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Factors associated with physical activity referral completion and health outcomes

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ABSTRACT

Participant socio-demographic characteristics and referral reason were investigated in relation to completion and health outcomes in a Primary Care Physical Activity Referral Scheme using a prospective population-based longitudinal design. Participants (n=1735) were recruited over a two-year period. A three-stage binary logistic regression analysis identified the factors associated with the outcomes of completion (model 1), body mass reduction (model 2) and blood pressure reduction (model 3). Participant age, gender, ethnicity, occupation and referral reason were the independent variables for model 1, with the variables of completion added in model 2 and completion and body mass reduction added in model 3. Logistic regression analysis revealed that increasing age is associated with the likelihood of completion (Odds Ratio, OR = 1.019; Confidence Interval, CI = 1.008-1.030; $p = 0.001$). Participants with a pulmonary condition are less likely to complete (OR = 0.546; CI = 0.346-0.860; $p < 0.01$) compared to those referred for cardiovascular conditions. For ethnicity, in comparison to the white category, patients in the mixed category are significantly more likely to achieve a reduction in body mass (OR = 3.991; CI = 1.191-13.373; $p < 0.05$). Those who complete are more likely to achieve a reduction in body mass (OR = 3.541; CI = 2.721-4.608; $p < 0.001$). When compared to the unemployed category, the skilled manual category had an increased likelihood of achieving a reduction in blood pressure (OR = 1.875; CI = 1.044-3.227; $p < 0.05$). Participants who completed also demonstrated an increased likelihood of a reduction in blood pressure (OR = 1.680; CI = 1.250-2.003; $p < 0.001$). Furthermore, those participants who achieved a reduction in body mass had an increased likelihood of achieving a reduction in blood pressure (OR = 1.292; CI = 1.008-1.641; $p < 0.05$). Completion is associated with health outcomes of reduced body mass and blood pressure.

INTRODUCTION

The importance of regular physical activity has gained increasing prominence within public health policy in the UK and many other developed countries. For example, in response to the UK national trend in obesity, a range of initiatives that promote physical activity have been launched, including a national social marketing campaign (Change4Life) and the Healthy Communities Initiative (Department of Health, 2008). Now, more than ever, primary care is recognised as an important setting for changing physical activity behaviour in those in most need (Church & Blair, 2009; Gidlow & Murphy, 2009; Williams, 2009). Of the various physical activity interventions in primary care, Physical Activity Referral Schemes have arguably become one of the most prevalent physical activity interventions in the UK (Dugdill et al, 2005) and similar primary care based interventions also exist in other countries (e.g., Morgan, 2005).

An absence of evidence regarding the effectiveness of Physical Activity Referral Schemes at increasing physical activity levels is well documented (e.g., Williams 2009). The lack of evidence is even more acute when attempting to determine who Physical Activity Referral Schemes are most appropriate for (Gidlow et al, 2005), and answers to such questions are of great importance given the scarcity of resources. To date, limited randomised controlled trials into effectiveness have been completed (NICE, 2006), so these forms of evaluation will continue to provide important evidence in the future (Williams 2009). However, to better understand factors associated with attendance and completion of Physical Activity Referral Schemes, and related health outcomes, population-based longitudinal studies (also referred to as before and after studies) undoubtedly have an important role. To our knowledge, only three such studies have been published for UK data, all of which focused solely on attendance as the outcome (Harrison et al, 2005; Gidlow et al, 2007; James et al, 2008). Whilst attendance (including uptake and completion) is important, given the public health role of Physical Activity Referral Schemes it is also necessary to explore associations between attendance and other health related outcomes. In particular, changes in body mass and blood pressure, and the factors involved in such changes, are extremely important from a public health perspective and have been highlighted as potentially modifiable through short-term exercise programmes (Taylor et al, 1998; Dugdill & Graham, 2004).

Elevated body mass and blood pressure are associated with a range of adverse health outcomes (Department of Health, 2004b), including an increased risk of cardiovascular disease (Kannel et al., 2002). Small decreases in body mass and blood pressure are known to be clinically important for long-term health outcomes. Based on the current trends in obesity it is predicted that, without concerted action, obesity prevalence will rise to 50% by 2050 (Department of Health, 2008). Prospective studies have shown that high levels of leisure-time physical activity are associated with lower risk of gains in body mass (Di Pietro, 1999; Fogelholm & Kukkonen-Harjula, 2000). There is also some evidence that more active adults tend to embrace other positive health behaviours, such as healthy eating (Blair et al., 1985). Experimental interventions to reduce body mass through increased physical activity have demonstrated a dose-response effect (Kasemiemi et al., 2001), and the most recent physical activity guidelines now recognise this (e.g., US Department of Health and Human Services, 2008). Given the prevalence of physical inactivity and obesity, it is important to evaluate the potential body mass reducing role of prevalent physical activity interventions such as Physical Activity Referral Schemes.

It is well recognised that small decreases in blood pressure in the population as a whole would dramatically reduce the incidence of cardiovascular disease (Cook et al, 1995). The resulting savings to the National Health Service would be considerable (National Institute for Health and Clinical Excellence, 2006b). Prospective cohort studies have revealed that those who are regularly more physically active are less likely to have elevated blood pressure (Wareham et al., 2000). Experimental interventions have confirmed that a reduction in blood pressure can be achieved through modest increases in physical activity (Kaseniemi et al., 2001), and such reductions have been observed in both hypertensive (Moreau et al., 2001; Ishikawa-Takata et al., 2003) and normotensive populations (Fortman et al., 1988). Given the prevalence of physical inactivity and hypertension, it is important to evaluate the potential blood pressure reducing role of prevalent physical activity interventions such as

Physical Activity Referral Schemes.

Ethnicity and socioeconomic factors have frequently been linked with physical activity and health outcomes (Burton et al, 2003; Department of Health, 2004a). Those from ethnic minority and low socioeconomic status groups, and particularly women, are known to be less active, and have an increased incidence of poor health (Department of Health, 2004a). Previous Physical Activity Referral Schemes studies employing a population-based longitudinal design (also known as a before and after design) have involved participant samples with somewhat limited diversity. Of the three existing UK studies, two involved a largely rural (~50%) and predominantly white British (>90%) population (Gidlow et al, 2007; James et al, 2008). The other study evaluated a scheme based in an urban, relatively deprived area, but, due to the extremely limited ethnic diversity in the population, ethnicity was not reported (Harrison et al, 2005). The present study reports findings from an evaluation of a collaborative Physical Activity Referral Schemes run by Greenwich Leisure Limited, Greenwich Teaching Primary Care Trust and Greenwich Council. The London Borough of Greenwich is ethnically diverse, with less than three-quarters of the population being white (74.9%) compared with 89.5% for the UK as a whole. The ethnic diversity is also confounded by a relatively large migrant population. Unemployment in Greenwich is also above the national average (5.4 versus 3.4%), and as high as 14.8% in some areas. In keeping with this relative deprivation, life expectancy in Greenwich is below average; 74.5 years for males and 80.1 years for females, compared with 76.5 years and 80.9 years, respectively, for the UK. The diversity within the Greenwich population provides an opportunity to explore known factors leading to health inequalities in relation to Physical Activity Referral Schemes outcomes.

Given the socio-demographic profile of the study sample and the proposed health-related outcomes, the present study, using a population-based longitudinal design, aims to investigate socio-demographic characteristics and referral reason in relation to: (i) attendance; (ii) reduction in body mass, and; (iii) reduction in blood pressure.

METHODS

Sample

All patients referred to a metropolitan Physical Activity Referral Schemes over a two-year period (April 2005 - March 2007) were invited to participate. Prior ethical approval was granted by the lead author's University Research Ethics Committee. The Bexley and Greenwich Research committee were also consulted. Patients were referred to the Physical Activity Referral Schemes if: (a) they had an existing condition that would benefit from regular exercise; (b) they were at increased risk of developing a condition that might be prevented by regular exercise; (c) they were a member of a community that would be less likely to access existing exercise opportunities. Out of 1735 potential participants, 420 were excluded because of incomplete data, leaving 1315 to be included in the analysis. Table 1 provides a description of those participants included in the analysis.

Physical activity referral scheme

All participants were referred by a primary care health professional to one of five leisure centres. After the exercise professional in the leisure centre made contact with the patient and assessed their needs, suitable (i.e., those meeting inclusion criteria) patients were offered a range of individual and group exercise sessions for a period up to 26 weeks. A programme of individual or group exercise was negotiated on a client-centred basis between participant and exercise professional. This process took into account the goals and capabilities of the referred patient. The exercise professional provided a consistent point of contact for participants. Regular (every 6 weeks) feedback on progress was provided by the exercise professional, allowing modification of participant's goals. The exercise environment included the gyms, studios, and swimming pools within the five leisure centres. Participants were able to access the facilities outside of the allocated sessions if they wished.

Assessment of participant completion outcome

Binary outcome categories were formed: completers, who attended the final scheduled session; non- completers, who failed to attend the final scheduled session. This approach is consistent with previous research (Lord & Green, 1995; Hammond et al, 1997). Completion in the present study provides a proxy measure for attendance, since 90.1% of participants who were categorized as completers attended >80% of scheduled sessions (Gidlow et al, 2005).

Assessment of health outcomes

Exercise professionals conducted routine assessments of participant body mass and blood pressure. Body mass (kg) was determined using standard scales with a resolution of 0.1 kg. Blood pressure (mmHg) was determined through automated sphygmomanometry over the brachial artery at heart level after being seated for a period of five minutes. Diastolic and systolic measures were combined to obtain mean arterial pressure (Mean Arterial Pressure = Diastolic Blood Pressure + [1/3(Systolic Blood Pressure – Diastolic Blood Pressure)] (Tortora & Derrickson, 2006)), creating a single blood pressure value for entry into logistic regression analysis. Change in blood pressure was determined as the difference between initial mean arterial pressure and final mean arterial pressure recorded at the last scheduled session. Similarly, change in body mass was determined as the difference between initial mass and final mass recorded at the last scheduled session.

Assessment of socio-demographic characteristics

Data collected by health professionals at the point of referral included participant age, gender, ethnicity, occupation, primary referral reason (i.e., clinical condition). Age was retained as a continuous variable for regression models. Ethnicity was grouped into five broad categories (white, asian, black, chinese, mixed) to allow adequate group sizes for meaningful analysis. Categories were based on ethnic groupings provided by the primary care trusts, in accordance with the published guide for the collection and classification of ethnic data (Department of Health, 2003). As a measure of socioeconomic position, participants were placed into one of eight social classes based on occupation.

Assessment of referral reason

The reasons for referral were grouped into eight broad categories which incorporated related conditions, similar to those chosen by James et al (2008) (cardiovascular, pulmonary, metabolic, orthopaedic, neuromuscular, sensory, mental health, miscellaneous). This categorisation was assisted by the International Classification of Disease (World Health Organisation, 2000), and was consistent with approaches in recent policy documents (Department of Health 2004b).

Statistical analysis

A three-stage binary logistic regression (Bagley et al, 2001; Kirkwood & Sterne, 2003) was used (referred to as three models) to identify participant socio-demographic characteristics and referral reasons associated with the three binary outcomes of completion, body mass reduction and blood pressure reduction (Table 2). Five common independent variables were entered into each regression model: age, gender, ethnicity, occupation and referral reason. In addition, completion was available for entry into model two, and completion and body mass reduction was available for entry into model three (Figure 1). There was a strong rationale for inclusion of all five potential independent variables in each regression model, regardless of whether or not they were subsequently found to be statistically important. The selection of each independent variable was based on evidence from prior research, and therefore all variables were entered simultaneously into each regression model.

*****Table 2: Binary outcome variables for logistic regression models******

*****Figure 1: Variables included in the multiple-stage regression*****

All goodness of fit tests (Hosmer & Lemeshow; Cox & Snell; Nagelkerke) suggested that the three models were good fits of the data. The predicted outcomes agreed well with actual outcomes (56 – 68%) in every model. Residuals were examined in an attempt to isolate any points where the model may have fit the data poorly. No cases were seen to fall outside those values deemed to cause concern (Field, 2005).

Discriminant analysis was used to determine whether or not differences in group sizes for the binary outcome would influence the findings. The largest discrepancy in binary outcome group size in model 2 (group 0: n=877; group 1: n=438) had no influence on the findings; i.e., the results presented were the same regardless of whether group sizes were assumed to be equal or were accounted for in the analysis.

RESULTS

The majority of participants were women (65.4%) and 59% of participants were under the age of 50 years. The three most highly represented ethnic groups were white (69.4%), black (17.6%) and asian (11.2%). The three most highly represented occupations were unemployed (35.7%), retired (21.7%), and skilled non-manual (14.8%). The most prevalent primary referral reason was metabolic condition (36.3%), followed by orthopaedic (24.7%) and cardiovascular (17.5%). Out of the 1315 participants referred, 57% completed their exercise programme, 33.3% achieved a body mass reduction, and 49.2% reduced their blood pressure.

******** Table 3: Binary logistic regression analysis outcomes ********

Findings from the three-stage binary logistic regression analysis are provided in Table 3. The findings from model one revealed that increasing age was associated with the likelihood of patients completing (Odds Ratio, OR = 1.019; Confidence Interval, CI = 1.008- 1.030; p = 0.001); for every increase in decade of age there was a 19 % increase in the likelihood of completing. Ethnicity was associated with the likelihood of completion, with participants in the mixed category being more likely to complete (OR = 6.310; CI = 1.388-28.695; $p < 0.05$). Participants with a pulmonary condition were less likely to complete (OR = 0.546; CI = 0.346-0.860; $p < 0.01$) than those referred for cardiovascular conditions.

Model two revealed that, in comparison to the white category, participants in the mixed category are significantly more likely to achieve a reduction in body mass (OR = 3.991; CI = 1.191-13.373; $p < 0.05$). Those who complete are more likely to achieve a reduction in body mass (OR = 3.541; CI = 2.721-4.608; $p < 0.001$).

Model three indicated that, compared those in the unemployed category, participants in skilled manual occupational category had an increased likelihood of achieving a reduction in blood pressure (OR = 1.875; CI = 1.044-3.227; $p < 0.05$). Participants who completed also demonstrated an increased likelihood of a reduction in blood pressure (OR = 1.680; CI = 1.250-2.003; $p < 0.001$), than non-completers. Those who achieved a reduction in body mass had an increased likelihood of blood pressure reductions (OR = 1.292; CI = 1.008-1.641; $p < 0.05$).

DISCUSSION

Physical Activity Referral Schemes operate across the majority of Primary Care Trusts in the UK (Gidlow & Murphy, 2009), but little is known about the factors associated with Physical Activity Referral Schemes completion and other outcomes. The findings from the present study, from a diverse metropolitan population, have revealed that completion of a course of scheduled sessions is associated with older age, ethnicity and referral reason. Furthermore, reductions in body mass and blood pressure are associated with completion, and reduction in blood pressure is associated with reduction in body mass.

Better adherence and increased rates of completion of scheduled exercise sessions with increasing age is consistent with existing Physical Activity Referral Schemes research (Dugdill et al, 2005; Gidlow et al, 2007; James et al, 2008), research examining other types of physical activity scheme (Anton et al, 2001; Martin & Sinden, 2001; Fox et al, 2007) and reviews on this subject (Ashworth et al, 2005; Stathi, 2009). An age-related reduction in time constraints provides a plausible explanation for this finding, which is consistent with time constraints being the most frequently cited physical activity barrier in adults (Biddle & Mutrie, 2008). Younger and middle aged adults are likely to have a greater number of commitments that might be prioritised at the expense of physical activity, such as work and a young family. The social environment for scheduled exercise sessions may also be better received by older adults. Greater rates of referral and uptake of Physical Activity Referral Schemes opportunities by adults in middle- and early old-age (Harrison et al, 2005; Gidlow et al, 2007) may have created a social environment more suited to certain age profiles (Hardcastle & Taylor, 2001). Furthermore, the relative importance of physical activity as a means of social interaction in older people (Stathi et al., 2003; Stathi, 2009) not only supports this notion, but also represents a potentially important factor contributing to higher completion rates in older people whereby developing social networks increases their likelihood of continued attendance. The Physical Activity Referral Schemes in the present investigation specifically encouraged social interaction through group exercise, the proactive role of the facilitators, and organised coffee meetings. Although it is well documented that physical activity reduces with age (Trost et al, 2002; Taylor et al., 2004; Stathi, 2009), this same literature may offer an insight into the reasons for the apparent popularity of Physical Activity Referral Schemes for older adults. The safe and well supervised environment for exercise may offset reported barriers of fear of falling and fear of exacerbating existing medical conditions (Lim & Taylor, 2005). Furthermore, according to Resnick & Spellbringer (2000), this greater awareness of health issues can be a motivating factor for participating in preventative health programmes.

The greater likelihood of completion of scheduled exercise sessions in men reported elsewhere (Gidlow et al, 2007; James et al, 2008) was not evident in the present study. Whilst this may reflect a social environment for exercise where men and women feel equally supported, a number of other factors may have contributed to this finding. The greater proportion of recruited participants were women, and this finding is typical of exercise interventions in general, where men are known to be harder to recruit, with women accounting for approximately sixty per cent of participants (e.g., Gidlow et al, 2005; Harrison et al, 2005; James et al., 2008). The equal likelihood of completion of scheduled exercise sessions in the present study should be interpreted in light of a greater proportion of women taking up the opportunity in the first place. Recruitment of men to Physical Activity Referral Schemes clearly remains a challenge for health professionals.

Traditionally, physical activity interventions tend to attract *white*, middle-aged, well-educated, and more affluent individuals (Godin & Shephard, 1983; Dunn, 1996; Hillsdon & Thorogood, 1996; Hillsdon et al, 1999; Simons-Morton et al., 2000; Adams & White, 2003; McKay et al., 2003; Hillsdon et al., 2005). A review concluded that interventions for ethnic minorities and those on low incomes could be successful, but that conditions necessary for success were not clear (Taylor et al, 1998). Indeed, when the influences on a given behaviour (such as physical activity) are so multi-factorial, it is difficult to tease out necessary conditions for success. In Physical Activity Referral Schemes research a consistent relationship is already evident between attendance and the correlates of age, gender, referral reason and socio-economic position (Taylor et al., 1998; Dugdill et al., 2005; Gidlow et al, 2007; Hardcastle et al, 2008; James et al, 2008). Perhaps due to limited ethnic variation in the study samples, or potential problems in targeting a diverse sample, the influence of ethnicity on Physical Activity Referral Schemes completion remains unclear. The Physical Activity Referral Schemes in the present study actively targeted ethnic groups from a diverse population, providing a facilitated pathway to promote access and minimise barriers. The support provided by the staff and the wide diversity of those attending the scheduled exercise sessions may have also encouraged members of different ethnic groups to attend. It should be noted that, although those in the 'mixed' ethnicity group were more likely to successfully attend (compared with the 'white' group), the small numbers of mixed ethnicity participants (n=14) is a limitation of the present study. However, given the diverse nature of the Greenwich borough population, the present findings offer new insight into the potential for using Physical Activity Referral Schemes in ethnically diverse populations, and provides a useful start point for further research.

Several researchers have investigated the association between referral reason and attendance at scheduled exercise sessions. Dugdill & Graham (2004) reported lower attendance in those referred primarily for ‘overweight’; individuals referred post myocardial infarction (i.e. cardiac rehabilitation) tended to attend more scheduled sessions. High compliance with exercise for such serious medical conditions has been reported elsewhere (Friedman et al, 1997). Similarly, James et al (2008) reported that the likelihood of taking up a Physical Activity Referral Schemes intervention opportunity was reduced in those referred for reasons of overweight or mental health. In the present study, compared with those referred for cardiovascular conditions, participants referred with pulmonary conditions were less likely to complete the scheduled exercise sessions. Pulmonary conditions such as bronchitis and emphysema are permanent and progressive, characterised by shortness of breath upon exertion, often with fatigue, coughing and wheezing (Reardon et al, 2005). Although physical training is considered crucial to increase exercise capacity, functional status and associated quality of life, such symptoms are likely to make exercise an uncomfortable experience. Where deterioration is evident, patients may perceive limited improvement from the exercise, especially compared with cardiac patients for whom noticeable improvements in function from exercise are much more attainable (Hillsdon et al, 2005). Pulmonary conditions are also unstable, can vary with seasonal changes (e.g., cold weather), and are aggravated by the flu and chest infections (Glezen et al, 1987). Consequential interruptions to regular attendance at scheduled sessions may reduce participant motivation. It should also not be overlooked that chronic respiratory disease is also associated with an increased risk of mental health conditions such as anxiety and depression (Dowson et al, 2004). Mental health conditions are already associated with poor uptake in the Physical Activity Referral Schemes literature (James et al., 2008). Future research might reasonably focus on the potential of exercise groups comprised of participants with similar conditions.

To our knowledge, this is the first Physical Activity Referral Schemes study of its type to explore factors associated with both completion and health related outcomes. Although it has been speculated that completion of the scheduled exercise sessions in previous studies would be likely to result in reductions in body mass and positive changes in other health related outcomes (e.g. blood pressure), it was not possible to make such claims with any certainty (Gidlow et al, 2007; James et al, 2008). In the present study, completion is associated with body mass reduction and reduced blood pressure. It is well established at an individual level that increasing physical activity has the potential to cause body mass loss through increased total daily energy expenditure, and possibly through an improvement in other lifestyle choices that might reduce energy intake, such as healthier eating (Blair et al., 1985). Physical activity alone (rather than coupled with dietary intervention) has been linked with modest body mass loss of around 0.5-1 kg per month (US Department of Health and Human Services, 1996). Although substantial body mass reduction might not be a realistic target for a relatively short Physical Activity Referral Schemes intervention (up to 12 weeks), a meta-analysis reported a mean body mass reduction of between 15.0 and 7.5 kg over the study duration (8-30 weeks) in exercise only interventions, depending on the intensity of intervention (Anderson et al 2001). Within the present Physical Activity Referral Schemes, it is therefore not surprising to see that previous assumptions regarding the association between completion and health related outcomes has been confirmed for reduction of body mass and blood pressure.

An association between body mass reduction and blood pressure reduction has been observed previously (Stevens et al, 2001). The blood pressure lowering effect of modest loss of body mass (5-10 %) in both hypertensive and normotensive patients has been reported (Mertens & Van Gaal, 2000). Even modest exercise interventions have been shown to reduce blood pressure (Wilmore, 2001; Ishikawa-Takata et al, 2003; Cornelissen & Fagard, 2005), however the addition of a programme targeting energy intake has been shown to further enhance this effect (Blumenthal et al., 2000). Moreover, such reductions in blood pressure are seen both in those who are overweight and those who are normal weight (Whelton et al., 2002). In the present study, completion of scheduled exercise sessions was positively associated with reduced body mass, and mass loss was positively associated with reduced blood pressure. To our knowledge, this is the first time such an association has been reported for a Physical Activity Referral Schemes when using a prospective population-based longitudinal design. Other research exploring physical activity interventions has found a noticeable decrease in blood pressure (Grant et al., 2004; Taylor & Fox, 2005; Isaacs et al., 2007). The extent to which the findings of the present study reflect the effect of the scheduled exercise sessions as opposed to other lifestyle changes is unknown. However, given the prominence of overweight and hypertension as risk factors for cardiovascular disease, any intervention that reduces the prevalence of these risk factors has important public health benefits.

There are well known socioeconomic position gradients for various health outcomes, such as blood pressure (e.g. Shaper et al 1981; Ebrahim et al. 2004), and for physical activity itself (Health Education Authority, 1995; Gidlow, 2006). A small decrease in the average population blood pressure level could dramatically reduce the incidence of cardiovascular disease in the population (Cook et al, 1995), leading to significant savings to the NHS (National Institute for Health and Clinical Excellence, 2006b). Therefore, the potential for Physical Activity Referral Schemes to reduce blood pressure, especially within lower socioeconomic groups, is worth considering. It is worth noting that socioeconomic position has been associated with uptake and attendance of Physical Activity Referral Schemes (Gidlow et al, 2007). In the present study, skilled manual employment was associated with reduced blood pressure. It is possible that the supplementation of work based physical activity with scheduled exercise sessions was more likely to lead to a reduction in blood pressure.

Although strong associations have been reported in the present study, and in many cases these confirm previous findings, the design of the present study does not permit any conclusions about causality. For example, although completion was associated with body mass reduction, and both completion and body mass reduction were associated with blood pressure reduction, we cannot be sure about the factors that caused a reduction in either body mass or blood pressure. Study designs employing a control group are better suited to determining the extent to which increases in physical activity as part of Physical Activity Referral Schemes cause the improvements in health indices. A particular limitation of the present study is that measurements of body mass and blood pressure were made by a range of exercise practitioners in the ‘field’ setting, and, despite rigorous training, the reliability of the measurements were likely to be poorer than those made by a trained researcher. However, the large number of participants in the present study provides good statistical power, even in the presence of poorer measurement reliability. It should also be emphasised that the study design benefits from good ecological validity, which is extremely important when attempting to determine key factors involved in the success of the Physical Activity Referral Schemes process.

CONCLUSIONS

The present research demonstrates the value of prospective population-based longitudinal studies of Physical Activity Referral Schemes. The findings from this and similar studies (Harrison et al., 2005; Gidlow et al., 2007; James et al., 2008) make an important contribution to the area by addressing a gap in knowledge. The present study revealed that, within a diverse metropolitan population, the likelihood of scheme completion increased with age, was lower in those referred with a pulmonary condition, and the possible ethnic association requires further study. Completion was also associated with body mass and blood pressure reductions, and body mass reduction is associated with blood pressure reduction. Interestingly, those in the skilled manual occupational group were more likely to demonstrate a blood pressure reduction. These findings support and build on previous findings and further emphasise that programme completion must remain a priority for Physical Activity Referral Schemes. Strategies to better accommodate patients referred with pulmonary conditions should be explored. Given the importance of completion for body mass and blood pressure reduction, health and exercise professionals need to develop strategies to improve completion rates during referral and uptake phases of Physical Activity Referral Schemes.

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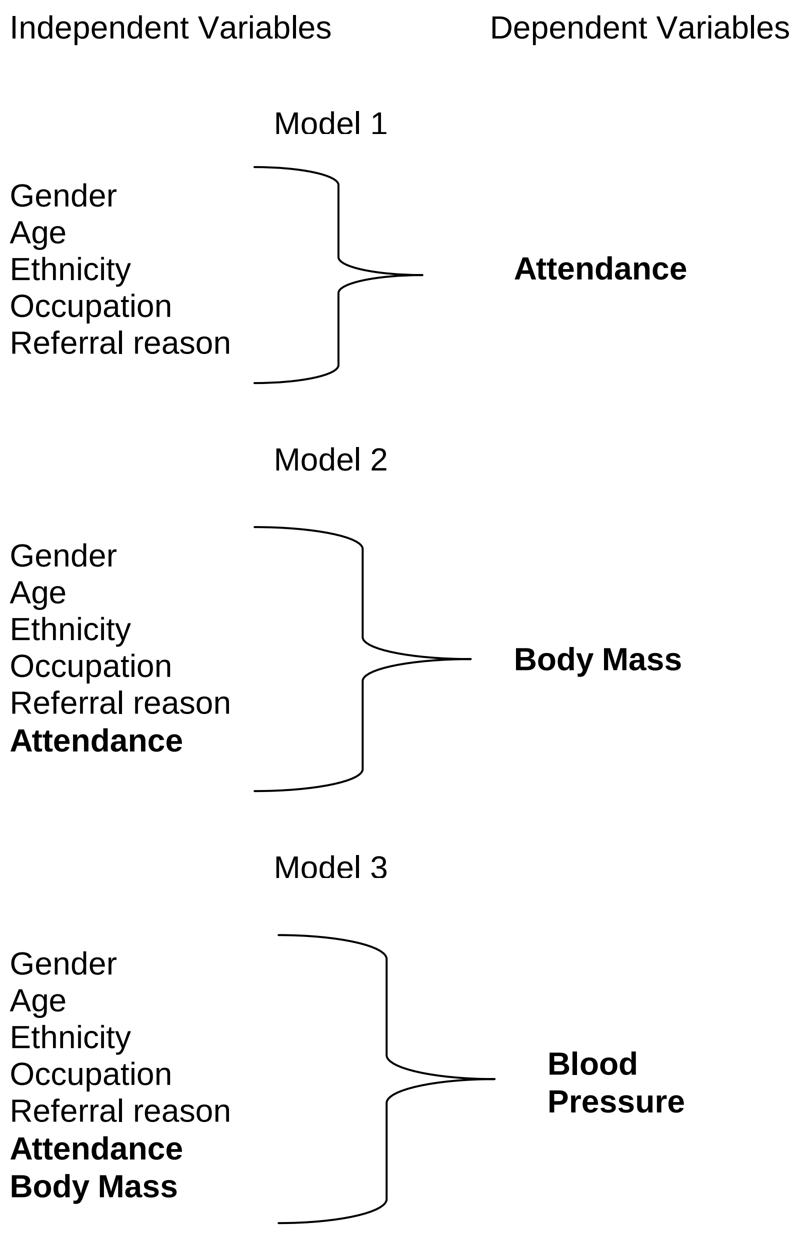

Figure 1: Variables included in the multiple-stage regression

Table 1: Descriptive characteristics of participants

	n	%
Gender		
Female	860	65.4
Male	455	34.6
Age		
Over 50	539	41.0
Under 50	776	59.0
Ethnicity		
White Background	913	69.4
Asian Background	147	11.2
Black Background	231	17.6
Chinese Background	10	0.8
Mixed Background	14	1.1
Occupation		
Unemployed	470	35.7
Retired	286	21.7
Unskilled	75	5.7
Partly skilled	97	7.4
Skilled manual	63	4.7
Skilled non manual	194	14.8
Managerial	70	5.3
Referral reason		
Cardiovascular heart disease	230	17.5
Pulmonary Diseases	130	9.9
Metabolic Diseases	478	36.3
Orthopaedic Diseases	325	24.7
Neuromuscular Disorders	14	1.1
Mental Health	123	9.4
Miscellaneous	15	1.1

Table 2: Binary outcome variables for logistic regression models

LR Model	Binary outcome 0		Binary outcome 1
1	Non-completion (n = 565)	vs.	Completion (n = 750)
2	Non reduction in body mass (n = 877)	vs.	Reduction in body mass (n = 438)
3	Non reduction in blood pressure (n = 668)	vs.	Reduction in blood pressure (n = 647)

Table 3: Binary logistic regression outcomes

	Model 1 OR (95%CI)	*p*	Model 2 OR (95%CI)	*p*	Model 3 OR (95%CI)	*p*
Gender						
Male	1.000 (ref)		1.000 (ref)		1.000 (ref)	
Female	0.923 (0.721 to 1.182)	0.526	1.075 (0.825 to 1.401)	0.593	0.923 (0.724 to 1.176)	0.515
Age (continuous)	1.019 (1.008 to 1.030)	0.001	0.998 (0.986 to 1.009)	0.670	0.999 (0.989 to 1.009)	0.698
Ethnicity		0.038		0.111		0.539
White	1.000 (ref)		1.000 (ref)		1.000 (ref)	
Asian	1.383 (0.946 to 2.202)	0.094	1.330 (0.904 to 1.955)	0.148	1.080 (0.750 to 1.558)	0.677
Black	0.866 (0.640 to 1.172)	0.352	1.185 (0.855 to 1.641)	0.307	0.987 (0.724 to 1.321)	0.884
Chinese	0.795 (0.224 to 2.825)	0.723	1.555 (0.395 to 6.121)	0.528	2.458 (0.602 to 9.792)	0.212
Mixed	6.310 (1.388 to 28.695)	0.017	3.991 (1.191 to 13.373)	0.025	2.214 (0.624 to 6.709)	0.237
Occupation		0.408		0.451		0.166
Unemployed	1.000		1.000 (ref)		1.00 (ref)	
Retired	1.300 (0.889 to 1.901)	0.176	0.811 (0.541 to 1.216)	0.311	0.832 (0.576 to 1.211)	0.343
Unskilled	0.874 (0.529 to 1.444)	0.600	0.900 (0.514 to 1.575)	0.712	0.734 (0.441 to 1.217)	0.239
Partly skilled	1.238 (0.786 to 1.952)	0.375	0.648 (0.387 to 1.085)	0.099	0.892 (0.577 to 1.422)	0.667
Skilled manual	1.018 (0.591 to 1.725)	0.950	1.373 (0.770 to 2.449)	0.282	1.875 (1.044 to 3.227)	0.035
Skilled non-manual	1.324 (0.935 to 1.875)	0.114	0.930 (0.641 to 1.350)	0.704	1.228 (0.868 to 1.732)	0.248
Managerial	1.610 (0.950 to 2.729)	0.077	0.661 (0.371 to 1.732)	0.160	0.884 (0.536 to 1.501)	0.679
Professional	1.328 (0.762 to 2.317)	0.317	0.963 (0.535 to 1.732)	0.899	1.046 (0.603 to 1.800)	0.884
Referral reason		0.065		0.587		0.698
Cardiovascular	1.000 (ref)		1.000 (ref)		1.000 (ref)	
Pulmonary	0.546 (0.346 to 0.860)	0.009	0.951 (0.580 to 1.558)	0.842	0.863 (0.552 to 1.353)	0.523
Metabolic	0.755 (0.537 to 1.061)	0.106	1.146 (0.803 to 1.637)	0.453	1.156 (0.829 to 1.604)	0.396
Orthopaedic	0.724 (0.505 to 1.040)	0.081	0.892 (0.609 to 1.307)	0.558	0.918 (0.650 to 1.310)	0.653
Neuromuscular	2.670 (0.709 to 10.055)	0.147	0.622 (0.183 to 2.110)	0.446	0.918 (0.315 to 2.807)	0.912
Mental	0.919 (0.571 to 1.479)	0.728	0.835 (0.499 to 1.397)	0.492	0.879 (0.555 to 1.412)	0.609
Miscellaneous	0.635 (0.217 to 1.854)	0.406	1.550 (0.504 to 4.772)	0.445	0.945 (0.318 to 2.671)	0.880
Completion						
Non-completion	N/I		1.000 (ref)		1.000 (ref)	
Completion	N/I	N/I	3.541 (2.721 to 4.608)	<0.001	1.680 (1.250 to 2.003)	<0.001
Body mass						
Non-reduction	N/I		N/I		1.000 (ref)	
Reduction	N/I	N/I	N/I	N/I	1.292 (1.008 to 1.641)	0.043

Note: N/I indicates that data were not included; OR is Odds Ratio; CI is Confidence Interval