)		**Unweighted count**	**% 30+ mins [95% CI]**	**Mean mins**	**Median mins (participants)**
	$5,001 – $10,000	*269*	19% [13.1, 24.3]	22	60
	$10,001 – $15,000	*565*	21% [17.3, 25.7]	29	60
	$15,001 – $20,000	*416*	20% [15.7, 25.2]	28	60
	$20,001 – $25,000	*366*	18% [12.7, 22.4]	24	60
	$25,001 – $30,000	*302*	26% [20.5, 31.9]	65	100
	$30,001 – $40,000	*477*	16% [12.1, 20.7]	30	50
	$40,001 – $50,000	*387*	22% [17.4, 27.4]	40	75
	$50,001 – $70,000	*448*	18% [13.1, 22.0]	40	80
	$70,001 – $100,000	*197*	16% [9.9, 22.1]	18	60
	$100,001 or more	*140*	18% [11.1, 25.6]	21	100
	Don't know	*272*	13% [8.1, 18.2]	16	60
	Refused	*170*	18% [11.1, 24.4]	48	90
Q337 Income – household income in the past 1 year [adj using p336 instead of Live alone]	Up to $15,000	*328*	15% [10.3, 20.0]	23	40
	$15001 – $25,000	*527*	19% [14.4, 22.9]	28	60
	$25,001 – $40,000	*587*	20% [15.5, 23.7]	39	70
	$40,001 – $50,000	*351*	23% [17.7, 28.2]	42	60
	$50,001 – $70,000	*591*	23% [18.7, 27.1]	30	70
	$70,001 – $100,000	*564*	18% [14.0, 22.1]	33	80
	$100,001 or more	*617*	19% [15.4, 23.4]	29	60
	Don't know	*663*	20% [16.3, 24.1]	35	70
	Refused	*199*	22% [15.6, 28.7]	47	90
Household income adjusted for household size	Less than $22.5k	*574*	20% [15.4, 23.6]	39	60
	$22.5k up to $35k	*637*	21% [16.9, 24.9]	35	60
	$35k up to $50k	*677*	19% [15.2, 22.9]	26	60
	$50k up to $80k	*620*	21% [16.7, 24.8]	41	70
	$80k or more	*832*	17% [13.8, 20.7]	24	60
Household income adjusted for household size	Less than $20k	*334*	21% [15.5, 26.0]	48	75
	$20k up to $30k	*645*	20% [15.6, 23.5]	31	60
	$30k up to $40k	*523*	21% [17.0, 25.7]	31	70
	$40k up to $50k	*386*	18% [13.0, 22.5]	23	60
	$50k up to $70k	*470*	21% [16.0, 25.1]	37	60
	$70k up to $100k	*568*	20% [16.1, 24.4]	35	60
	$100k or more	*414*	13% [9.1, 17.6]	17	80
NZiDEP score	No deprivation characteristics	*2736*	18% [16.1, 20.4]	26	60
	1 deprivation characteristic	*822*	22% [18.8, 26.1]	39	60
	2 deprivation	*382*	25% [19.8, 30.1]	69	90

(Active transport at moderate or vigorous intensity)		**Unweighted count**	**% 30+ mins [95% CI]**	**Mean mins**	**Median mins (participants)**
	characteristics				
	3–4 deprivation characteristics	*338*	22% [16.9, 27.4]	33	60
	5+ deprivation characteristics	*149*	23% [15.8, 30.7]	54	90
Q32 Work – time spent working per week – working for more or less than 30 hours a week	Does not work in a job, business or farm	*1663*	18% [15.1, 20.3]	25	60
	Less than 30 hours	*735*	27% [22.6, 30.5]	38	70
	More than (or equal to) 30 hours	*2029*	19% [16.8, 21.7]	37	85
Q33 Work – main working environment	Don't work	*1663*	18% [15.1, 20.3]	25	60
	Mostly in an office (include home office)	*916*	23% [19.7, 26.7]	29	75
	Mostly in a shop	*264*	26% [20.2, 32.2]	52	60
	Mostly in a factory or workshop	*378*	25% [20.0, 30.3]	40	90
	Mostly outside	*503*	15% [11.1, 19.3]	62	180
	Mostly inside a house	*229*	18% [11.9, 23.7]	21	110
	Mostly in a vehicle	*93*	6% [0.1, 11.3]	11	20
	None of the above	*381*	20% [15.6, 25.4]	26	60
Q334 Occupation – type of occupation	Student	*333*	37% [31.4, 42.8]	58	80
	Home duties (not otherwise employed)	*397*	15% [10.6, 19.6]	18	60
	Retired	*872*	12% [9.3, 15.4]	11	40
	Beneficiary/unemployed	*254*	24% [17.8, 29.8]	57	80
	Clerical or sales employee	*384*	24% [19.1, 29.3]	28	60
	Semi-skilled worker	*210*	18% [12.1, 24.5]	54	105
	Technical or skilled worker	*461*	16% [12.1, 20.8]	41	90
	Business manager/executive	*210*	15% [8.7, 20.3]	19	70
	Business proprietor or self employed	*362*	16% [11.3, 20.9]	25	60
	Teacher/nurse/police/ other trained service worker	*392*	22% [16.7, 26.6]	36	60
	Professional or senior government official	*134*	31% [22.5, 38.7]	52	140
	Labourer, manual, agricultural or domestic	*229*	20% [13.5, 25.6]	30	90

(Active transport at moderate or vigorous intensity)		**Unweighted count**	**% 30+ mins [95% CI]**	**Mean mins**	**Median mins (participants)**
	worker				
	Farm owner or farm manager	*97*	14% [6.0, 21.7]	47	220
	Other	*90*	19% [10.2, 27.8]	32	60
	Don't know	*2*			
TV/DVD/video: hours in past 7 days	0	*168*	26% [18.9, 33.4]	34	85
	Up to 3.5	*429*	24% [19.4, 29.1]	40	60
	>3.5 – 7	*769*	22% [18.4, 25.9]	37	70
	>7 – 14	*1428*	20% [17.1, 22.8]	33	60
	>14 – 21	*852*	19% [15.1, 22.0]	25	70
	>21	*781*	15% [11.9, 18.7]	36	60
Computer (excl. work/school): hours in past 7 days	0	*2067*	18% [15.3, 20.1]	34	75
	Up to 3.5	*1309*	21% [17.8, 23.8]	29	60
	>3.5 – 7	*508*	25% [20.1, 29.2]	35	80
	>7 – 14	*320*	21% [15.2, 25.8]	40	60
	>14 – 21	*134*	23% [15.5, 31.1]	63	70
	>21	*89*	22% [13.1, 31.4]	17	70
TV/DVD/video + computer (excl. work/school): hours in past 7 days	Up to 3.5	*287*	22% [15.9, 27.1]	40	45
	Up to 7	*614*	23% [19.2, 27.5]	37	70
	>7 – 14	*1297*	20% [16.9, 22.8]	32	60
	>14 – 21	*1027*	20% [16.8, 23.3]	28	80
	>21	*1202*	18% [15.0, 20.9]	36	60

* The high mean for Pacific peoples is unusually unstable as reflected in the margin of error of over 100 minutes. This often results from a small number of high durations coinciding with high statistical weights.

** Even some of the medians are fairly unstable and should not be taken too seriously where the number of participants is not large. For example, the very high median for *Occupation: farm owner or farm manager* is based on durations from only 16 participants; the high median for *Main working environment: mostly outside* has a large margin of error of 75 minutes.