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The geography of recreational physical activity in England

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Abstract

Levels of physical activity have declined considerably over recent decades in England, and there is evidence that activity patterns vary across areas. Previous studies of the geography of physical activity have frequently relied on model based synthetic estimates. Using data from a large population survey this study develops a direct measure of recreational physical activity and investigates variations in activity patterns across English Local Authorities. For both sexes the results show a distinct geography of recreational physical activity associated with north/south variations and urban/rural status. The environmental and behavioural factors driving those patterns are still poorly understood. We conclude that the variations observed might reflect recreational opportunities and the socio-cultural context of areas.

Keywords

recreational physical activity; geographical variation; socio-demographics; urban-rural status; England

Introduction

A physical activity related energy expenditure of 1000 kcal per week has been linked with a fall in all-cause mortality risk of approximately 30% (Kesaniemi et al., 2001) and is associated with a reduction in the incidence of diseases such as coronary heart disease and type 2 diabetes (Department of Health, 2004). In England, however, there is evidence that average levels of energy expenditure from physical activity have declined in recent decades by as much as 800kcal/day (James, 1995). For example, the mean distance walked has fallen by approximately 26% and that cycled by 24%, whilst employment in manual occupations involving heavy physical activity has reduced considerably (Butland et al., 2007). A decline in overall physical activity is one reason behind an increasing prevalence of obesity, which rose by approximately 10% in adults between 1993 and 2007 (The Health and Social Care Information Centre, 2007).

Studies of the geography of health outcomes can provide new evidence on the role of population demographics as aspects of the physical and social environment as drivers of health related behaviours. Prior conceptual work has shown that spatial variations in health outcomes result from compositional, contextual and collective effects (Macintyre et al., 2002). Compositional effects refer to characteristics of individuals in particular areas and comprise, for example, individual demographic characteristics or individual-level socio-

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economic status. These factors have been linked to physical activity patterns. For example, men are more active than women (Livingstone et al., 2001; Livingstone et al., 2003), and there is distinct gradient in levels of physical activity across the socio-economic strata (Gidlow et al., 2006). In contrast to compositional effects, contextual effects refer to characteristics of places where people live and work. For example, attributes such as safety or attractiveness of green spaces have been associated with activity patterns, independent of compositional effects (Trost et al., 2002; Wendel-Vos et al., 2007). Collective effects comprise factors that are concerned with social, cultural and historical features of places. For example, various studies have shown that cultural background impacts on attitudes towards exercise behaviours and affects levels of physical activity (Mavoa and McCabe, 2008; Sarrafzadegan et al., 2008; Fischbacher et al., 2004). Therefore, collective factors offer an additional perspective on the socioeconomic, psychological, and epidemiological angles of the exploration of area effects on health and related behaviours (Macintyre et al., 2002).

Although individual and area characteristics have been linked to activity patterns, studies on geographical variations in physical activity over large areas are scarce. There is some evidence from the US that regional differences in activity and inactivity patterns might be related to urban and rural settings respectively (Martin et al., 2005). Earlier work from the UK suggested that levels of unfit, based on BMI, blood pressure and respiratory function, were high in the West and the Midlands compared to the South and East (Blaxter, 1990). But to our knowledge there is only one recent study of the geography of physical activity in England. Ellis et al. (2007) investigated variations in physical activity levels across just 39 deprived towns and cities, highlighting low levels of physical activity, particularly amongst residents of more northern industrialised towns. Their findings suggested that inequalities related to social, economic, historical and physical environments remained an important public health issue with respect to physical activity.

With the publication of the Black Report in 1980 by the former UK Department of Health and Social Security (Department of Health and Social Security, 1980), spatial disparities in health obtained a widely accepted political platform. The report emphasised that inequalities in health were both persistent and widening, in particular for those at the lower end of the socio-economic ladder living in the northern regions of England. Similar gradients have subsequently been shown for other countries including Germany (Voigtländer et al., 2010) and Italy (Mangano, 2010). Thirty years after the publication of the Black Report, the message has lost none of its topicality; Wilkinson and Pickett (2010) recently described significant inter- and intranational differences in 23 of the richest countries in the world for obesity and weight related behaviours.

Due to the paucity of comprehensive datasets on health and health related behaviours, research investigating health disparities frequently depends on the production of synthetic estimates when patterns are being analysed for small geographical units of analysis. Synthetic estimates have been produced and validated for a variety of health behaviours and outcomes including the prevalence of smoking, fruit and vegetable intake, drinking, diabetes and obesity (Scarborough et al., 2009; Scholes et al., 2007; Twigg et al., 2000; Moon et al., 2007). Based on the Health Survey for England, Dibben et al. (2004) produced two sets of synthetic estimates of physical inactivity (proportion doing under 5 hours of physical activity per week) for English Local Authority Districts for the years 2001 and 2003. The results show distinct variations between some of the districts, partly differing for males and females (maps available from: British Heart Foundation, 2008).

Synthetic estimates of health and health related behaviours appear attractive for small area analyses by facilitating the comparison of particular localities with national averages. Indeed, it has been shown that synthetic estimates can be more accurate than underpowered

national survey estimates (The EURAREA Consortium, 2004). However, limitations of synthetic estimation include the fact that they are based on deterministic model outputs rather than objective measurements in local areas. Therefore, they are solely a function of the population prevalence of those characteristics used to estimate them. This is limiting as it is often the areas that do not conform to expectations from population demographics that are interesting from a research perspective. A related limitation is that it is not possible to further separate estimates for specific population subgroups, and confidence intervals surrounding the estimates can be wide, hindering geographical comparisons (Scholes et al., 2007). Scarborough et al. (2009) recently highlighted problems with the estimates of Dibben et al. (2004) related to model misspecification and invalid predictive validity due to the statistical dominance of age and sex. The authors concluded that public health policy and health interventions should not be based on results derived from these estimates.

Whilst the development of synthetic estimates for small geographical units can be useful if there are no other robust data available, the use of original measurements provides the possibility to understand actual patterns of health and related behaviours for local areas. In England Local Authority Districts provide a suitable scale for comparison of health behaviours and outcomes as they are large enough to provide adequate study power (mean population per local authority in 2001: 138 810) (Office for National Statistics, 2001b) but relatively environmentally homogeneous due to the fact they do not mix large urban and rural areas within their boundaries. A number of studies executed at this scale have provided new insights into the aetiology of a range of health outcomes (Jones et al., 2008; Jones and Bentham, 2009; Jones and Bentham, 1997; McLeod et al., 2000).

Recently outputs from the Sport England Active People Survey (APS) have become available at the local authority district scale in England. The sample size of the APS is large, with over 350,000 responses from adults. For the first time this provides the potential for the development of a set of comprehensive measures of geographical variations in physical activity covering the whole of England that are not based on synthetic estimates. Using data from the 2006 APS, this study has thus been undertaken to provide new evidence on geographical variations in physical activity and associated energy expenditure, with a focus on that undertaken for recreation.

Methods

Developing a measure of physical activity

Our measures of physical activity were based on data from the 2006 APS, a telephone survey of 363 724 adults (aged 16 to 85+) commissioned by Sport England and conducted between 2005 and 2006 across 354 English Local Authorities (Ipsos Mori, 2006). To achieve a nationally representative sample Random Digit Dialling was used with one respondent randomly selected from the eligible household members. On average, 250 telephone interviews were conducted with the residents of each Local Authority in each quarter of the study period.

The APS provided information on the frequency and duration of self-reported recreational physical activities and the number of days respondents walked at moderate intensity for 30 minutes or more within the 28 days preceding the interview. Those reporting walking were asked on how many of those days they were walking particularly for the purpose of health or recreation. No information was collected on occupational physical activity. APS participants were excluded from our study if they failed to provide full enough information for their physical activity to be determined, or if they reported over 16 hours of mean daily activity (Howley, 2001; Masse et al., 2005).

The primary physical activity measure was energy expenditure. The intensity level of a particular activity can be defined as the rate of energy expenditure related to body mass, expressed as metabolic rate. The resting metabolic rate equals an energy expenditure of approximately 1 kcal/kg/hour. Metabolic equivalents (METs) are multiples of the resting metabolic rate, and for adults METs can be taken as numerical equivalents to energy expenditure (Howley, 2001; Masse et al., 2005).

In order to calculate a measure of energy expenditure for each participant, the Compendium of Physical Activities was used (Ainsworth et al., 2000). It provides look-up tables for activities according to their respective MET intensity level, with a range of 0.9 METs (sleeping) to 18 METs (running at 10.9 mph). The appropriate MET-level provided by the Compendium of Physical Activities was assigned to each of the 237 activities mentioned by participants in the APS. In rare cases where particular activities were not listed in the Compendium of Physical Activities, the MET-level of a similarly patterned activity was assigned. In a few cases (e.g. for “modern pentathlon”) it was necessary to calculate the median of several activities involved (pistol shooting, fencing, freestyle swimming, jumping, cross-country run). The physical activity measure generated, expressed as MET-min/week, is based on the methodology applied by Ball et al. (2003):

$$\text{MET-min/week} = \sum (\text{number of days undertaken the activity} \times \text{time per session} \times \text{MET-level of activity}).$$

From this, an additional measure of more sedentary behaviour, an identifier of non-active respondents, was assigned to those who reported no physical activities (MET-min/week = 0).

Analysing geographical patterns

To investigate the geography of physical activity in England, the indicator of the Local Authority within which each APS respondent resided was used to compute directly age-standardised average MET-min/week (standard population: English adults aged 16 to 85+ (Office for National Statistics, 2001a)), as well as rates of non-activity. As there is considerable evidence that levels of physical activity differ between men and women (Livingstone et al., 2003; Livingstone et al., 2001) analyses were stratified by sex. Maps were produced across Local Authorities for total physical activity energy expenditure, that associated with walking, and for rates of non-activity. To explore the existence of spatial clustering in the mapped outputs, Moran's I statistics were calculated.

To provide context to the observed geographical patterns, the Government Office Region in which each Local Authority fell was identified. In addition, the urban-rural status of each Local Authority was ascertained using a published classification (Defra, 2005), as was whether the Local Authority fell in the North or South of England (Scarborough and Allender, 2008). Differences in the ranking of outcomes by these categorisations were tested using Kruskal-Wallis tests (Monte Carlo method) and the highest and lowest scoring Local Authorities were identified. Preliminary analysis showed that walking prevalence was particularly high in London boroughs, so those were treated as a third category in the tests. Due to the small number of interviews (< 200) obtained in each, the Isles of Scilly and the City of London were excluded from analysis. All analyses were undertaken in SPSS 16.0.

Results

From the original dataset, 3401 individuals were excluded either due to incomplete questionnaires (3380) or reporting >16 hours/day physical activity (21), leaving 360323

participants. Table 1 summarises the physical activity characteristics of the included sample, of which 42% were male (compared to 48% in the 2001 Census in England), 24% were aged under 35 (compared to 32%), and 20% were aged over 64 (compared to 19%). Some 93% (compared to 92%) of participants gave their ethnic origin as White.

The mean total physical activity energy expenditure reported for men was 839 MET-min/week (750 excluding walking) and for women 483 MET-min/week (394 excluding walking). The mean total energy expenditure for indoor swimming was 70 MET-min/week (13% of the respondents), 178 MET-min/week for going to the gym (10% of the respondents), and for recreational cycling 41 MET-min/week (8% of the respondents). Mean total walking-associated energy expenditure was 89 MET-min/week for both men and women, whilst that for recreational walking was 53 MET-min/week for men and 58 MET-min/week for women. The mean ratio of reported physical activity energy expenditure, excluding walking, to overall walking was 8.1 for men and 4.6 for women.

Figure 1 maps between-district variations in total physical activity energy expenditure across England. There is evidence of a general trend of higher physical activity in more southerly districts. Spatial clustering in the mapped pattern is low but statistically significant for both males (Moran's $I = 0.06$, $p < 0.01$) and females (Moran's $I = 0.07$, $p < 0.01$). Figure 2 highlights variations in rates of non-activity, which generally mirror that of physical activity. Spatial clustering was again relatively low, but statistically significant for both males (Moran's $I = 0.07$, $p < 0.01$) and females (Moran's $I = 0.09$, $p < 0.01$). Figure 3 depicts between district variations in total walking associated energy expenditure. A similar north-south gradient is apparent to that observed for overall physical activity, with again relatively low but statistically significant clustering for both males (Moran's $I = 0.03$, $p < 0.01$) and females (Moran's $I = 0.14$, $p < 0.01$).

Figure 4 shows the urban-rural status and Government Office Regions of the 30 (15 for males and 15 for females) Local Authorities ranked with the highest and lowest overall MET-min/week. It is noteworthy that 22 (73%) of the highest physical activity Local Authorities are rural, whilst 27 (90%) of the lowest are urban. Although the broad geographical patterns are similar, the districts with the highest and lowest physical activity differ for men and women. Whereas both high and low physical activity districts are found in northern and southern Government Office Regions, 10 (33%) of the lowest physical activity Local Authorities are in London. Figure 5 shows the Local Authorities with the lowest and highest rates of non-active respondents respectively. The pattern is generally the inverse of that for overall physical activity, with the 70% of the districts with low levels of non-active respondents being rural, although the disparities between males and females are much smaller than for overall physical activity. Twenty-one (70%) of the Local Authorities with the fewest non-active respondents also fell within the southeast or the southwest Government Office Regions. In terms of walking, there are particularly distinctive urban-rural disparities, with 26 of the 30 (87%) of districts with the lowest levels of walking associated energy expenditure being urban (Figure 6). With the exception of Brighton, all of the urban Local Authorities with high walking associated energy expenditure were London boroughs. Again, disparities between males and females were relatively low.

For females there were highly statistically significant differences ($p < 0.001$) for all outcomes when comparing the urban-rural and north-south status of districts. For males, this was also the case for north-south status (all $p < 0.001$) and, for urban-rural status, for all outcomes except overall physical activity ($p = 0.450$).

Discussion

Overall physical activity, walking, and non-active behaviours show a divide of lower levels of physical activity amongst residents of more northerly districts compared to those of the south, yet it is the urban-rural disparities that are particularly striking. Residents of urban districts generally reported less overall physical activity and walking energy expenditures compared to their rural counterparts, and were also more likely to report non-participation in any of the physical activity behaviours measured.

To our knowledge, this study is unique in being the first to examine the geography of physical activity for the whole of England without resorting to synthetic estimates. Other strengths include the very large sample size of the APS, representing approximately 1% of the total adult population in 2006 (Office for National Statistics, 2007). Compared to the general population, the sample comprised a slightly higher percentage of males and adults aged under 35, but was generally comparable. The large sample size allowed us to examine disparities by sex, geographical region, and urban-rural status. The APS also provided information on participation in a very wide range of physical activities and this allowed a rigorous methodology to be applied in order to estimate energy expenditures for every participant.

In terms of weaknesses, the MET-values in the Compendium of Physical Activities are derived from young, college-age men and thus do not account for individual differences in energy expenditure associated with age, gender, ethnicity or weight status. The outcomes studied were based on self-report, and the physical activity questions, although similar to those used elsewhere, have not been subjected to validation. Self-report measures of physical activity can be susceptible to bias whereby some respondents, particularly the least active, may overestimate the frequency and intensity of their physical activity (Adams et al., 2005; Masse et al., 2005; Wilcox et al., 2001), although this may not influence the geographical disparities depicted. Furthermore, overall walking was recorded, but our findings show a particular emphasis on recreational physical activity. Compared to recent self report data from Stoke on Trent, England, our calculated total average MET-min/week for recreational physical activities are particularly high for men (839 vs. 604), although similar for women (483 vs. 501) (Cochrane et al., 2009).

It is noteworthy that the APS only records energy expenditure associated with walks lasting 30 minutes or more, and many transport related walks would not reach that threshold. This is most likely one reason why METs associated with walking in our sample are small compared with those from other recreational physical activity, which is at odds to the known low levels of participation in sport (Lader et al., 2006; Uitenbroek and McQueen, 1991). It has been suggested that bouts of physical activity as short as 10 minutes have beneficial effects for health (Warburton et al., 2006), and thus even relatively short transport related walking or cycling trips may accumulate to contribute to the overall health benefits of physical activity. A further limitation is that the APS recorded no information on physical activity associated with employment or incidental activities such as housework or gardening which means that overall levels of energy expenditure will be underestimated, and the contribution of recreation overestimated.

Although prior research has highlighted high car use in rural areas and poorer accessibility to facilities for health and recreation (Moseley and Owen, 2008) our results show these areas to have higher recreational physical activity and, in particular, higher levels of recreational walking compared to urban areas. Thus, our findings illustrate the supportiveness of the rural environment for certain forms of recreation. In terms of urban areas, only residents of districts in London reported high mean total walking-associated energy expenditure, most

likely reflecting a combination of the restrictions on car use, the developed public transport system, and the generally good walkability of environments within the city.

With respect to the observed north-south gradients, low levels of physical activity in some areas may be associated with the socio-cultural context of de-industrialisation, whereby cultures of non-participation in physical activities outside work may have developed in places where levels of employment in physically demanding occupations were historically high. In England, the period of most rapid industrial change occurred in the 1970s and had a particular impact in the Midlands and North (Imrie, 1991; Jarvis et al., 2001) where residents are now more likely to report poor health (Mitchell et al., 2000). It is noteworthy that we found districts in the Midlands and North to have generally lower levels of physical activity and higher levels of non-activity, and it is possible that cultures of non-participation in physical activity persist in these places despite the decline in physical jobs. We suggest this possible context of deindustrialisation is a rather unexplored dimension of the obesity epidemic for which putative mechanisms merit further research.

Conclusion

We have described distinctive geographical variations in levels of predominantly recreational physical activity across England. Our findings have implications for interventions to encourage physical activity. For example, Gidlow et al. (2007) have shown uptake and adherence in Physical Activity Referral Schemes in primary care to be poorest amongst rural residents. Such schemes are often facility based, yet our results highlight the importance of recreational walking amongst rural populations. Taken together this evidence suggests that an increased focus on non-facility based interventions might improve adherence, especially amongst populations living further from facilities. Certainly the distinct patterns that we reveal suggest that more effective interventions may be those that are designed with their social and geographical setting in mind.

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Figure 1.
Age - adjusted total physical activity across English Local Authorities, 2005 - 2006.

*MET-min/week = 0

Figure 2.
Age-adjusted non-active population across English Local Authorities, 2005 – 2006.

Figure 3.
Age-adjusted total walking across English Local Authorities, 2005 – 2006.

Government Office Regions: NE – North East, NW – North West, Y – Yorkshire, E – East, WM – West Midlands, EM – East Midlands, SW – South West, SE – South East, L – London.

Figure 4.

Local Authorities with the (A) highest and (B) lowest age-adjusted MET-min/week of total recreational physical activity, 2005 – 2006.

Government Office Regions: NE – North East, NW – North West, Y – Yorkshire, E – East, WM – West Midlands, EM – East Midlands, SW – South West, SE – South East, L – London.

Figure 5.

Local Authorities with the (A) lowest and (B) highest age-adjusted rate of non-active people, 2005 – 2006 [*MET-min/week = 0].

Government Office Regions: NE – North East, NW – North West, Y – Yorkshire, E – East, WM – West Midlands, EM – East Midlands, SW – South West, SE – South East, L – London.

Figure 6.

Local Authorities with the (A) highest and (B) lowest age-adjusted MET-min/week of total walking, 2005 – 2006.

Table 1

Active People Survey 1 – descriptive statistics for the physical activity outcomes.

Data source: Sport England, Active People Survey 1, 2005 - 2006

	Total		Males		Females	
	Frequency	%	Frequency	%	Frequency	%
Total physical activity (PA) ^a						
Inactive respondents (PA = 0 MET-min/week)	154 649	42.9	57 429	38.4	97 220	46.2
Active respondents (PA > 0 MET-min/week)	205 674	57.1	92 296	61.6	113 378	53.8
Respondents exercising 675 MET-min/week ^b	104 270	28.9	52 741	35.2	51 529	24.5
Walking (W)						
Non-walkers (W = 0 MET-min/week) ^c	261 657	72.6	106 349	71.0	155 308	73.7
Walkers (W > 0 MET-min/week)	98 666	27.4	43 376	29.0	55 290	26.3
<i>recreational walkers</i>	72 823	73.8	30 557	70.4	42 266	76.4
<i>non-recreational walkers</i>	47 811	48.5	22 225	51.2	25 586	46.3

^a Including recreational activities and non-recreational walks at a moderate pace 30 minutes.^b Government recommendation for moderate physical activity = 4.5 METs × 30 minutes × 5 days.^c No walking at moderate pace in 5 days 30 minutes.