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Public Health

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Original Research

Effects of a workplace travel plan intervention encouraging active travel to work: outcomes from a three-year time-series study

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ARTICLE INFO

Article history:

Received 4 December 2015

Received in revised form

12 February 2016

Accepted 13 February 2016

Available online 25 March 2016

Keywords:

Travel plan

Transport plan

Transportation demand management plan

Mobility management plan

Workplace

Active travel

ABSTRACT

Objective: To evaluate the effects of a three-year workplace travel plan intervention on increasing active travel to work.**Study design:** A time-series study with staff was conducted in 2011 ($n = 804$), 2012 ($n = 904$), 2013 ($n = 872$) and 2014 ($n = 687$).**Methods:** A travel plan was implemented at a large, outer-suburban worksite in Sydney, Australia. Implementation was assessed by reviewing annual reports including travel plan actions and their status. Annual cross-sectional on-line surveys assessed primary outcomes which included change in the proportion of staff travelling to work via active modes. Multivariate logistic regression was used to adjust for confounders.**Results:** Strategies to encourage active travel were partially implemented. An average survey response rate was 23% ($n = 817$). The proportion of staff travelling actively to work increased by 4%–6% across intervention years compared to the baseline, and this increase was significant in 2012 ($P = 0.04$) and 2013 ($P = 0.003$). Compared to baseline, after adjusting for distances staff lived from work staff had 33% (95% CI 1%–74%) greater odds of travelling to work via active modes in 2012, and 50% (95% CI 15%–96%) greater odds in 2013. There was no evidence of change in physical activity levels.**Conclusions:** A workplace travel plan which only included strategies to encourage active travel to work achieved small but significant increases in active travel. Workplace travel plans appear to be a promising way to increase active travel to work.

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Introduction

Walking and cycling are healthier than car driving and are promoted as active travel.¹ Public transport can be considered as active travel when access and egress walking contributes to physical activity that is significant to population guidelines for physical activity for health.^{2–4} Epidemiological research suggests reducing car driving and increasing active travel for commuting results in overall increased physical activity,⁵ is associated with decreased body weight and reduced risk of myocardial infarction in both cross-sectional and longitudinal studies.^{4–16}

Promoting active travel, and promoting alternatives to driving cars to destinations via travel planning, are considered promising approaches to encouraging physical activity and reducing traffic congestion.^{17–24} The work setting is a logical place to promote active travel since in many countries the majority of adults work,²⁵ and a large proportion of journeys to work are made by private motor vehicles.^{26,27} Workplace travel plans, also referred to as transportation demand management plans in North America and mobility management plans in Europe,²⁸ aim to promote active and sustainable forms of transport and reduce driving private motor vehicles to work. Travel plans are a site-based delivery mechanism for transport management options.²⁹

Research on the effect of workplace travel plans for increasing active travel and decreasing driving to work is not conclusive. A Cochrane review of organisational travel plans for improving health identified only 17 studies, five of which were conducted in workplaces.^{30,31} These workplace studies investigated the effectiveness of single actions within travel plans, rather than an overall travel plan. A recently published systematic review of the effect of active travel interventions conducted in work settings on driving to work identified 12 controlled and longitudinal studies,¹⁸ one of which was a workplace travel plan intervention which achieved a 42% decrease in driving alone at the intervention site and a 5% decrease at the control site. The review calls for more published intervention research on workplace travel plans.³²

Given workplace travel plans show promise for increasing active travel to work, they deserve attention from researchers, practitioners and policy makers. More published evaluations will assist development, implementation and evaluation of individual travel plans, and also inform decisions on potential policy and regulatory support for broad adoption by medium and large organisations. The purpose of this study is to present the main outcomes from the evaluation of a three-year workplace travel plan intervention.

Methods

Design

The study design for evaluation of the travel plan intervention was a time-series study without control. Between the baseline survey conducted in 2011 and 2014, four annual cross-sectional on-line surveys were used to assess changes in outcomes.

Setting and context

The south-west Sydney growth centre

Liverpool Hospital is located in an outer metropolitan area which is a major ‘growth centre’ in south-west Sydney, Australia. This principal referral teaching hospital is a large workplace which employed almost 3900 staff by September 2014. Liverpool Hospital required a travel plan as a condition of a major re-development completed in 2012.

Walking, cycling and public transport

Most of the area within a 10 km radius of the hospital is flat. Although the off-road cycling network in the area was extensive, apart from the route to the north along the railway, there were significant gaps in the cycling network in the immediate surrounds of the hospital. Fig. 1 shows a transport access guide. The Hospital was well serviced by heavy rail, with two stations within 10–15 min easy walking distance. Hospital staff also had access to an extensive bus network.

Staff parking for private motor vehicles

In 2011, 800 car spaces were available for approximately 3200 staff on-site, with significant parking overspill in the roads surrounding the hospital and on the hospital campus. The hospital re-development increased parking to over 1600 car spaces for approximately 3900 staff by early 2013. Parking for staff was charged at below market rates for the surrounding area and remained stable, creating a financial incentive to drive to work. All parking infrastructure was owned by the hospital, and parking was managed via a waiting list that did not prioritise parking based on need.

Intervention

The Liverpool Hospital Travel Plan 2011–2014 was developed to contribute to the transport objectives of the Liverpool Hospital Sustainability Taskforce. It aimed to promote active forms of transport and decrease the proportion of staff driving to work by 10% by 2014. The intervention was underpinned by theories including stages of change theory for actions aimed at individuals, and capacity building and organisational change theory for actions aimed at the organisation. It employed a mix of strategies including policy (e.g. completing a parking management study to inform a new parking policy, public transport ticket salary deduction/sacrifice schemes), infrastructure (e.g. provision of end of trip facilities, marking of carpooling spaces in staff car park) and behaviour change (e.g. cycling and walking programs).³³

The plan was developed by a working group led by the Health Promotion Service and supported by a senior transport consultant between May and December 2011. It followed typical stages of travel planning as shown in Table 1, and the development of the plan involved a needs assessment, gaining commitment from senior management and strategy development. The needs assessment included five activities: identifying organisational level barriers and enablers for travel planning, auditing the transport and physical environment of the hospital, a staff travel survey, analysis of the distance all staff live from work and interviews with hospital managers. Details of the travel plans development are



Fig. 1 – Liverpool Hospital access guide showing local transport context.

Table 1 – Four year timeline of workplace travel plan stages & actions.

Year	Stage	Key workplace travel plan actions complete/incomplete ^a
2011	Commitment & Development	Present to Executive and gain Executive approval. Development of the travel plan has been described elsewhere. ³⁴
2012	Implementation	Run staff feedback sessions and launch website. Pilot salary deduction of public transport passes and investigate salary sacrifice . ^b Implement Ride to Work Day and Walk to Work Day events. Install bike racks and secure bike storage. Assess all staff access to showers and lockers. Pilot digital (Facebook, website, YouTube) staff engagement strategies. Implement a series of cycling skills courses and lunch time rides.
2013	Implementation	Brand behaviour change programs 'Staff Travel CHOICES'. Implement targeted recruitment strategies – living <5 km from work, physically inactive, drivers. Run Staff Travel Expo event and launch CHOICES programs to all staff - personal journey planning, walk to work, cycle to work and carpooling programs . Update Transport Access Guide & map of walking/cycling routes. Conduct stage 1 and of parking management study. Incorporate information on transport CHOICES in new staff induction. Communicate regularly via existing staff channels. Implement secure bike parking policy.
2014	Maintenance	Deliver staff Travel 'pop-up' stands including personal journey planning. Run lunch time rides and walk to work program. Run cycle to work and carpooling programs . Deliver stage 1 and stage 2 parking management study ahead of completing the current contract. Include information on transport in staff induction. Organise for walk to work program to be managed by library staff.

^a **Incomplete** actions from the Liverpool Hospital Travel Plan 2011–14 are highlighted in bold text.

^b Salary sacrifice refers to employees being able to make pretax purchases which reduce their taxable income.

described elsewhere.³⁴ Fidelity of implementation was measured via annual reports which documented travel plan actions that had been implemented and ones that had not.

Survey participants and travel survey

The survey of all staff on the campus was a self-administered on-line questionnaire in 2011, 2012, 2013 and 2014. Staff groups without email access also received paper copies of the questionnaire via a stand set up at their sign-off area. It assessed main travel mode to work, physical activity, intention to travel to work by active transport modes, what might encourage them to travel actively to work (baseline only), and demographic information.

In four surveys, all staff were emailed using the standard distribution list and invited to participate. A flyer was distributed to all staff via the mail room, and posters were placed around the hospital to promote participation. Similar small prizes were offered to increase participation (e.g. four \$100 shopping vouchers). The survey ran for two weeks at the same time and in similar spring weather conditions, with a reminder sent seven days after the survey started. Since each survey was cross-sectional, the sample obtained differs each year. Therefore, comparisons to the baseline sample were made each year and logistic regression models were built to adjust for potential confounding from the change in demographic variables between baseline and each subsequent survey sample. A comparison of the demographic variables

for baseline staff survey participants compared to the same data for all hospital staff is presented in a the [supplementary data \(see Appendix A\)](#).

Outcome measures

The main outcome measure included travel mode used in the previous week. It was validated at baseline and showed good agreement with travel diaries.² Participants were asked, 'How did you travel to work this week? If you used more than one form of transport, show the method used for the longest (distance) part of the journey', and 13 response categories were available for each day of the week. The main survey outcome measures were the proportion of employees travelling to work via four different transport modes (the travel mode split) and who had travelled actively to work, i.e., who had ridden a bike or walked for the 'longest (distance) portion' of their journey to work on most working days in the last week. Public transport was included within active transport modes since in this local transport context, and for many other workplaces, staff needed to walk approximately 10 min to bus and rail interchanges. Bouts of 10 min or more are considered significant contributions to physical activity in guidelines.³⁵

Secondary outcome measures included the proportion of staff meeting standard physical activity guidelines of >150 min of Moderate and Vigorous Physical Activity (MVPA) per week, which was examined using the previously validated short

version of the International Physical Activity Questionnaire (IPAQ).³⁶ Data were not collected for physical activity in the 2012 intervention year to reduce respondent burden.

Analysis

Analyses were performed using SAS 9.4. Comparison of demographic variables for staff survey respondents in the intervention years of 2012, 2013 and 2014 were made with baseline in 2011 using Pearson's Chi-squared test. A comparison of baseline survey participants to all staff is reported elsewhere,³⁴ and provided in the [Supplementary File](#). Differences in main travel mode each intervention year compared to 2011 were also tested using Pearson's Chi-squared test.

Multivariate logistic regression was used to adjust for potential confounders and to assess potential effect modifiers. Univariate and multivariable logistic regression models including the variables of occupation, age, gender, distance staff lived from work and all of their interaction terms were built to examine the change in the main outcome measure of the proportion of staff travelling to work via active modes each year compared with baseline. Forwards addition method with a significance level of $P = 0.01$ was used to assess whether interaction terms were included in the base model. To assess potential confounders backward elimination was used with criteria for inclusion in the base model being a 10% change in the estimate of effect (odds ratio), then a material difference in the precision (i.e. change in standard error) and lastly significant variables that do not confound or affect precision could be removed from the base model. Odds ratio (OR) and adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated as a measure of the likelihood of change after allowing for confounders.

For secondary physical activity outcome measure, to assign participants to the appropriate physical activity category we multiplied their vigorous intensity minutes by two and added them to their minutes of moderate physical activity and walking. We then used the moderate activity cut-points (<150 min/week for the physically inactive category, 150–299 min/week for the sufficiently active category and ≥ 300 min/week for the very active category) to determine the appropriate physical activity category. The sufficient and very active categories were collapsed to form the adequate physical activity for health category. Pearson's Chi-squared tests were used to assess changes in the proportion of staff achieving adequate physical activity.

Results

Implementation of the intervention as planned

[Table 1](#) provides a timeline of intervention actions implemented each year showing some incomplete actions. The incomplete actions highlight the fact that strategies including discouraging driving (e.g. parking price increases, reduction in the ratio of car spaces to staff) were not a part of the intervention. This meant that the actions were focussed solely on encouragement of active transport, and the majority of these were behavioural or structural with little policy support and

no financial incentives. Most strategies to maintain intervention effects were yet to be implemented.

Survey response rates and survey participants

The response rate to the on-line survey averaged 23%, and was 25% at baseline ($n = 804$), 26% in 2012 ($n = 904$), 24% in 2013 ($n = 872$) and 18% in 2014 ($n = 682$). Demographic characteristics of the survey respondents each year versus baseline compared in [Table 2](#) show many differences except for age. There were also many differences between the survey population at baseline and the total staff population at the hospital – see the [supplementary data](#).

Comparisons of staff travel modes to work

[Table 3](#) presents comparisons of travel mode to work of staff survey respondents in 2011 and the three subsequent years. It shows a decrease in driving to work each year compared to the baseline and a shift towards increases in public transport use and walking/cycling.

Driving to work decreases from 83% of staff travel to work at baseline to 74% in 2012, then 73% in 2013 and 70% in 2014. Public transport use for trips to work increases from 11% at baseline to 14% in 2012, then tapers off to 13% and finally 12% in 2013 and 2014 respectively. Walking/Cycling to work was 4% amongst staff survey respondents at baseline and increases to 5%, then 7% and 5% in 2012, 2013 and 2014 respectively.

Overall, there was a modest decrease in the proportion of staff survey respondents driving to work and corresponding small increases in active travel in the intervention years versus baseline, and these increases were statistically significant in all years except the final intervention year in 2014. With the 'Other' category removed, the proportion of staff survey respondents driving to work was 86% of at baseline, this decreased by 7%, to 79% in 2012 and 2013 tapering out to 81% (a 5% decrease from baseline) in 2014. Active travel increased from approximately 16% at baseline to 20% in 2012, 22% in 2013 and back to 20% in 2014.

Effect of the intervention on active travel to work

[Table 4](#) presents the results for the main outcome of the intervention effect on active travel to work amongst staff survey respondents over three years compared to baseline. After adjustment for the confounder of distance the adjusted odds of active travel in the 2012 intervention year were 33% greater with 95% CI 1%–74%, in the 2013 intervention year the adjusted odds of active travel increased by 50% with 95% CI 15%–96% and in 2014 the odds of active travel increased by 30%, yet the 95% CI ranged from a 3% decrease in the adjusted odds of active travel to a 74% increase.

Effect of the intervention on physical activity

At baseline in 2011, 76% of staff survey completers achieved adequate physical activity for health. This proportion increased to 78% in 2013 and 81% in 2014, although the difference in the proportions was not significant in 2013 ($P = 0.5$)

Table 2 – Comparisons of demography of staff survey respondents between baseline in 2011 and three subsequent years.

	2011 n (%)	2012 n (%)	P ^a	2013 n (%)	P ^a	2014 n (%)	P ^a
Total	804 (100)	904 (100)		872 (100)		682 (100)	
Occupation type			0.8		0.003		0.001
Clinical	379 (61)	508 (61)		563 (68)		465 (72)	
Non-clinical	245 (39)	319 (39)		262 (32)		176 (28)	
Age in years			0.6		0.1		0.1
18–34	167 (27)	221 (29)		255 (32)		203 (32)	
35–54	342 (55)	424 (55)		401 (50)		317 (51)	
≥55	112 (18)	127 (16)		149 (18)		105 (17)	
Gender			0.06		0.02		0.001
Female	469 (76)	580 (71)		648 (81)		519 (83)	
Male	152 (24)	236 (29)		156 (19)		106 (17)	
Distance from home to work^b			0.08		0.01		0.001
>10 km	510 (66)	551 (61)		524 (60)		371 (54)	
5–10 km	114 (15)	160 (18)		173 (20)		150 (22)	
<5 km	146 (19)	193 (21)		173 (20)		161 (24)	

^a Pearson Chi-squared test of the difference in the proportions each year compared to baseline in 2011.

^b Based on post code of residence in Sydney, Australia.

Table 3 – Comparisons of Liverpool Hospital staff survey respondents travel mode to work between 2011 and three subsequent years.

	2011 n (%)	2012 n (%)	P ^a	2013 n (%)	P ^a	2014 n (%)	P ^a
Total	804 (100)	904 (100)		872 (100)		682 (100)	
Travel mode by four groups			0.001		0.001		0.001
Private motor vehicle	605 (83)	641 (74)		637 (73)		479 (70)	
Public transport	83 (11)	118 (14)		117 (13)		79 (12)	
Walked/cycled	28 (4)	40 (5)		57 (7)		37 (5)	
Other ^c	14 (2)	66 (7)		61 (7)		87 (13)	
Two travel mode by two groups^b			0.03		0.003		0.06
Private motor vehicle	615 (86)	641 (79)		637 (79)		479 (81)	
Active travel	113 (16)	158 (20)		174 (22)		116 (20)	

^a Pearson Chi-squared test of the difference in the proportions each year compared to baseline in 2011.

^b Some percentages do not add to 100 due to rounding.

^c The other category includes responses 'Worked at home', 'Other' and 'I did not go to work'.

or 2014 ($P = 0.2$). Of the staff who reported driving to work at baseline 75% achieved adequate physical activity levels compared to 76% amongst staff who reported active travel to work, and in 2013 77% of drivers versus 80% of active travellers. There was little change in 2014.

Discussion

This travel plan implemented strategies to encourage active travel, but did not implement strategies to discourage driving and most of the strategies intended to sustain effects were not implemented. There was a small yet consistent 4–6% increase in active travel across three years of follow-up compared to baseline, and this remained significant in 2012 and 2013 after adjustment for distance staff live from work, which is a known strong predictor of active travel to work.^{2,37} Although there was a consistent trend towards increasing the proportion of staff achieving adequate physical activity for health across the three intervention years, the difference was not statistically significant. Workplace travel plans appear to be a

promising way for increasing staff active travel to work in medium and large workplaces.

A challenge for the present study is that parking policy could not be implemented in the study period due to existing contractual arrangements. This meant that the travel plan was reliant on actions which focussed solely on encouraging active travel. Some workplace travel plan researchers have suggested that parking policy is central to managing overall travel demand at a site, or recommend coupling strategies for discouraging driving with strategies to encourage active travel.^{23,38–40} A review of 21 exemplar workplace travel plans in the UK found organisations at 13 sites which addressed parking achieved an average 24% reduction in staff driving cars to work compared to 10% at eight sites that had not.²³

Secular trends in journey to work are unlikely to account for reductions in staff driving to work presented in this paper. Census data on journey to work patterns from the 2011 Census show 78% of people commuting to Liverpool as a destination of work arrived via private motor vehicles as drivers or passengers.⁴¹ The Census is conducted every five years and the next is due in 2016, so comparisons over the

Table 4 – Crude and adjusted intervention effect on active travel to work amongst survey respondents each year.

Model for the intervention year	Active travel to work and distance from work					
	Univariate analysis OR ^a	95% CI	P	Multivariate analysis AOR ^b	95% CI	P
Model 1 – Active Travel Year 1 vs baseline	1.34	1.03, 1.76	0.03	1.33	1.01, 1.74	0.04
Distance staff live from work ^c			0.001			0.001
>10 km	1.00	–		1.00	–	
5–10 km	0.90	0.61, 1.35		0.89	0.60, 1.324	
<5 km	2.02	1.48, 2.74		1.99	1.47, 2.71	
Model 2 – Active Travel Year 2 vs baseline	1.49	1.15, 1.94	0.003	1.50	1.15, 1.96	0.003
Distance staff live from work ^c			0.02			0.01
>10 km	1.00	–		1.00	–	
5–10 km	0.78	0.54, 1.14		0.75	0.51, 1.10	
<5 km	1.43	1.04, 1.95		1.41	1.03, 1.93	
Model 3 – Active Travel Year 3 vs baseline	1.31	0.99, 1.75	0.06	1.30	0.97, 1.74	0.08
Distance staff live from work ^c			0.001			0.001
>10 km	1.00	–		1.00	–	
5–10 km	0.69	0.44, 1.09		0.66	0.42, 1.05	
<5 km	2.00	1.45, 2.78		1.95	1.41, 2.72	

^a Univariate analysis assessed the significance of the effect of each individual demographic variable on active travel in the intervention year, and only the assessment of change in active travel and distance in the comparison of year to baseline is presented. Table 2 provides n and % for demographic variables, and Table 3 provides n and % for active travel each year.

^b Multivariate logistic regression models assessed confounding and effect modification from variables including occupation, age, gender and distance and their interaction terms, before adjusting for distance staff live from work in all models.

^c By post code of residence in Sydney, Australia.

period of the travel plan implementation are not possible yet. However, commuting to work (defined as the first trip to work each day) for the Sydney Greater Metropolitan Area between 2001 and 2011 remained stable at 70%, suggesting the proportion of staff driving in our study decreased whilst it is likely to have been stable in the general population.²⁷ There were no changes in the area to public transport, walking and cycling paths as well as policy and programs that were not part of the intervention that explain the results.

Travel plans can be required as a condition of planning consent for new developments and re-developments that will accommodate medium and large organisations in some countries.^{42–46} In many developed countries medium and large organisations employ the majority of the workforce,^{47,48} therefore with effective policy and regulatory support there is potential for the impacts of travel plans to reach large segments of these populations.

The present study found no change in physical activity despite an increase in active travel overall. A relatively high proportion of staff were achieving adequate physical activity for health at baseline and whilst this did increase, the change was not significant.

Study limitations and strengths

It is possible that amongst the population of hospital staff who did increase their active travel to work, some individuals may have substituted this for other physical activity, although our study design was unable to detect this. The survey measure for physical activity may not accurate enough to predict an overall increase in physical activity in intervention studies since validation studies show the IPAQ only demonstrated moderate agreement with objectively measured physical activity,³⁶ although the IPAQ short questionnaire has been used

in workplace intervention studies understanding its limitations.⁴⁹

Although the survey response rates were acceptable for workplace studies using on-line surveys of the nature used in this study,⁵⁰ sample selection bias was evident that could hamper the study findings. Also, the single site study design without a control group does not allow us to compare the study outcomes amongst employees in other organisations not receiving the intervention during the study period. Further research with stronger study designs is required to confirm the effect of workplace travel plans on active travel to work.

Strengths of this study include the study measures being repeated four times annually in similar conditions, and the consistency of the findings for the main outcomes across time points. Assessment of potential confounders and effect modifiers also increases confidence in these results. The study intentionally mimicked pragmatic methods usually used for evaluating workplace travel plans, and validated survey questions adapted from the UK Department for Transport's Essential Guide to Travel Planning,² so that the results are likely to be valid, reliable and transferrable to non-research contexts. The model for program management applied health promotion skills which ensured implementation and evaluation, factors often cited as weaknesses of travel plans,^{38,51} were well supported.

Future research

Future studies of the effectiveness of workplace travel plans should address issues of confounding by employing strong study designs such as controlled before-after studies and cluster-randomised controlled trials. To support a temporal relationship between travel plan interventions and their outcomes these effectiveness studies could consider creating a

randomly selected sub-sample based on a sample size calculated to be appropriate for assessing the main study outcome, and follow these staff longitudinally across implementation years. Randomisation of the sub-group would address the issue of selection bias in voluntary all staff surveys, and gathering data on the turnover of all staff compared to this sub-group could assist the assessment of whether loss to follow-up was different from general staff attrition rates. If the main results from the sub-sample were consistent with those from the all-staff survey sample it would increase confidence in results being generated by the commonly used cross-sectional all staff survey evaluations of workplace travel plans, and these pragmatic evaluations could be continued. Objective measurement of staff travel via site intercept surveys could also be considered in well-resourced studies.

Since the current study evaluated a complex intervention, a qualitative component of this evaluation will be submitted for publication in a peer-reviewed journal. It will share key barriers and enablers to successful workplace travel plan implementation from the perspectives of health and transport practitioners who supported the implementation of this travel plan and others. These learnings may assist other practitioners, researchers and policy makers supporting travel plan implementation.

Conclusions

A workplace travel plan which only included strategies to encourage active travel to work achieved small but significant increases in active travel. Further research with stronger study designs is required to confirm the effect of workplace travel plans on active travel to work. This research could consider pragmatic approaches to implementing controlled trials that are likely to be suitable for scaling up for broad policy adoption, or when well supported by regulation that requires the development of travel plans.

Author statements

Acknowledgements

The authors acknowledge Health Promotion Service staff who contributed to the implementation of the plan, including Jeni Bindon, Mandy Williams, George Anderson, Drew Aras and Amanda Caddy. We also acknowledge the Liverpool Hospital Executive and the Sustainability Taskforce members for their support of the implementation of the plan. We thank Huilan Xu, a biostatistician who provided advice on the analysis. We thank the anonymous reviewers and editorial office, whose feedback enhanced the manuscript. We are also grateful to David Meiklejohn and Alice Woodruff, senior transport consultants from UrbanTrans Australia and New Zealand, for technical support and to Bruce Herbes from VisualVoice for providing the access guide image for Fig. 1 with permission from Liverpool Hospital.

Ethical approval

The study was approved by the South West Sydney Research Ethics Committee.

Funding

Funding for the research was initially provided by the Health Promotion Service, South Western Sydney & Sydney Local Health Districts. This analysis is a component of a dissertation for a Doctor of Philosophy with the School of Public Health at the University of Sydney, and the PhD student's time evaluating the project was funded by a University of Sydney Postgraduate Award.

Competing interests

The authors declare here are no competing interests.

Author contributions

Author 1 conceptualised the study, collected all data, contributed to the development of an analysis plan, conducted the analysis with minimal assistance, and wrote all manuscript drafts.

Author 2 provided guidance on all aspects of the studies development, provided substantial input into the analysis plan, reviewed all stages of data analysis and contributed to all drafts of the manuscript.

Author 3 provided guidance on all aspects of the studies development, provided input into the analysis plan, reviewed all stages of data analysis and contributed to all drafts of the manuscript.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.puhe.2016.02.012>.