Cycling for transport and recreation: associations with socio-economic position, environmental perceptions, and psychological disposition

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Abstract

OBJECTIVE: Interest is growing in promoting utility cycling (i.e., for transport) as a means of incorporating daily physical activity (PA) into people's lives, but little is known about correlates of utility cycling. Our primary aim was to examine cross-sectional relationships between socio-economic characteristics, neighborhood environment perceptions and psychological disposition with utility cycling (with or without additional recreational cycling). A secondary aim was to compare these relationships with those for recreation-only cycling.

METHOD: Baseline survey data (2007) from 10,233 participants in HABITAT, a multilevel longitudinal study of PA, sedentary behavior, and health in Brisbane adults aged 40-65 years, were analysed using multinomial regression modelling.

RESULTS: Greater income, habitual PA, and positive beliefs about PA were associated with utility and recreation-only cycling ($p<0.05$). Always having vehicle access and not in the labor force were associated with recreation-only cycling ($p<0.05$). Some or no vehicle access, part-time employment, and perceived environmental factors (little crime, few cul-de-sacs, nearby transport and recreational destinations) were associated with utility cycling ($p<0.05$).

CONCLUSION: Our findings suggest differences in associations between socio-economic, neighborhood perceptions and psychological factors and utility and recreation-only cycling in Brisbane residents aged 40-65 years. Tailored approaches appear to be required to promote utility and recreational cycling.

Keywords: active transportation, physical activity, health promotion, influences

Introduction

Governments in low cycling countries are promoting utility cycling (cycling for transport) as a means of incorporating physical activity (PA) into people's daily lives and consequently improving their health (Oja et al., 2011) and reducing carbon dioxide emissions (Rojas-Rueda et al., 2011). In Australia, the National Cycling Strategy presents priority government actions for increasing cycling (Ausroads Ltd, 2010). Actions include promoting utility cycling, improving bicycle infrastructure and end-of-trip facilities, and integrating cycling needs in transport and land use planning (Ausroads Ltd, 2010). Census data indicate that such actions may be effective: from 2006 to 2011 the percentage of Australians travelling to work by bicycle increased by 15% (Australian Bicycle Council, 2013). However, bicycle mode share to work remains low, 1.3% (Australian Bicycle Council, 2013), similar to rates in the U.S. and UK but low compared with some European countries (Pucher and Buehler 2012).

According to ecological models (Sallis et al., 2006), strategies to increase utility cycling must be multi-level, accounting for individual factors as well as the social and physical environmental context. Evidence about the relationship between individual characteristics and utility cycling is growing (Beenackers et al., 2012; Bopp et al., 2012; Heinen et al., 2009; Titze et al., 2007; Titze et al., 2008; Titze et al., 2010): utility cycling is associated with younger age and being male in low cycling countries like Australia (Bopp et al., 2012; Garrard et al., 2008; Sahlqvist et al., 2013; Titze et al., 2010; Winters et al., 2007). There are inconsistent findings for socio-economic characteristics like income (Heinen et al., 2009). The evidence supporting associations between psychological factors and utility cycling is also limited but suggests that constructs from the Theory of Planned Behavior (e.g., attitude) influence decisions to cycle to work (Heinen et al., 2009). Of the subjective environment, the perceived presence of destinations has received the most attention as a correlate of commuting cycling (Beenackers et al., 2012; Heinen et al., 2009).

Studies examining utility cycling correlates have compared utility cyclists with non-utility cyclists. This is problematic because non-utility cyclists include recreation-only cyclists, who are likely to have different perceptions about cycling than non-cyclists. Our primary aim was to use an ecological model to examine cross-sectional associations between utility cycling (with or without additional recreational cycling) and socio-economic characteristics, perceptions

of the neighborhood environment, and psychological disposition, with non-cyclists serving as the referent group. A secondary aim was to compare these associations with those for recreation-only cycling.

Methods

Sample and procedure

Baseline data from HABITAT, a study of PA, sedentary behavior, and health in adults aged 40-65 years and residing in Brisbane, Australia, in 2007, were used for these analyses. As reported previously (Burton et al., 2009), a multi-stage probability sampling design was developed to select a stratified random sample of Census Collector's Districts (CCD), and within each CCD, adults aged 40-65 years were randomly selected. CCDs are used by the Australian Bureau of Statistics to collect census data and in Brisbane, compose an average of 200 households with similar socio-economic characteristics. Selected adults were mailed a self-administered questionnaire between May and July, 2007 (Turrell et al., 2010). For the current analysis, factors hypothesized to be associated with cycling based on previous research (Bopp et al., 2012; Heinen et al., 2009; Panter and Jones 2010; Titze et al., 2010) were examined. In total, 11,036 (68.5% response rate) usable surveys were returned, and participants were representative of the general Brisbane population (Turrell et al., 2010). The University Human Research Ethics Committee at Queensland University of Technology provided ethical clearance (Ref. No. 3967H).

Cycling behavior

Participants reported the frequency of recreational cycling ('cycling for exercise or recreation') in the last 12 months (6 response options, from 'never' to 'more than once a week') and the time (hours and mins) 'spent cycling for transport in the last week'. They were instructed that cycling for transport includes 'travel to and from work, to do errands, or to go from place to place' and to not include time spent cycling for exercise or recreation in their estimations. Participants were categorised as: (1) non-cyclists if they reported recreational cycling less than monthly and no minutes of utility cycling; (2) recreation-only cyclists if they reported recreational cycling at least monthly and no minutes of utility cycling, and (3) utility cyclists if

they reported any minutes of utility cycling in addition to any reports of recreational cycling. Most utility cyclists (88.9%) were recreational cyclists.

Socio-demographic variables

Participants reported age, sex, and household composition. As measures of socio-economic position, they reported gross household income (11 categories collapsed into 4 and an additional missing category), employment status (10 categories collapsed into full-time, part-time/casual, and not in the labor force), and availability of a motor vehicle for personal use (yes, always; yes, sometimes; no).

Perceptions of the neighborhood

Scales and items that form the abbreviated version of the Neighborhood Environment Walkability Scale (NEWS-A) (Cerin et al., 2007; Saelens et al., 2003) with acceptable reliability (Turrell et al., 2011) were used. These included scales measuring traffic volume, aesthetics, and crime in the neighborhood. Item responses were on a 5-point Likert scale (1=strongly disagree; 5=strongly agree). Counts of recreational facilities (e.g., bike path, public park) that participants reported were located within a 5-min drive and separately of transport destinations including public transportation (e.g., supermarket, post office, train station, bus stop) within a 20-min walk were calculated and treated as continuous variables. Five individual items about the neighborhood streets were also included: many traffic slowing devices in the suburb, many streets having cul-de-sacs (reverse coded), many four-way intersections, and many hilly streets. Responses were on a 5-point Likert scale (1=strongly disagree; 5=strongly agree), and were grouped into agree (response of 4 or 5) or disagree/neutral (response of 1-3) as done previously (Titze et al., 2010).

Psychological factors

In keeping with an expanded Theory of Planned Behavior (Montano and Kasprzyk 2008) and supported by studies of utility cycling (Heinen et al., 2009), theoretical constructs included attitude towards PA (affective and instrumental), social support for PA, self-efficacy towards PA, and PA habit. Scales from previous work with acceptable measurement properties were used (Burton et al., 2007; Sallis et al., 1997). Item responses were measured on a 5-point scale.

Responses ranged from strongly disagree (1) to strongly agree (5) except social support responses ranged from never (1) to very often (5).

Analysis

Analysis was carried out with STATA/SE 11.2 (StataCorp, College Station, Texas). Principal components analysis with VARIMAX rotation was conducted to assess factor structure of all scales, and Cronbach's alpha was computed as a measure of internal consistency of each scale. After removing one item from the crime scale ('there are unsecured dogs in my suburb'), all scales had adequate measurement properties (see Supplementary material A), and the mean score of scale items was computed to create a composite scale score. Scores on scales measuring perceptions of the neighborhood were collapsed into tertiles based on the distribution of the data. Descriptive statistics were generated for all variables.

A series of multivariable multinomial regression models was computed to examine the separate and joint influence of socio-economic, perceived environment and psychological factors on utility and recreation-only cycling behavior. In the first model, socio-economic variables were the predictor variables. In the second, environmental factors were the predictors, and in the third, psychological variables were the predictors. The final model included all predictor variables found to be significant in a previous model at $p<0.10$. All models were adjusted for age, sex and household composition, and to account for clustering of participants within CCD, the survey (*svy*) command in STATA/SE was used. Statistical significance was set at $p<0.05$.

Before modelling, careful attention was made to correlations among predictor variables, to confirm that these variables were not highly correlated ($r<0.70$), and thus to prevent multicollinearity. After final modelling, multicollinearity testing was conducted: models were rerun as OLS regression models and Variance Inflation Factors (VIFs) were checked. All VIFs were low (< 2), indicating that multicollinearity was not present. Also after final modelling, the Hausman test (*suest* command in STATA/SE) was run for all models to check for Independence of Irrelevant Alternatives, and no evidence against the correct specification of the multinomial logic for any model was found.

Results

Of 11,036 eligible participants, two were excluded based on age; 238 (2.2%) were excluded because they were missing cycling data; and 563 (5.1%) were excluded because they were missing data on predictor variables (≤ 2.0% of data from any predictor were missing). Thus, data from 10,233 were included in the analysis. Excluded participants were more likely to be female, single, in low income households, and not in the labor force ($p \leq 0.001$), and less likely to have favourable perceptions of their neighborhood environment, to have social support for PA, or to have made PA a habit ($p<0.05$; see Supplementary material B).

Of the analytical sample, 18.0% were categorised as recreation-only cyclists, and 3.8% as utility cyclists, who tended to also be recreational cyclists. Most recreation-only cyclists (54.2%) cycled at least weekly, while utility cyclists averaged 120 min of utility cycling in the previous week (IQR 60, 240). Descriptions of the sample are displayed in Table 1.

[TABLE 1 APPROXIMATELY HERE]

Results of regression modelling are shown in Tables 2-3. Table 2 shows that as household income decreased, odds of cycling for recreation only and utility decreased. The odds of recreation-only cycling were lower for participants having no motor vehicle access and for those outside the labor force while the odds of utility cycling were higher for participants with no or sometime motor vehicle access and for part-time/casual workers. Five perceived environment factors were associated with cycling. The odds of recreation-only cycling were higher for those who perceived the most neighborhood greenery. In contrast, greenery was not associated with utility cycling, but perceived crime and having many cul-de-sacs decreased odds of utility cycling. For both cycling types, the odds increased as the number of recreational facilities reported to be nearby increased. For utility cycling, the odds also increased as the number of transport destinations reported nearby increased. All psychological factors were associated with increased odds of cycling for recreation only or utility. PA habit showed the strongest associations with both cycling types.

[TABLE 2 APPROXIMATELY HERE]

Odds ratios fluctuated little from these models to the fully-adjusted model (Table 3). Among socio-economic factors, lower household income was associated with decreased odds of recreation-only and utility cycling, as in Table 2, with odds ratios much lower for utility cycling than for recreation-only cycling. Although these associations were attenuated in the fully adjusted model, they remained significant. As in Table 2, the odds of recreation-only cycling

were lower for participants having no motor vehicle access and for those outside the labor force, while the odds of utility cycling were higher for participants with no or sometime motor vehicle access and for part-time/casual workers. With full adjustment, no perceived environment factors were associated with recreation-only cycling; however, all five found to be associated with utility cycling in the earlier modeling remained significant for utility cycling. Similarly, all psychological factors in the full model remained associated with both types of cycling.

[TABLE 3 APPROXIMATELY HERE]

Discussion

This study examined the separate and joint associations between socio-economic, perceived environment and psychological factors and utility cycling, after modelling recreation-only cycling behavior separately. In this large representative sample of Brisbane adults aged 40-65 years, 3.8% of participants reported utility cycling in the previous week. This is more than the 1.3% reported previously for commuting to work in Brisbane or the 0.09% to 3.1% in other Australia's capital cities (Australia Bureau of Statistics, 2011). Differences between findings reflect that the current study included all utility cycling, not only commuting cycle, and previous research in Queensland indicates that some cyclists travel by bicycle to shops and recreational facilities as well as to work and places of study (Sahlqvist and Heesch 2012). Findings of utility cycling correlates in the current study were robust, with the strength of associations showing little change between separate modelling of socio-economic, perceived environment and psychological factors and the full modelling of these factors together.

Findings that socio-economic factors were associated with utility cycling add to the literature as the role of socio-economic position has not been well established. Consistent with other studies (Heinen et al., 2009; Sahlqvist and Heesch 2012; Titze et al., 2010), car ownership was found to be negatively associated with the likelihood of an individual being a cyclist. The association between income and cycling has been unclear in the literature (Heinen et al., 2009). Some travel data (Bartley Consulting Pty Ltd 2008; Buehler et al., 2011; Merom et al., 2010) suggest a socio-economic gradient in utility cycling in car-dependent English-speaking countries, and our findings from the fully-adjusted model indicated a threshold effect, with cyclists in the top household income bracket more likely to engage in utility cycling than all other income groups. A recent study from a high-cycling country suggests that part-time workers are more

likely to cycle to work (Engbers and Hendriksen 2010),which is consistent with the current study, as one of the strongest positive associations was between part-time or casual work and utility cycling.

Perceptions of less supportive neighborhoods were associated with reduced likelihood of utility cycling. These were neighborhoods perceived to have the most crime; many cul-de-sacs; and few nearby recreational or transport destinations, including few public transport destinations. This result adds to the growing number of studies indicating that perceptions of the physical environment, including perceived access to destinations, are associated with utility cycling specifically and active transport (walking or cycling to destinations) more broadly (Heinen et al., 2009; Panter and Jones 2010; Titze et al., 2010). Studies showing crime perceptions to be a possible deterrent to utility cycling are scarce, and our findings in indicate that this factor should be considered in future research into utility cycling correlates and in efforts to increase utility cycling. The failure to detect more associations with environmental factors may reflect the assessment of neighborhood environmental factors only. Bicycle utility trips, most often to commute, are typically much longer in Queensland (Sahlqvist and Heesch 2012). Another Australian study found that perceived neighborhood aesthetics and the presence of traffic slowing devices to be correlated with utility cycling (Titze et al., 2010).

All theory-based psychological factors were positively associated with utility cycling, with habituated PA found to one of the strongest correlates of utility cycling. These findings add support to the limited amount of research on the role of these constructs (Beenackers et al., 2012; Heinen et al., 2009; Panter and Jones 2010; Titze et al., 2010) on utility cycling and active transport behavior, highlighting the importance of interventions that encourage regular cycling in order to develop cycling habits.

This is among the first studies to separately report utility and recreation-only cycling. Given low levels of cycling, previous studies have tended to examine factors associated with all types of cycling behavior combined or have assessed utility cycling without accounting for differences in recreation-only cyclists and non-cyclists in the modelling. This is important as experience with recreational cycling likely influence perceptions about cycling behavior. Indeed, our findings indicate differences in associations between socio-economic position and utility cycling versus recreation-only cycling. The social gradient between income and cycling was more pronounced for utility cycling. Whereas lack of consistent motor vehicle access and part-

time or casual employment increased the likelihood of utility cycling, having no motor vehicle access and being outside the labor force decreased the likelihood of recreation-only cycling, suggesting differential effects of socio-economic position on utility versus recreational cycling and potential opportunities for interventions targeting low socio-economic populations. With full adjustment, no perceived environment factor was associated with recreation-only cycling and this is consistent with previous research (Titze et al., 2010). However, all psychological factors were positively associated with both types of cycling. This finding could reflect that these factors addressed perceptions and attitudes towards PA rather than a type of cycling specifically although these factors have been inconsistently correlated with active travel (Panter and Jones 2010).

Strengths of the study include the high response rate that resulted in a representative sample of adults aged 40-65 years in Brisbane, Australia. Previous studies have tended to primarily recruit younger to middle-aged adults in higher socio-economic populations. Limitations include the cross-sectional design and the use of self-report data. Notably, relationships between factors examined and cycling are likely to be complex, and further investigation of the relationships between these factors is required to better understand the correlates of utility and recreation-only cycling.

In conclusion, this study indicates that socio-economic, perceived environmental and psychological factors are correlates of utility cycling and differ from recreation-only cycling correlates, in adults, aged 40-65 years, residing in Brisbane. Different interventions are likely to be required to encourage these two different physical activity behaviors. The finding that socio-economic status was associated with both utility and recreation-only cycling, although differently, suggests that bicycle advocates and government policy-makers need to consider the differential impact of future bicycle promotion and infrastructure changes across socio-economic groups and seek to reduce inequalities across groups in their planning of such initiatives. The finding that perceived environmental factors were associated with utility cycling indicates that to increase utility cycling, city planners and planned community developers should consider the possible impact of perceptions of the environment on utility cycling. Noteworthy are perceptions about the amount of green space (e.g., some aesthetics but not too much to interfere with direct bikeways to destinations), crime levels (less crime would be safer), street connectivity (fewer cul-de-sacs for more direct travel to destinations) and access to more destinations nearby.

Consequently, planners and developers should consider addressing these features of the built environment in future new developments and the revitalisation of older developments that could improve such perceptions and encourage utility cycling. Last, the finding that psychological disposition was associated with utility and recreation-only cycling suggests a role for health educators and promoters in changing attitudes and perceptions about physical activity, in initiatives to encourage both types of cycling. In summary, along with findings from previous studies in low-cycling countries, the findings of this study may inform policy and program development to encourage cycling in these countries and, in particular, to reduce inequities in recreation and utility cycling.

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Statement of conflicts of interest

The authors declare no conflicts of interest regarding the present paper.

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