# Has cycling decreased in Australia? A comparison of 1985/86 and 2011 surveys

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## Key Findings

- There is a scarcity of Australian cycling data, which makes it difficult to assess whether cycling has increased or decreased over time;
- Surveys conducted in 1985/86 and 2011 estimate a 25.1% increase in bicycle trips when the Australian population 9 years and older increased by 58.5%
- Australian demographics have changed substantially and must be accounted for in an analysis;
- Comparison using indirect age-sex standardised rates indicates trips by bicycle have increased by 11%;
- Australian governments should increase investments into cycling infrastructure to accommodate increased cycling and to improve cycling safety.

## Abstract

There has historically been very little data on cycling in Australia. This lack of data has made it difficult to track whether cycling has changed over a long period of time. The number of cycling trips per day per person increased by 25.1% from the Day-to-Day Travel in Australia 1985/86 Survey to the 2011 National Cycling Participation Survey, while the Australian population 9 years of age and older has increased by 58.5%. The crude rate estimates a 20% reduction in cycling relative to population; however, this analysis does not account for changing Australian demographics during that time. When the rates of cycling are age-sex standardised, cycling trips in Australia increased by an estimated 11.0% (95% CI: 10.8%, 11.1%). The estimated increases in cycling trips, both in raw numbers and age-sex adjusted rates, support increased investments in cycling in Australia.

## Keywords

Bicycling; Cycling exposure; Research methods; Epidemiology

## Introduction

Accurate travel data is needed to estimate modal share and its trends over time. This data can then be used to make informed decisions regarding optimal allocation of limited resources and to assist in estimating rates of injuries or fatalities. Data on cycling in Australia has been very limited which makes it difficult to determine if cycling has increased or decreased over time.

The Australian Bureau of Statistics (ABS) has collected the Method of Travel to Work for Persons (MTWP) data since 1976 and data collection has continued as part of the census every five years (ABS, 2012). This data is limited in its usefulness since data is collected on single days five years apart, Census Day has changed from late June to early August, it is impossible to identify a traveller's primary travel mode, and the 1976 data was a 50% sample and not a census (ABS, 2005).

Other Australian-wide data sources include the Day-to-Day Travel in Australia 1985-86 (DDTA) Survey (Adena & Montesin, 1988), Exercise, Recreation and Sport Survey (ERASS) collected annually from 2001 to 2010 (Australian Sports Commission, 2010), and the National Cycling Participation (NCP) Survey collected every other year since 2011 (Munro, 2019). These surveys utilised different methodologies and their estimated trends are in opposite directions: the ERASS surveys estimate increased cycling, while NCPS estimates a decline. Irrespective of the results from these data sources, it is difficult to estimate trends in cycling without routinely collected surveys using a standard methodology.

The majority of available Australian data report the proportion who have ridden a bicycle over a fixed time frame, while the 1985-86 DDTA and 2011 NCP surveys report bicycle trips per day. Other measures of cycling such as kilometres or time travelled have not been collected Australia-wide or they have been estimated from other data sources (Cosgrove, 2011).

A previous study (Gillham & Rissel, 2012) compared the number of bicycle trips per day from the 1985-86 DDTA and 2011 NCP surveys, and contrasted these results to changes in Australian population estimates. The authors report the daily average number of bicycle trips for those aged 9 years and older increased by 26.2%; however, the Australian population increased by 58.4% during that time. This led the authors to conclude daily cycling participation decreased by 32.2% relative to population growth, which is the difference in their estimates of population and bicycle trip growth.

A crude comparison of changes in bicycle trips and the population is likely to be inaccurate for a few reasons. First, the two surveys were collected for different reasons with dissimilar methodologies. For example, the 1985-86 survey covered all modes of travel with data prospectively collected over 13 months using a travel diary. The 2011 survey collected data on cycling only, was performed over the phone, and responders were retrospectively asked about cycling in the past week, month or year. These differences make any comparison between these surveys tenuous at best, and any analysis should clearly identify these issues as limitations.

The absolute difference of percentages is not a valid comparison of one measure relative to another. A more appropriate comparison is to the ratio of crude rates of trips per person per day for the two surveys. In this case, the crude rates were an estimated 0.1326 and 0.1032 trips per person per day respectively for the 1985-86 and 2011 surveys. This is a rate ratio of 0.778 which can be interpreted as a 22.2% decrease from 1985-86 to 2011 surveys. These values are population estimates and therefore contain a certain amount of uncertainty in their values. This uncertainty can be expressed with a confidence interval or estimated standard error.

Finally, a simple comparison of crude rates does not account for the changing Australian population, and so the comparison of crude rates is also not correct. This can be done by comparing age-sex standardised rates via the basic epidemiological method of standardised incidence ratios. The aim of this study, therefore, is to compare cycling exposure, measured by trips per person per day, estimated from the 1985-86 DDTA Survey and 2011 NCP Survey while accounting for changing demographics in the Australian population and differences in survey methods.

## Methods

Cycling travel data was extracted from the 1985-86 DDTA Survey (Adena & Montesin, 1988) and the 2011 NCP Survey (Munro, 2011). Australian population data was downloaded from the ABS website.

For the DDTA survey, the number of trips per person per day was tabulated by strata for age (9-15 years, yearly strata for 16-25 years, 26-29 years, 30-59 years, 60-64 years, 65+ years) and sex. This report also provided the 1981 Australian population by age and sex strata. The 2011 NCP survey collected data on when a responder last cycled (“last 7 days”, “last month” or “last year”). Those who cycled in the past week were also asked how many bike trips they made over the last seven days. Those who had cycled in the past month or year but not the past week did not provide data on their number of bike trips.

The age categories between the surveys can be matched, with one notable exception. The DDTA surveyed those nine years of age and older, while the NCP survey included all ages and those nine years of age are part of the 5-9 years group. To minimise potential computation errors, NCP survey data for those aged under 10 years have been excluded from the analysis.

The 2011 NCP survey reported an average of 5.4 bike trips were taken for those who had cycled in the past week. Note this estimate is across all age groups including those under 10 years of age. Clearly, those who responded they had cycled in the past month or year but not the past week should contribute data to the total number of trips. With those issues in mind, some assumptions are needed to estimate the number of bike trips taken to be as consistent as possible with the DDTA survey. These include that the average number of trips is the same across all strata for those cycling in the past week, those who cycled in the past month but not the past week took 12 bike trips on average in the past year, and those who had cycled in the past year but not the past month took 1 bike trip in the past year and no more. Under those assumptions, the total estimated number of trips per person per day $T_1$ from the 2011 NCP Survey is

$$T_1 = \sum_{i=1}^{k} \left( \frac{5.4p_{1i}}{7} + \frac{12(p_{2i} - p_{1i})}{365.25} + \frac{p_{3i} - p_{1i} - p_{2i}}{365.25} \right) n_i \quad (1)$$

for age/sex strata $i = 1, \ldots, k$, where $p_1i$, $p_2i$ and $p_3i$ are the estimated proportions of those cycling in the past week, month and year respectively, and $n_1$ is the 2010 population.

Letting $T_0$ be the total bike trips from the DDTA survey, the crude rate is then the ratio $T_1/T_0$. As discussed, this is a naïve comparison as it does not account for changing demographics. A more appropriate comparison is the standardised incidence ratio (SIR) which is the ratio of observed trips and the expected number of trips.

The expected number of trips is computed assuming the average bike trips per person per day in 1985-86 by age and sex has remained constant, given by

$$E_1 = \sum_{i=1}^{k} \frac{t_{0i}}{n_{0i}} \times n_i \quad (2)$$

where $t_{0i}$ is the average trips per person per day and $n_{0i}$ is the population size for strata $i = 1, \ldots, k$ in the DDTA survey. The SIR is then the ratio of the number of estimated trips versus the expected number of trips,

$$SIR = \frac{T_1}{E_1} \quad (3)$$

and a (1 - $a$) confidence interval can be computed as

$$\left[\frac{\chi^2_{2T_1,\alpha/2}}{2E_1}, \frac{\chi^2_{2(T_1+1),1-\alpha/2}}{2E_1}\right]. \quad (4)$$

It is common to report the SIR and its confidence interval by the transformation (*SIR* – 1) as it can be interpreted as a percentage increase or decrease in the number of events relative to what was expected.

The extracted data and R code (v3.4.3 "Kite-Eating Tree") to compute the statistical results are provided as supplementary material.

# Results

The estimated number of bicycle trips in Australia increased by 25.1% from the 1985-86 DDTA survey to the 2011 NCP survey, while the Australian population nine years and older increased by 58.5%. The crude rate was 0.80 or an estimated 20% reduction in bike trips relative to population. When age and sex standardised, the SIR estimated an increase in bike trips of 11.0% (95% CI: 10.8%, 11.1%).

**Table 1. Summary statistics of 1985-86 DDTA and 2011 NCP surveys**

| | **1985-86 DDTA** | **2011 NCP** | **Comparison** |
|---|---|---|---|
| **Estimated Trips** (per person per day) | 1,656,100 | 2,072,478 | +25.1% |
| **Population** (9+ years) | 12,488,000 | 19,515,563 | +58.5% |
| **Crude Rate** | | | 0.8008 |
| **Expected Trips** | | 1,867,758 | |
| **SIR** (95% CI) | | | 1.110 (1.108, 1.111) |

# Discussion

This study estimates the number of bicycle trips in Australia increased by 11% from 1985/86 to 2011 using age-sex standardisation to account for changing population demographics. In raw numbers, the estimated trips by bicycle increased by 25% which was less than the increase in population. The discrepancy between crude and age-sex standardised rates can readily be explained by the ageing Australian population. Both surveys support the hypothesis that as one gets older, the less likely they are to cycle. These results do not suggest older people should not cycle, but it does suggest older age makes cycling less attractive, albeit the data used in this study predate the recent popularity of e-bikes among older persons.

This study highlights the general lack of Australian cycling data and the need to collect relevant data in the future. This data is crucial to our understanding of trends in road safety by allowing estimation of injury and fatality rates per amount of cycling exposure instead of simple population rates. Mobility data can take on several forms such as number of trips, distance and time travelled by mode of transport including by bicycle. Other countries such as The Netherlands and Finland have collected such data using stratified random sampling surveys and travel diaries (SWOV, 2013; Radun & Olivier, 2018). It is recommended that Australia collects high-quality mobility data using standard methods collected on a routine basis.

The results from this study contrast greatly with Gillham and Rissel (2012) who claimed Australian cycling reduced by 32.2%. Changes in Australian population demographics over the past several decades have been well-documented and need to be accounted for in any analysis such as age-sex standardisation. The authors attributed the decline to a focus on motorised transport, a lack of cycling infrastructure, and bicycle helmet legislation. The results from this study do not support the argument Australian bicycle helmet legislation has deterred cycling.

This study does support the increase in cycling infrastructure expenditures since Australian bicycle trips have increased by 25%. Further, the majority of Australians identify a lack of cycling infrastructure as the reason for not cycling or not cycling more (National Heart Foundation, 2011), while Australian mobility is instead often centred on personal motorised vehicles (BITRE, 2012). Increased cycling infrastructure may also help address rising congestion in urban areas (Department of Infrastructure and Regional Development, 2016).

Any analysis using these data has several limitations. The primary comparison is the number of bike trips in 1985-86 to

2011; however, the 2011 NCP survey provided little detail on how the average trips were computed and estimates are not available by age or sex. There are also some discrepancies in the 2011 NCP survey on bike trips. The possible categories in the survey script (Appendix A) are "1 or 2 trips", "3 to 5 trips", "5 to 10 trips", "More than 10 trips", and "Don't know". However, this data summarised in Table 4.6 of Munro (2011) contain the categories "≤2 trips", "3-4 trips", "5-6 trips", "7-10 trips", and "11+ trips". In Section 4.2 and Figure 4.1 of the NCP report, the average number of trips by state, territory and Australia-wide are provided; however, it is unclear how these were computed from those categories.

It is unclear whether the estimated SIR holds for later NCP surveys. The question regarding number of trips was not included in any of the later surveys. For the 2011 survey, the number of bike trips was not collected for those cycling in the past month or year but not the past week. It is clear their data should contribute to the estimated number of bike trips, but the approach chosen may provide inaccurate results. However, when trips are counted only for those cycling in the past week, there is still an estimated increase in cycling (+7.86%, 95% CI: 7.71%, 8.01%). Finally, as we noted in the methods section, the age categories used between the surveys did not fully match and data aggregation could not reconcile those nine years of age. Finally, variance estimates in accordance to the study design were not reported in the DDTA survey and, therefore, the reported confidence intervals are likely too narrow. Bootstrap confidence intervals were computed and the results were similar albeit the intervals were slightly wider (95% CI: 1.109, 1.126).

## Conclusions

There are far too few data on cycling in Australia, and the limited available data is often misused or incorrectly interpreted. When accounting for changing population demographics, the results of this study suggest cycling has increased in Australia from 1985-86 to 2011 by 11%, although any analysis on disparate data sources should be interpreted with caution. The estimated increase in bike trips, both in raw terms and age-sex adjusted, supports increasing resources for cycling in Australia.

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