THE CONTRIBUTION OF WALKING AND CYCLING TO ACHIEVING RECOMMENDED LEVELS OF PHYSICAL ACTIVITY

Dr Kiron Chatterjee
Senior Lecturer in Transport Planning
University of the West of England, Bristol

Jeremy Hardin
Director
AECOM

Abstract

The 2008 Health Survey for England suggests that at least two-thirds of adults in England do not meet recommended levels of physical activity. There is a gap in knowledge on the extent to which walking and cycling contribute to the physical activity of different groups in the population. The gap exists because until now there has not been a large-scale data set that contains detailed information on both walking and cycling activity and overall physical activity. A survey has been undertaken as part of the evaluation of the Cycling City and Towns programme that has collected data on 30,000 individuals in 12 towns and cities in England. The survey obtained information for all individuals about the amount of physical activity of different types they undertake. 10,000 individuals completed travel diaries recording details of all journeys on foot and by bicycle during a seven day period. Analysis of the data shows how walking, cycling and exercise/sport are complementary activities, rather than substitutable activities, but also shows that cycling helps a substantial minority of the population to be physically active when they would not be otherwise. Regression modelling is used to relate individual level of walking, cycling and exercise/sports to personal, household and residential area characteristics. It reveals similarities and differences in the characteristics associated with each type of physical activity. Further analysis is required to identify barriers and motivators to walking and cycling for those that are inactive to assist effective targeting of public policy interventions.

Introduction

The health benefits of physically active lifestyles are well documented (DoH, 2004) and there is a target that by 2020 70% of adults in England meet the Chief Medical Officer's recommendation of 30 minutes or more moderate or vigorous physical activity on at least five days per weeks (DCMS, 2002). The Health Survey for England 2008 (Craig et al., 2009) provides population-wide results for physical activity based on two different measurement methods.

The main measurement method used for a sample of 15,000 adults aged 16 and over was based on self-reported frequencies of physical activity over a four week period for activities across four domains: home activities (housework, gardening, DIY, building); walks; sports and exercise activities (including cycling); and occupational activities. Results based on this method show that 39% of men and 29% of women achieve the recommended physical activity level. The second measurement method used for a sample of 2480 adults was based on accelerometers. It showed only 6% of men and 4% of women achieved the recommended physical activity level. Craig et al. (2009) note that there are limitations of both measurement methods and reasons to suspect over-estimation in self-reporting (due in particular to social desirability bias) and under-estimation in accelerometer measurements (due to activities such as cycling and swimming not being well monitored).

Craig and Shelton (2008) report that the majority of adults would like to do more physical activity but the most common barriers cited for failing to do so are work commitments and not having enough leisure time. This has led to suggestions that *"For most people, the easiest and most acceptable forms of physical activity are those that can be incorporated*

into everyday life. Examples include walking or cycling instead of travelling by car….." (DoH, 2004). Government initiatives to increase physical activity have focused both on structured exercise and sports and on lifestyle activities such as walking and cycling. Results from the Health Survey for England 2008 do not provide much insight into the contribution of walking and cycling to total physical activity. The average number of hours per week spent walking at 'fairly brisk' or 'fast' pace was recorded as 2.2 for men and 1.9 for women. This is a similar amount of time as that recorded for home activities and for sports and exercise activities. Craig et al. (2009) acknowledge that planned activities such as sports and exercise are recalled more easily than routine activities such as utility walking and cycling and the latter are therefore likely to be under-reported. Cycling was included among sports and exercise activities and therefore utility cycling is especially likely to be under-reported. There is hence the need for more rigorous data to be collected on walking and cycling to understand its contribution to overall physical activity.

The National Travel Survey (NTS) has been measuring travel behaviour in Great Britain since 1965/66 with comparable measurements for walking and cycling available since 1975/76. The average number of walking trips per year decreased from 325 in 1975/76 to 228 in 2009 and cycling trips decreased from 30 in 1975/76 to 15 in 2009 (Chatterjee and Dudley, 2008). While NTS provides valuable information on walking and cycling trends, it does not collect information about other physical activity and hence it is unable to reveal the changing contribution of walking and cycling to overall physical activity.

Various policy initiatives have been taken since 1996 to reverse the decline in walking and cycling. There has been little indication of success with past initiatives, but renewed interest has arisen in the last few years due to studies showing the large potential benefits to society of increased walking and cycling. Research for Cycling England (SQW, 2007) has suggested benefit-to-cost ratios (BCR) for cycling interventions of between 1.36 and 7.44, allowing for health as well as congestion benefits. While investment in cycling is now increasing, it has been noted that there remains an evidence gap on *"the extent to which different types of transport proposals are likely to lead to changes in levels of walking and cycling activity"* (DfT, 2007).

In recent years notable initiatives have included the establishment of Cycling England in 2005 with additional support for cycling (as a competitive sport) taking place through Sport England. The Department of Health is partnering Natural England for the Walking for Health programme which focuses on local volunteer-led health walks. In February 2010, the Department for Transport and Department of Health jointly published an Active Travel Strategy (DfT, 2010) where it was noted there is promising evidence for behaviour change emerging from current programmes and made a commitment to on-going monitoring and evaluation of investment.

The main emphasis of monitoring and evaluation studies is assessing changes in walking and cycling behaviour, but secondary outcomes such as increased physical activity depend on the behaviour that has been replaced by increased walking or cycling and therefore require other behaviours to be measured (Krizek *et al.*, 2009). For example, it needs to be checked if an increase in utility cycling replaces walking or other physical activity. Hence, at present there is uncertainty about the potential to achieve substantial change in physical activity through increased walking and cycling. Jones et al. (2007) state that studies of the relationship between the physical environment and physical activity tend to have focused on a restricted range of physical activity outcomes and do not allow results to be obtained on overall activity levels.

This paper presents results from a baseline survey of 30,000 individuals (adults and children) in 12 towns and cities in England undertaken in 2009 as part of the evaluation of the Cycling City and Towns programme. The survey collected detailed information on walking and cycling and physical activity and this is used to examine the contribution walking and cycling make to overall physical activity.

Cycling City and Towns Evaluation

In October 2005, six Cycling Demonstration Towns (CDTs) were given the opportunity to trial large-scale cycling investment programmes. Preliminary results have been reported from

investment in the six CDTs (Aylesbury, Brighton & Hove, Darlington, Derby, Exeter and Lancaster with Morecambe) over a three-year period (Sloman et al., 2009). Telephone interview surveys were carried out in each town in 2006 and 2009 with quota samples of 1,500 adults aged 16 and over. The number of adults saying that they cycled in a typical week increased from 24.3% in 2006 to 27.7% in 2009. At the same time a decrease was observed in the number of physically inactive adults from 26.2% to 23.6%. This provides a promising indication of increased cycling leading to an increase in overall physical activity, but it is important to note limitations of the survey. The survey asked about typical cycling and physical activity during the last 12 months and this may not provide accurate data. Also different samples were obtained in the two surveys and hence it is not possible to identify if the fall in inactive people is directly due to them taking up cycling.

In January 2008, the Secretary of State for Transport announced an increase in Cycling England's budget from £30m to £140m for the three-year period from 2008/09 to 2010/11. The budget increase led to an additional 12 'Cycling City and Towns' (CCTs) being chosen for investment. The investment programme involves targeted spending over a three-year period and is funding a mixture of initiatives such as improvements to cycle routes, training for children in schools and marketing and promotion work. The 12 new CCTs are Blackpool, Bristol, Cambridge, Chester, Colchester, Leighton-Linslade, Shrewsbury, Southend, Southport, Stoke-on-Trent, Woking and York. The investment programmes commenced between October 2008 and March 2009. The Department for Transport has commissioned a research study to evaluate the Government's investment in the CCTs. The study is being led by AECOM in association with the University of the West of England and the Tavistock Institute. For the evaluation study, a main objective is to obtain robust evidence about the 'whole-town' impacts of the investment in terms of cycling behaviour and other travel behaviour outcomes and physical activity outcomes.

Household Survey

Household surveys have been chosen as the main method to obtain data on travel behaviour and physical activity. A baseline survey was conducted in all 12 CCTs between July and October 2009. A repeat household survey is planned for 2012, one year after the CCT programme funding period ends. The baseline survey was conducted through face-to-face interviews. These are more expensive than telephone interviews or postal questionnaires, but enable better quality data to be acquired as interviewers can provide explanation and clarification tailored to individuals.

The decision was taken to survey 1,250 households in each CCT with a pre-determined random sub-sample of 425 of these households asked to complete a travel diary. These sample sizes were chosen in order to be able to detect changes between the two surveys of 3% in the percentage of cyclists in each CCT and an increase of 20% in cycling trips across the programme. A two-stage clustered sample design was used in each CCT. Output Areas (OA) (which typically contain 125 households) have been selected at random in each CCT (about 200 in each) and a small number of addresses (about 12) selected at random from each OA. The addresses within each OA have been selected using the small-user Postal Address File, the Post Office's list of addresses in the UK.

Survey administration procedures used for the baseline survey were similar to those used for NTS. NTS achieved a 59% household response rate in 2008 and a 58% response rate was achieved for the baseline survey in this study. Travel diaries were completed in 85% of households selected to complete them. The household survey comprises three different parts: household interview; 7-day travel diary; and attitudes questionnaire. Each household member is interviewed in turn to obtain information as part of the household interview. An adult is asked to respond on behalf of children aged five or over. Households selected to complete the travel diary are not told about the diary until the end of the interview. The attitudes questionnaire is a self-completion questionnaire given to adult respondents after they have completed the interview or the travel diary (if applicable).

Physical activity

It was not considered feasible given the scale of the survey to achieve objective measurement of physical activity through activity monitors (e.g. accelerometers). Physical activity information was obtained in the household interview for adults through self-recall

questions from the European Prospective Investigation into Cancer (EPIC) study. This was also the basis for measuring physical activity in the CDTs. The questions ask about occupational (employment-related) physical activity and the typical time spent per week over the last year (asked for both winter and summer) in six different types of non-occupational physical activity (walking, cycling, gardening, housework, DIY and other physical exercise/sport). The survey also asked adults the number of days in the past week where they had done a total of at least 30 minutes physical activity (excluding occupational physical activity and housework) which raised their breathing rate.

A simple four-level index (known as the Cambridge EPIC PA index) has been developed to classify the physical activity of individuals based on the EPIC questions for occupational physical activity and the typical time spent per week cycling and in other physical exercise/sport (the two non-occupational types of physical activity regarded to be of higher intensity). This is shown in Table 1. The validity of the Cambridge EPIC PA index has been demonstrated in two studies where the association between the index scores and objectively measured energy expenditure has been assessed (Wareham et al, 2003, and Cust et al., 2008). An alternative physical activity index based on both lower and higher intensity physical activity was found to have low association with objectively measured energy expenditure. It has also been shown that the Cambridge EPIC PA index is meaningful for public health, as it was found that compared to the inactive group the relative risk of all-cause mortality (after controlling for other factors) was decreased for people in the three other groups (0.83 for moderately inactive, 0.68 for moderately active and 0.68 for active).

Table 1: Physical Activity Classifications Based on Cambridge EPIC PA Index

	Cycling and other physical exercise/sport (average hours per day)			
Occupational physical activity	0	>=0 and <=0.5	>0.5 and <=1.0	>1.0
Sedentary or non-worker	Inactive	Moderately inactive	Moderately active	Active
Standing	Moderately inactive	Moderately active	Active	Active
Physical work	Moderately active	Active	Active	Active
Heavy manual	Active	Active	Active	Active

It has been established that time spent in sedentary activities is a separate disease risk factor to physical inactivity (WHO, 2002) and it is therefore of interest whether higher levels of walking and cycling activity are associated with reduced sedentary time. The survey included a question on the typical time spent per week over the last year in sedentary screen-based activities (in particular watching TV and using a computer).

Children are not the focus of this paper, but for children aged between 5 and 15 a different approach to measuring physical activity had to be adopted. A review highlighted the lack of validated self-report or proxy-report physical activity survey instruments for children. However, a review by Ferreira *et al.* (2006) of environmental correlates of physical activity in young people reported that time spent outdoors has been found to be a positive correlate. For children, the survey included questions on the amount of time per day that has typically been spent outside in the last year.

Travel behaviour

In the interview component of the survey all respondents were asked to provide some travel behaviour information, especially relating to cycling. This included questions asked about the journey to work, availability of a bicycle, frequency of use of a bicycle and about any cycling

trips during the previous week. Information was also obtained for each household member on socio-demographics (age, gender, ethnicity, etc.).

The 7-day travel diary was used to obtain detailed trip-making data for the sub-sample of households selected for the travel diary. A difference in design to NTS is that walking trips of any length are required on all seven days and not just the last day. This is because it is of particular interest to this study to know about any substitution of walking by cycling. The interviewer introduced the travel diary after interviews had been concluded with all household members. A £5 incentive was offered to each respondent completing their diary. The interviewer returned to collect the diaries at the end of the 7-day diary period and during this visit checked that it had been completed accurately and fully.

Baseline Survey Results

Results are presented with respect to the following research questions:

- *How prevalent is walking and cycling and how active are adults in the CCTs?*
- *To what extent do walking and cycling substitute for each other and for other physical activity?*
- *Are walking and cycling associated with being less sedentary?*
- *Do walkers and cyclists have higher overall levels of physical activity?*
- *How much does walking and cycling contribute to achieving recommended physical activity?*
- *Are those who have recently started cycling otherwise physically active?*
- *What are characteristics of those who do more walking, cycling and other physical exercise/sport?*

Aggregate results are presented for adults aged 16 and above across the 12 CCTs. The total sample size is 26,493. Weights have been obtained to take account of survey non-response. These allow results to be generated that are representative of the population of the CCTs. Applying these weights was not found to make a large difference and results are reported subsequently without weighting. For travel diary data it is important to account for diary reporting drop-off (fewer trips reported at end of 7-day period than start of period). Weights have not yet been developed for diary reporting drop-off.

Prevalence of walking and cycling and physically active adults

Table 2 shows a greater prevalence of walking than cycling and that time spent in both activities is higher based on EPIC questions (which refer to typical behaviour in past 12 months) than 7-day travel diaries. It can be expected that there is over-reporting in responses to EPIC questions and under-reporting in recording of walking and cycling trips in 7-day diaries. Comparisons of cycling behaviour reported by the two different methods can be made for the diary sample of 8,715 respondents. In the face-to-face interview 23.9% of adults said they do some cycling in a typical week (EPIC question), 20.2% said they cycle at least once per week and 16.0% said they had cycled on at least one day during the last week. However, data from the completed diaries indicated that only 9.7% cycled during the diary reporting week.

Table 3 presents physical activity classifications based on the Cambridge EPIC index and based on self-reported days in the previous week where 30 minutes physical activity achieved. 37.2% of the interview sample is calculated to be inactive (the figure is 35.6% if weighting is applied for non-response). In comparison, it was found that 26.2% of the population of the CDTs were inactive in the baseline survey in 2006 (Cavill et al., 2009). It is unclear why a lower level of physical activity has been recorded in the CCT survey. The same questions were used in both surveys and in both surveys the physical activity questions were asked at the start of the survey before other topics were introduced. The difference may be related to the different survey administration methods Respondents may be less inclined to exaggerate their physical activity in face-to-face interviews than telephone interviews.

13.0% of the CCT sample indicated that they achieve the recommended physical activity level. This is lower than the 34% recorded in the Health Survey for England 2008. The difference in results can be explained by differences in measurement of this indicator. The

Health Survey for England 2008 calculated this indicator by aggregating detailed responses for self-reported physical activity, while the CCT survey has a single question asking adults the number of days in the past week where at least 30 minutes had been spent in physical activity and asking them to exclude any contribution from occupational activity and housework.

Table 2: Walking and Cycling Activity Levels

Hours spent per week	Walking (EPIC question)	Walking (7-day diary)	Cycling (EPIC question)	Cycling (7-day diary)
None	1819 (6.9%)	2815 (32.3%)	20095 (76.1%)	7878 (90.4%)
> 0 and <= 1.75	2796 (10.6%)	2817 (32.3%)	1992 (7.5%)	410 (4.7%)
> 1.75 and <= 3.5	6476 (24.5%)	1394 (16.0%)	1861 (7.0%)	204 (2.3%)
> 3.5 and <= 7.0	7379 (27.9%)	1208 (13.9%)	1469 (5.6%)	160 (1.8%)
> 7.0	7953 (30.1%)	481 (5.5%)	1006 (3.8%)	63 (0.7%)
Total sample	26423 (100%)	8715 (100%)	26423 (100%)	8715 (100%)

Note: Missing data for 70 respondents for EPIC questions.

Table 3: Physical Activity Classifications

Cambridge EPIC index	Number (%)
Inactive	9815 (37.2%)
Moderately inactive	6240 (23.7%)
Moderately active	5060 (19.2%)
Active	5247 (19.9%)
Total sample (missing data for 131 respondents)	26362
Recommended physical activity level	Number (%)
Low (30 mins < 1 day/week)	12802 (52.3%)
Moderate (30 mins >= 1 day/week and < 5 days/week)	8506 (34.7%)
Meets (30 mins >= 5 days/week)	3185 (13.0%)
Total sample (missing data for 2000 respondents)	24493

Substitution between walking, cycling and other physical activity

Table 4 shows positive correlations between time spent walking and time spent cycling, doing other physical exercise/sport and time spent doing domestic physical activity (gardening, housework, DIY). It also indicates a positive correlation between time spent cycling and time spent doing other physical exercise/sport. It was checked whether these correlations were similar for male and female respondents and for younger and older respondents and it was found that they were similar for these sub-groups. The diary data showed a positive correlation between time spent walking and time spent cycling but of a lower magnitude (ρ=0.040).

It is found that levels of engagement in the above four physical activity categories are similar across the respondents in the four occupational physical activity categories (sedentary, standing, physical work, heavy manual) with non-workers generally less active. It is found

that those who usually cycle to work are distributed across the occupational physical activity categories in a similar way to other workers. Those who usually walk to work are more likely to be in standing occupations than those who commute by other means.

The baseline survey results indicate that walking, cycling and physical exercise/sport complement each other, rather than substitute for each other. This implies that many adults participate in all three activities and other adults do not participate in any of them. It needs to be noted, however, that a high proportion of respondents spend time walking but do not cycle (70.0% of total sample) and spend time doing other physical exercise/sport but do not cycle (25.0% of total sample). 9.7% of the total sample spend time cycling but do not other physical exercise/sport. 51.1% of the total sample do not spend time cycling or doing other physical exercise/sport.

Table 4: Pearson Correlations between Different Types of Physical Activity

	Hours per week walking (EPIC)	Hours per week cycling (EPIC)	Hours per week other PE (EPIC)	Hours per week domestic (EPIC)
Hours per week walking (EPIC)	1	0.094**	0.121**	0.245**
Hours per week cycling (EPIC)	0.094**	1	0.158**	0.016**
Hours per week other PE (EPIC)	0.121**	0.158**	1	-0.002
Hours per week domestic (EPIC)	0.245**	0.016**	-0.002	1

Notes: Sample size = 26423 (missing data for 70 respondents). ** indicates statistically significant at 0.01 level (two-tailed)

Walking, cycling and sedentary time

Correlations were obtained between the reported time spent in different types of physical activity and time spent in home sedentary (screen-based) activities. No correlation was found between time spent walking or time spent in other physical exercise/sport and sedentary time. A modest negative correlation of 0.020 was found between time spent cycling and sedentary time. Cyclists therefore spend slightly less time in sedentary (screen-based) activities at home than non-cyclists and this provides a health benefit additional to that from the physical activity associated with cycling.

Walking, cycling and overall physical activity

By definition, those who report that they cycle in a typical week will be classified to be at least moderately inactive according to the Cambridge EPIC index. The reported amount of walking is not taken into account in the index. Table 5 demonstrates that of those reporting any cycling in a typical week (23.9% of total sample) the percentage of the total sample classified as moderately inactive is 5.5%, moderately active is 6.5% and active is 11.9%. The specific classification of an individual adult depends on the amount of time they spend cycling, the amount of time they spend in other physical exercise/sport and their occupational physical activity.

Overall physical activity has also been measured by directly asking respondents the number of days in the past week that they did 30 minutes physical activity. This indicator is not explicitly determined by the amount of cycling reported so allows the contribution of cycling (and walking) to be independently assessed. 13.0% of the total sample indicated that they met recommended physical activity levels of 30 minutes physical activity on at least 5 days. Table 6 shows that adults reporting a high amount of cycling and other physical exercise/sport (more than 30 minutes per day) are much more likely to indicate that they meet the recommended physical activity level than other adults. It also shows that those reporting that they cycled in the seven-day diary are much more likely to indicate that they

meet the recommended physical activity level, but this is not the case for those reporting that they walk. Those respondents that said they usually cycle to work are also more likely to meet the recommended physical activity level. Different indicators used in the survey are consistent in suggesting that cyclists have a higher overall level of physical activity than non-cyclists. They show that cycling contributes strongly to overall physical activity but walking makes only a modestly contribution.

Table 5: Typical Time Spent Cycling and Cambridge EPIC PA Classifications

Hours spent per week cycling	Inactive	Moderately inactive	Moderately active	Active	Total
None	9815 (37.2%)	4784 (18.1%)	3347 (12.7%)	2104 (8.0%)	20050 (76.1%)
> 0 and <= 1.75	0 (0.0%)	910 (3.5%)	550 (2.1%)	523 (2.0%)	1983 (7.5%)
> 1.75 and <= 3.5	0 (0.0%)	546 (2.1%)	627 (2.4%)	683 (2.6%)	1856 (7.0%)
> 3.5 and <= 7.0	0 (0.0%)	0 (0.0%)	536 (2.0%)	930 (3.5%)	1466 (5.6%)
> 7.0	0 (0.0%)	0 (0.0%)	0 (0.0%)	1006 (3.8%)	1006 (3.8%)
Total	9815 (37.2%)	6240 (23.7%)	5060 (19.2%)	5246 (19.9%)	26361 (100%)

Notes: Sample size = 26361 (missing data for 132 respondents).

Table 6: Walking and Cycling and Meeting Recommended Physical Activity Level

Walking and cycling measure	Proportion meeting recommended PA level
Walking (EPIC none)	99 / 1674 (5.9%)
Walking (EPIC <= 3.5 hours/week)	815 / 8570 (9.5%)
Walking (EPIC > 3.5 hours/week)	2268 / 14652 (16.0%)
Cycling (EPIC none)	1850 / 18475 (10.0%)
Cycling (EPIC <= 3.5 hours/week)	569 / 3623 (15.7%)
Cycling (EPIC > 3.5 hours/week)	763 / 2358 (32.4%)
Other PE/sport (EPIC none)	1266 / 14422 (8.8%)
Other PE/sport (EPIC <= 3.5 hours/week)	708 / 6458 (11.0%)
Other PE/sport (EPIC > 3.5 hours/week)	1208 / 3576 (33.8%)
Total sample	3182 / 24456 (13.0%)
Walking (diary none)	323 / 2569 (12.6%)
Walking (diary <= 3.5 hours/week)	541 / 3908 (13.8%)
Walking (diary > 3.5 hours/week)	248 / 1572 (15.8%)
Cycling (diary none)	888 / 7248 (12.3%)
Cycling (diary <= 3.5 hours/week)	153 / 585 (26.2%)
Cycling (diary > 3.5 hours/week)	71 / 216 (32.9%)
Total sample	1112 / 8049 (13.8%)
Commute usually on foot	268 / 1546 (17.3%)
Commute usually by bicycle	383 / 1047 (36.6%)
Total sample of commuters	1953 / 12411 (15.7%)

Contribution of walking and cycling to achieving recommended physical activity

Without objective measurement of physical activity it is not possible to accurately assess the contribution of walking and cycling for achieving recommended physical activity levels. An indication of their importance can be gained, however, from the baseline survey data. Table 7 shows that 17,997 adults in the baseline survey sample are not in work or have sedentary jobs (68.3% of total sample) and of these 1,600 (6.1% of total sample) get physical activity through cycling and not through exercise/sport. 4,513 adults have standing jobs (17.1% of total sample) and of these 480 (1.8% of total sample) get physical activity through cycling and not exercise/sport. These results show that cycling plays an important role in enabling adults that have less active occupations to gain health-benefiting physical activity (estimated to be 8% of the total sample).

Further evidence is that 3,182 adults indicated they met the recommended physical activity level of 30 minutes physical activity on 5 days (13.0% of total sample) and 1,266 of these (5.2% of total sample) cycle in a typical week but do not do exercise/sport. 383 out of the 1,953 commuters meeting the recommended physical activity level said they usually cycle to work and 268 said they usually walk to work. 71 out of the 1,112 diary respondents meeting the recommended physical activity level reported cycling more than 30 minutes a day and 248 reported walking more than 30 minutes a day.

Table 7: Physical Activity Classifications Based on Cambridge EPIC Index

	Physical activity classification				
Work activity	Inactive	Moderately inactive	Moderately active	Active	Total
Sedentary or non-worker	9815	4308 (964 only cycle)	2262 (358 only cycle)	1612 (278 only cycle)	17997
Standing	0	1932	1350 (296 only cycle)	1231 (184 only cycle)	4513
Physical work	0	0	1448	1755 (396 only cycle)	3203
Heavy manual	0	0	0	648 (88 only cycle)	648
Total	9815	6240	5060	5246	26362

Notes: Sample size = 26362 (missing data for 131 respondents).

Other physical activity of those who have recently started cycling

A comparison has been made of the non-cycling physical activity of new/returning cyclists (2.5% of total sample), established cyclists (25.4% of total sample) and those that have not cycled in last 12 months (72.2%). This shows that new/returning cyclists are more likely to participate in other physical exercise/sport (61.5%) than non-cyclists (30.9%), and participate to a similar degree to established cyclists (59.9%). 57.3% of new/returning cyclists are not in work or in sedentary jobs compared to 60.7% of established cyclists and 71.2% of non-cyclists. This provides initial evidence that cycling investment may tend to attract those to cycle who are active anyway but longer term monitoring is required to substantiate this.

Characteristics of those that do more walking, cycling and exercise/sport

Ordered probit multiple regression models have been estimated to relate levels of walking, cycling, exercise/sport and overall physical activity to characteristics of the survey respondents and the areas they lived. The dependent variable for each of the three types of physical activity was the amount of time spent per week, categorised as follows: 0=none; 1=less than or equal to 15 minutes per day; 2=more than 15 minutes per day and less than or equal to 30 minutes per day; 3= more than 30 minutes per day and less than or equal to 1

hour per day; and 4=more than 1 hour per day. The dependent variable for overall physical activity was meeting recommended level of physical activity, categorised as: 0=low (less than 1 day per week); 1=moderate (more than 1 day per week and less than 5 days per week); and 2=meets (5 days a week or more). Table 8 summarises findings from the models. Coefficient values, model statistics, etc. are not reported in this paper.

Table 8: Characteristics Associated with More Walking, Cycling and Exercise/Sport

Characteristic	Walking (based on diary)	Cycling (based on diary)	Exercise/ sport (based on EPIC)	Meeting recommended PA
Personal				
Age	Aged 35-44	Under 65	Younger	Younger
Gender	-	Male	Male	Male
Disability/health	No disability	No disability	No disability	No disability
Ethnicity	-	White	White	White
Education	-	More qualified	More qualified	More qualified
Working status	-	-	Student	Part-time
Driving licence	-	-	Have licence	Have licence
Car access	No h'hold car	No car available	More h'hold cars	-
Household				
Household members	Under 5 year old	-	Fewer adults	Under 5 year old Fewer adults
Social grade (AB/C1/C2/DE)	AB	-	Higher grade	C1/C2
Area				
National cycle network	-	-	-	Nearer cycle network
Index of Multiple Deprivation (IMD)	-	-	Lower IMD score for Living Environment	-
ACORN area type (shown in decreasing order of positive association)	Urban prosperity Moderate means Comfortably off Wealthy achievers Hard pressed	No statistically significant difference	Wealthy achievers Urban prosperity Comfortably off Moderate means Hard pressed	Wealthy achievers Comfortably off Urban prosperity Hard pressed Moderate means
Towns (shown in decreasing order of positive association)	York Chester Cambridge Colchester Leighton Southend Blackpool Woking Southport Shrewsbury Bristol Stoke-on-Trent	Cambridge York Chester Colchester Shrewsbury Woking Southport Bristol Southend Leighton Blackpool Stoke-on-Trent	Woking Chester Southend Cambridge Bristol Blackpool Southport Colchester Leighton York Shrewsbury Stoke-on-Trent	Southend Woking Cambridge Southport Leighton Colchester Blackpool Bristol Shrewsbury Chester York Stoke-on-Trent
Model details				
Sample size	8502	8502	25777	23890
Nagelkerke R^2	0.057	0.144	0.168	0.149

Notes: Apart from ACORN area type and towns, results are only shown for characteristics that are statistically significant at 0.01 level.

Models were developed for walking and cycling based on both the EPIC questions and 7-day diary data. Results shown in Table 8 are based on the diary data as this is considered likely to be more valid. Table 8 shows that exercise/sport decreases with age (after accounting for other variables in the model), cycling decreases for those aged 65 and over and walking is similar over the age range (with those aged 35-44 walking more than other age groups). Females do less cycling and exercise/sport than males but there is no statistically significant difference in their amount of walking. The amount of cycling and exercise/sport increases with educational qualifications but the amount of walking is independent of educational qualifications. The amount of walking and cycling decreases with access to a car, but the amount of exercise/sport reported increases with the number of cars in the household.

More walking and overall physical activity is associated with living with a child aged under five. More walking is associated with living in a household with someone of managerial occupation (AB social grade), but the amount of cycling is independent of social grade. Exercise/sport increases with increasing social grade. Greater exercise/sport is associated with wealthier ACORN areas but cycling is independent of these. Lower exercise/sport is associated with those living in deprived areas with respect to the living environment (poorer quality housing, poorer air quality).

Each of the different types of physical activity varies strongly by town/city. Cambridge and Chester rank highly for each type of activity and Stoke-on-Trent ranks at the bottom for each type of activity. Only limited characteristics of the areas in which the respondents live have been taken into account and it could be sought to extend the characteristics considered (e.g. population density, presence of local amenities) to better explain the observed variation. Nevertheless, the difference between towns implies that they vary in how well their physical, organisational and social environments support the different types of activity.

Conclusions

The Cycling City and Towns (CCT) baseline survey provides a snapshot of walking and cycling behaviour and overall physical activity in 2009 in 12 towns/cities. Its chief purpose is to enable a comparison to be made with data collected after the CCT programme has been completed. Analysis of the baseline data has enabled it to be seen that those people with higher levels of cycling also have higher levels of walking and exercise/sports. Many cyclists have generally active lifestyles although a substantial proportion (about 20-25% of cyclists) does not do any exercise/sports. The finding that cycling complements walking and exercise/sports provides reassurance that successfully promoting cycling will increase overall physical activity, but it indicates the challenge of getting active those that do not any physical activity. It is estimated that 5% of the total survey sample achieve the national recommended physical activity level through cycling alone.

Regression modelling reveals similarities and differences in the characteristics associated with each type of physical activity. For example, both walking and cycling are more likely to be undertaken across the age range than exercise/sports (which implies that these make a valuable contribution to the overall physical activity of older adults) and females are equally likely to walk but are less likely to cycle and do exercise/sports (implying increasing the amount of cycling by females has strong potential to increase their overall physical activity). Reduced levels of all forms of physical activity are associated with older respondents, ethnic minority groups, those with fewer educational qualifications and those living in less economically prosperous areas (this represents a substantial public health challenge to address).

There are possibilities to extend the regression modelling to consider how additional characteristics of residential areas, such as local amenities, influence walking, cycling and exercise/sports participation. In the modelling undertaken so far no account has been taken of members of the same households sharing unmeasured characteristics and households from each sampled Output Area sharing unmeasured characteristics. Multi-level modelling can be used to account for both of these and obtain more robust parameter estimates. In the survey perceptions and attitudes to cycling have also been obtained for a sub-set of respondents and these can be analysed to identify factors that are discouraging those that are physically inactive from cycling. This type of detailed analysis can help with the design of effective policy interventions.

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