Are exercise referral schemes associated with an increase in physical activity? Observational findings using individual patient data meta-analysis from The National Referral database

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SUMMARY OF KEY FINDINGS

- Physical activity is widely considered to be effective in the prevention, management, and treatment of many chronic health disorders and a body of evidence supports its efficacy.
- However, few people achieve the recommended levels of physical activity to optimise their health and wellbeing.
- One approach to getting inactive people suffering from chronic disease to engage in physical activity is through exercise referral schemes.
- However, despite evidence of the benefits of physical activity, the evidence base regarding whether exercise referral schemes are an effective approach to increase physical activity is currently limited.
- The National Referral Database is a newly formed resource produced in collaboration by ukactive, the National Centre for Sport and Exercise Medicine in Sheffield, and ReferAll, which includes data on a variety of outcomes for patients both pre and post their ERS participation.
- In this study we examined if exercise referral schemes were associated with changes in physical activity in a large cohort of individuals throughout England, Scotland and Wales from The National Referral Database.
- We examined data from The National Referral Database for 5,246 participants across 13 different exercise referral schemes for which data was available for physical activity. The International Physical Activity Questionnaire was used to examine self-reported physical activity both before and after an exercise referral scheme.
- We used the technique of two stage individual patient data meta-analysis to determine physical activity before an exercise referral scheme, and how large changes in physical activity were. This approach involved calculating the median physical activity levels before, and change after, for participants within each exercise referral scheme. These were then pooled to produce an estimate of the overall change allowing for the variation of results across the different schemes.
- Most participants were classified as 'moderately active' before their exercise referral scheme participation. There was a statistically significant change in total physical activity with most of this accounted for by increases in moderate-vigorous physical activity (increasing 17 minutes and 29 minutes per week respectively), in addition to

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reductions in sitting time (reducing by 61 minutes per week). However, the size of the changes was not sufficient for participants to move from the ‘moderately active’ category to ‘highly active’ category.

- It is worth noting however that there was considerable variation in effectiveness between different exercise referral schemes. However, data was not available to determine why this may be.
- These findings suggest the need to consider exercise referral schemes and their implementation more critically. It would seem that they may not be targeting those who are most inactive and this may perhaps explain why changes were not sufficient to change activity category.
- Future implementation should considering ensuring that exercise referral schemes target populations where they are most likely to produce benefit (i.e. those currently inactive), and further research should look to identify best practices from across differing exercise referral schemes.

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Are exercise referral schemes associated with an increase in physical activity? Observational findings using individual patient data meta-analysis from The National Referral Database

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SCIENTIFIC ABSTRACT

Background: Exercise referral schemes (ERSs) within clinical populations offer inactive individuals the opportunity to increase physical activity levels over the length of scheme. Schemes are also intended to support the treatment of specific health conditions of medically referred individuals through increased physical activity behaviours. The extant literature concerning the impact of exercise referral on physical activity levels is inconsistent. It is of interest researchers, policy makers, commissioners and practitioners to to consider broadly whether meaningful change in physical activity levels are observed in people who undergo exercise referral, to identify potential effective policy actions in supporting active living. ***Purpose***: To examine if ERSs increase physical activity levels in a large cohort of individuals throughout England, Scotland and Wales from The National Referral Database. ***Method***: Data were obtained from 5246 participants from 12 different referral schemes. Average age was 53±15 years and, 68% of participants were female. Participants self-reported International Physical Activity Questionnaire (IPAQ) scores pre- and post- scheme, to determine if exercise referral had any impact on change in physical activity levels. Two stage individual patient data meta-analysis was performed on the both pre-ERS, and change scores, (i.e. post- minus pre-ERS scores) for MET-minutes/week calculated from IPAQ. Analyses were conducted on the continuous data collected using the IPAQ. ***Results*****:** For pre-ERS MET-minutes/week the estimate and 95%CI from random effects model was 676 MET-minutes/week [539 to 812 minutes]. For change in MET-minutes/week the estimate and 95%CI from random effects model for was an increase of 540 MET-minutes/week [396 to 684 minutes]. Significant heterogeneity was evident among the schemes (I^2 > 80%). Changes in total PA levels occurred as a result of increases in vigorous activity of 17 minutes [95%CI 9 to 24 minutes], increases in moderate activity of 29 minutes [95%CI 22 to 36 minutes], and reductions in sitting of -61 minutes [95%CI -78 to -43 minutes], though little change in walking (-5 minutes [95%CI -14 to 5 minutes]). ***Conclusion*****:** Observation of participants undergoing ERSs suggests that most are already 'moderately active' upon entering an ERS. Changes in physical activity behaviour associated with ERS participation were varied and primarily facilitated by increased moderate-to-vigorous physical activity and reduced sitting. However, this was not sufficient to result in IPAQ categorical change and participants where thus on average still classed as 'moderately active'. Further work is required to ensure ERSs are implemented to targeting the appropriate populations where they may result in the greatest benefit.

Key words: Exercise referral schemes; physical activity; individual patient data meta-analysis; health database.

INTRODUCTION

Physical activity is widely considered an effective prevention and management tool for a wide range of chronic health disorders (Pavey, et al. 2011; Pederson & Denollet 2003; Pederson & Saltin 2015). Physical activity is considered as any bodily movement created by skeletal muscles that results in greater demand of energy expenditure than at would normally be required (World Health Organization 2015; 2018). Physical activity can be conducted in many ways, including unstructured activities as part of an individual's daily living, leisure activities, or occupation, and is often performed without the explicitly desired goal of improving fitness. Improving health and fitness can be a by-product of these unstructured activities, although unstructured physical activity is decreasing within the modern era (Booth, et al. 2012).

Worldwide, one in four adults do not meet the current global recommendations for

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physical activity, which suggest that adults undertake 150 minutes of moderate-intensity activity per week (World Health Organization 2018). Approximately 20 million adults in the UK are not physically active (British Heart Foundation 2017), a figure that has remained relatively unchanged in the recent years (Sport England 2018). Physical inactivity is a public health dilemma in that it is associated with increased risk of non-communicable diseases (NCDs) includings obesity, cardiovascular diseases, diabetes, and premature death (British Heart Foundation 2017). Physical inactivity has reportedly increased globally, having serious consequences on health and wellbeing (Morgan, et al. 2016; Public Health England 2016; Sport England 2018).

In contrast to inactivity which is associated with a range of negatie health outcome, physical activity is associated with a range of positive health outcomes. Regular physical activity has been associated with reduced risk of cancers (World Health Organization 2018), delayed onset of dementia (Livingston, et al. 2017), reduced BMI and waist circumference (Mustelin, et al. 2009), decreased blood pressure (BP) and resting heart rate (RHR; Brukner, et al. 2005; Pederson and Saltin 2006 & 2015), reduced anxiety (Stonerock, et al. 2015) and depression (Blumenthal, et al. 1990; Mammen, et al. 2013; Pavey, et al. 2011), and overall improved mental health (Schuch, et al. 2016). Indeed, network meta-analyses have shown physical activity interventions, including structured bouts of physical activity (i.e. exercise), are similarly, and in some cases, more effective than drug treatments for secondary prevention (Naci and Ioannidis, 2013; Naci et al., 2018).

Considering this, interventions to increase physical activity in primary care might present a solution to reduce the heavy burden that inactivity related NCDs place upon the National Health Service (NHS) (Hansen, et al. 2013), which at present has risen to £1.2 billion per year (British Heart Foundation 2017). Exercise referral schemes (ERSs) are exercise interventions aimed at increasing the number of sedentary individuals becoming active, along with aiding the rehabilitation and management from chronic health disorders (NICE, 2014; Pavey, et al. 2011; Williams, et al. 2007). Schemes were first introduced in the 1990s in primary care settings across England to facilitate physical activity participation for individuals referred with chronic health disorders (Fox, et al. 1997). Professionals in primary care (usually general practitioners, but also nurses, physiotherapists and condition-specific specialists) typically refer individuals to third party service providers, usually in leisure centres and gyms, who then prescribe an exercise programme and monitor progress accordingly.

According to The National Institute for Health and Care Excellence (NICE) guidelines, ‘Physical Activity: Exercise Referral Schemes’ [Ph54] (2014), schemes should typically consist of a 12 weeks’ exercise prescription and should target currently inactive individuals with chornic health disorders, as evidence is not clear whether they are effective in other populations. However, the evidence for even this population specifically was considered weak at the time of the guidelines which in recent consulation have remained the same (NICE, 2018). The specific exercise prescription details of the NICE guidelines do not provide any details. In addition, ERSs have been described as ‘wild and woolly’, with a lack of agreement between stakeholders on how to determine impact (Henderson, et al. 2018). Although increasing physical activity levels is a primary aim of ERS there has been little research documenting change in physical activity levels after scheme completion; and what has been conducted appears conflicting (Chalder, et al. 2012; Murphy, et al. 2012; Pavey, et al. 2011; Webb, et al. 2016). This is of particular relevance as recent observational findings reported alongside this manuscript from ERSs schemes in The National Referral Database suggest that changes in health and wellbeing outcomes may not reach meaningful levels (Wade et al. 2019). It is important to provide an update of the evidence of the impact of ERSs on physical activity across England, Scotland and Wales in order to understand whether a possible explanation for the lack of health and wellbeing outcomes may be due to insufficient changes in physical activity levels. The aim of this study was therefore to examine changes in PA in participants who had completed an ERS, using observational data from The National Referral Database.

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METHODS

Study Design

Anonymised data were extracted from the The National Referral Database uploaded from ERSs across England, Wales and Scotland. Referrals from primary care to ERSs were made between September 2011 and December 2017. The database has been described elsewhere including database formation, data cleaning, and structure in detail (Steele et al. 2019). The study uses a longitudinal study design, as it follows uptake, participation, and completion of ERSs. Due to the inclusion of various schemes within the database, an individual patient data meta-analysis with a two-stage approach was used. Ethics approval was provided by Coventry University (P46119).

Outcome Measures

The self-reported International Physical Activity Questionnaire (IPAQ)-short form was used to determine weekly physical activity, in Metabolic Equivalent (MET) -minutes/week (described below), which was the primary outcome measure. Change in MET-minutes/week of self-reported physical activity pre- and post- scheme, was used to examine the impact ERS had on the participant's physical activity levels. The IPAQ-short form contains seven open-ended items surrounding the participants' last seven day recall of physical activity and sitting behaviours. Items were structured to provide scoring on walking, moderate-intensity and vigorous-intensity activity, in addition to sitting. The IPAQ has been designed for observational research and its test-retest reliability indicates good stability and high reliability (α >.80), along with concurrent validity (Craig, et al. 2003; Lee, et al. 2011). Both continuous and categorical indicators of physical activity come from IPAQ.

Continuous Analysis of IPAQ

Due to the non-normal distribution of energy expenditure in participants, it has been suggested that continuous indicators be presented as median MET-minutes/week (Ainsworth, et al. 2011). A MET is the ratio of the rate of energy expended during an activity to the rate of energy expended at rest (Nelson, et al. 2007). A MET is a unit of energy expenditure and by calculating MET-minutes, can be used to track the amount of physical activity an individual is doing per week (Ainsworth, et al. 2011).

Categorical Analysis of IPAQ

There are three categorical levels of physical activity scoring to classify populations through the IPAQ: 'low', 'moderate' and 'high'. Criteria set for each of the levels consider each question asked on the IPAQ form (Craig, et al. 2003). The 'high' category describes high levels of physical activity participation; either >1500 MET-minutes/week (consisting of vigorous activity on at least three days), or >3000 MET-minutes/week (consisting of any combination of activities across seven days). This provides a higher threshold of measures of total physical activity and is useful to examine population variation. The 'moderate' category defines an individual to be participating in some activity, more than those in the 'low' category (600 to 1499 MET-minutes/week). Those in the 'low' category do not engage in at least half an hour moderate-intensity physical activity most days (0 to 599 MET-minutes/week). Individuals in the 'low' category do not meet any criteria from the high or moderate categories, and are not participating in any regular physical activity.

Statistical Analyses

Two stage individual patient data meta-analysis was performed on the both the median pre-ERS, and median change scores, (i.e. post- minus pre-ERS scores) for MET-minutes. Analysis was also performed on the breakdown of vigorous and moderate intensity activity, walking, and sitting minutes for pre-ERS, as well as change scores. For stage one, both median pre-ERS for MET-minutes/week and mean pre-ERS for activity breakdowns, and median change scores for MET-minutes/week and mean for activity breakdowns, and their standard errors were derived for each scheme. The second stage involved performing a random effects meta-analysis using the 'metafor' package in R (version 3.5.0; R Core Development Team, https://www.r-project.org/) across all schemes to derive a final point estimate and precision of estimate (95% confidence intervals [CI]). Estimates were weighted by inverse sampling variance and restricted maximal likelihood estimation was used in all models. Schemes without sufficient participants (n < 4) were excluded from analysis. Robustness of main effects were

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considered through sensitivity analyses by removal of individual schemes and re-analysis of the random effects model. Where significant estimates became non-significant and vice versa, in addition to where there were considerable changes in the magnitude and/or precision of those estimates, the results of sensitivity analyses are reported.

An α level of 0.05 was used to determine statistical significance, however results were not interpreted dichotomously based purely on this, or whether the 95%CIs crossed zero. Instead, the point estimate and its precision was considered in light of the physical activity guidelines and interpreted with respect to how meaningful the change was. In this sense, progressively greater increases in MET-minutes/week are required as starting physical activity levels increase to move into a higher category. This was based upon the IPAQ 'low', 'moderate', and 'high' categories. For high we considered the lower threshold of 1500 MET-minutes/week. In essence, the analyses performed were with the intention of reporting broadly; do we observe a meaningful change in physical activity levels in people who are undergoing ERSs?

RESULTS

A total of 12 schemes were included in the final analysis, which included a total of 5246 participant's data with an average age of 53±15 years and 68% of whom were female.

Pre-ERS MET-minutes

For pre-ERS MET-minutes/week the estimate from random effects model was 676 MET-minutes/week [539 to 812 minutes], $p < 0.0001$). Figure 1 shows the forest plot for pre-ERS MET-minutes. Significant heterogeneity was evident among the schemes ($Q_{(11)} = 84.31$, $p < 0.0001$; $I^2 = 90.41\%$), however, sensitivity analysis did not reveal any influential schemes.

Pre-ERS Breakdown of Activity Minutes

For pre-ERS vigorous activity the estimate from random effects model was 25 minutes [16 to 34 minutes], $p < 0.0001$). Figure 2 shows the forest plot for pre-ERS vigorous minutes. Significant heterogeneity was evident among the schemes ($Q_{(10)} = 128.54$, $p < 0.0001$; $I^2 = 87.52\%$), however, sensitivity analysis did not reveal any influential schemes.

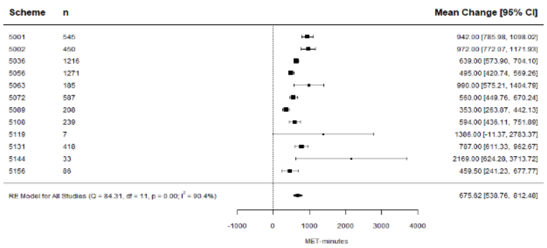

Figure 1. Forest plot of pre-ERS MET-minutes/week across schemes.

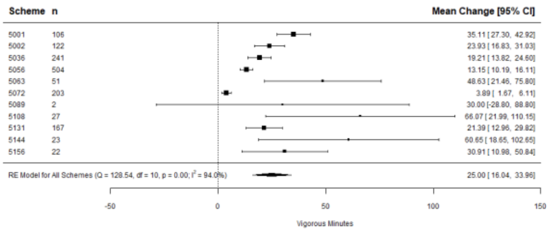

Figure 2. Forest plot of vigorous minutes across schemes.

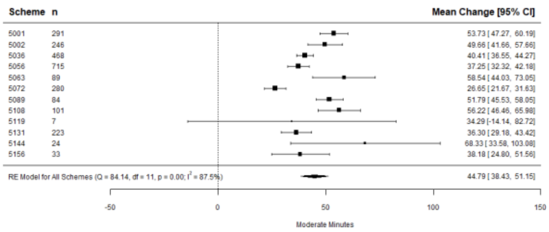

Figure 3. Forest plot of moderate minutes across schemes.

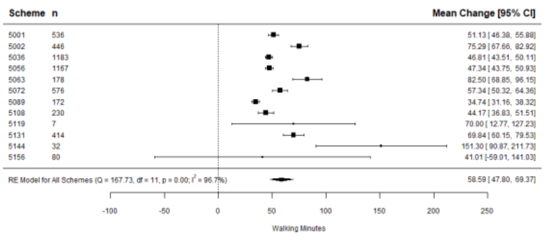

Figure 4. Forest plot of walking minutes across schemes.

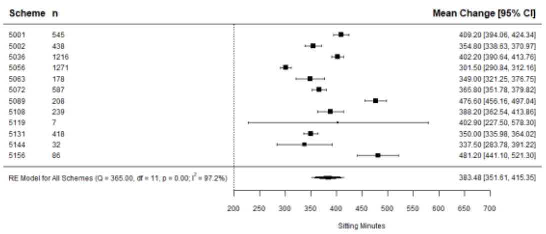

Figure 5. Forest plot of sitting minutes across schemes.

For pre-ERS moderate activity the estimate from random effects model was 45 minutes [38 to 51 minutes], $p < 0.0001$). Figure 3 shows the forest plot for pre-ERS moderate minutes. Significant heterogeneity was evident among the schemes ($Q_{(11)} = 84.15$, $p < 0.0001$;

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I^2 = 87.52%), however, sensitivity analysis did not reveal any influential schemes.

For pre-ERS walking the estimate from random effects model was 59 minutes [48 to 69 minutes], $p < 0.0001$). Figure 4 shows the forest plot for pre-ERS walking minutes. Significant heterogeneity was evident among the schemes ($Q_{(11)}$ = 167.73, $p < 0.0001$; I^2 = 96.66%), however, sensitivity analysis did not reveal any influential schemes.

For pre-ERS sitting the estimate from random effects model was 384 minutes [352 to 415 minutes], $p < 0.0001$). Figure 5 shows the forest plot for pre-ERS sitting minutes. Significant heterogeneity was evident among the schemes ($Q_{(11)}$ = 365.00, $p < 0.0001$; I^2 = 97.20%), however, sensitivity analysis did not reveal any influential schemes.

Change in MET-minutes

For change in MET-minutes/week the estimate from random effects model for was 540 MET-minutes/week [396 to 684 minutes], $p < 0.0001$). Figure 6 shows the forest plot for pre-ERS MET-minutes. Significant heterogeneity was evident among the schemes ($Q_{(11)}$ = 47.44, $p < 0.0001$; I^2 = 84.90%), however, sensitivity analysis did not reveal any influential schemes. Considering the estimate for pre-ERS MET-minutes/week (676 MET-minutes) it would seem that the estimate for change in MET-minutes/week resulted in participants beginning as moderately active and, though their activity levels increased, the change in activity levels were insufficient to result in a change in IPAQ category with them remaining moderately active.

Breakdown of Change in Activity Minutes

For change in vigorous activity the estimate from random effects model was 17 minutes [9 to 24 minutes], $p < 0.0001$). Figure 7 shows the forest plot for change in vigorous minutes. Significant heterogeneity was evident among the schemes ($Q_{(11)}$ = 480.16, $p < 0.0001$; I^2 = 97.87%), however, sensitivity analysis did not reveal any influential schemes.

For change in moderate activity the estimate from random effects model was 29 minutes [22 to 36 minutes], $p < 0.0001$). Figure 8 shows the forest plot for change in moderate minutes. Significant heterogeneity was evident among the schemes ($Q_{(11)}$ = 133.55, $p < 0.0001$;

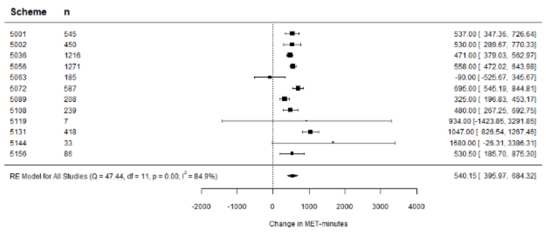

Figure 6. Forest plot of change in MET-minutes/week across schemes.

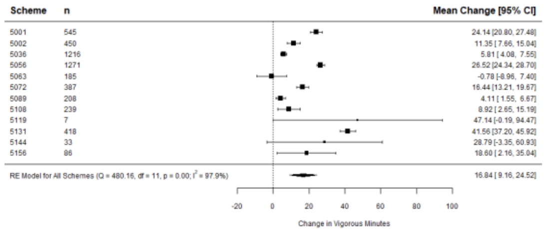

Figure 7. Forest plot of change in vigorous minutes across schemes.

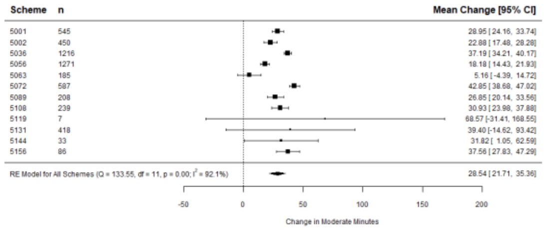

Figure 8. Forest plot of change in moderate minutes across schemes.

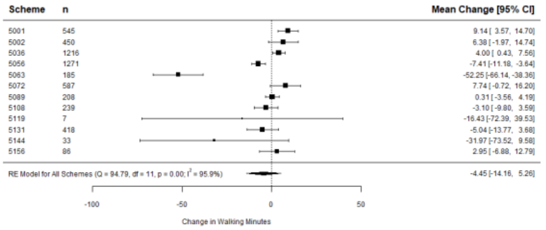

Figure 9. Forest plot of change in walking minutes across schemes.

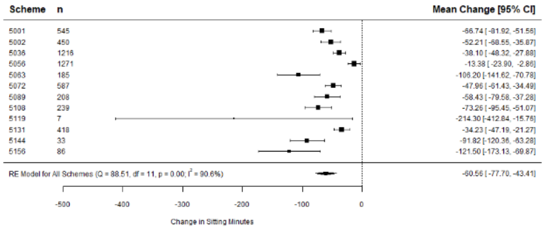

Figure 10. Forest plot of change in sitting minutes across schemes.

I^2 = 92.14%), however, sensitivity analysis did not reveal any influential schemes.

For change in walking the estimate from random effects model was -5 minutes [-14

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to 5 minutes], p = 0.3687). Figure 9 shows the forest plot for change in walking minutes. Significant heterogeneity was evident among the schemes ($Q_{(11)}$ = 94.79, p < 0.0001; I^2 = 95.91%), however, sensitivity analysis did not reveal any influential schemes.

For change in sitting the estimate from random effects model was -61 minutes [-78 to -43 minutes], p < 0.0001). Figure 10 shows the forest plot for change in sitting minutes. Significant heterogeneity was evident among the schemes ($Q_{(11)}$ = 88.51, p < 0.0001; I^2 = 90.63%), however, sensitivity analysis did not reveal any influential schemes.

DISCUSSION

The aim of the present study was to examine changes in PA in participants who had completed an ERS. This study utilised data from the UK's first National Referral Database (Steele et al., 2019). Pre-ERS participants total physical activity was classified as 'moderately active' completing a median 676 MET-minutes/week [539 to 812 minutes], comprising of 25 minutes [16 to 34 minutes] vigorous activity, 45 minutes [38 to 51 minutes] moderate activity, 59 minutes [48 to 69 minutes] walking, and 384 minutes [352 to 415 minutes] sitting. Significant increases of 540 MET-minutes/week [396 to 684 minutes] occurred in participants undergoing ERSs, and this change occurred as a result of increases in vigorous activity of 17 minutes [9 to 24 minutes], increases in moderate activity of 29 minutes [22 to 36 minutes], and reductions in sitting time of -61 minutes [-78 to -43 minutes]. Little change was reported in weekly walking minutes (-5 minutes [-14 to 5 minutes]). Overall changes were primarily facilitated by increased moderate-to-vigorous physical activity (MVPA) and reduced sitting, though this was not sufficient to result in categorical change and participants where on average still classed as 'moderately active'.

Research suggests that a dose-response relationship occurs between physical activity and health benefits if individuals can improve MET-minutes/week by 500-1000 MET/min/week (Nelson, et al. 2007). Here, participants change, though statistically significant, barely achieved this threshold, which may explain the small changes observed in health and wellbeing outcomes in persons undergoing ERSs (see accompanying manuscript; Wade et al. 2019). It is also thought that the dose-response curve for physical activity is steepest at the lowest end of the curve (Wasfy and Baggish 2016), i.e. moving from a 'no' or 'low' to a 'moderate' physical activity level. As participants in this study tended to be already moderately active at the beginning of their ERSs, it may be that the more meaningful health and wellness changes primarily occur in those who begin an ERS categorised as inactive. Indeed, in previous studies some proportion of participants undergoing ERSs have reported themselves as being 'moderately inactive' (15.3%; Murphy et al. 2012). Chalder et al. (2012) also reported that ~25-28% of their participants were already achieving at least 1000 MET-minutes/week of physical activity at baseline. This is perhaps a cause for concern as the NICE guidelines (2018) suggest ERSs should be targeted towards the inactive. The observational data presented here would suggest that this recommendation is not being followed.

ERS can and do increase physical activity levels, however the value of this to a participants health outcomes is less clear In their systematic review and meta-analysis, Pavey et al. (2011) reported that, compared with usual care, ERSs have a slightly greater impact on the number of participants achieving between 90-150 minutes of moderate activity per week. However, they noted that at the time evidence was weak. Using seven day physical activity recall, Murphy et al. (2012) found that ERS group participants at 12 months' post intervention achieved a median of 200 minutes of exercise compared with 165 for the control group. Chalder et al. (2012) found increases post intervention, though no significant differences, in proportion of participants meeting at least 1000 MET-minutes/week between ERS or usual care in depressed adults, though descriptively they noted slight differences (ERS = 52% at four months, 63% at eight months, and 58% at twelve months; Usual care = 43% at four months, 49% at eight months, and 40% at twelve months). Our results show changes likely do occur, although not of considerable magnitude.

It is also worth considering the nature of the change in physical activity levels. The increases in total physical activity where primarily driven by increases in MVPA and decreases in sitting. Participants increased MVPA per week by ~46

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minutes (17 minutes vigorous and 29 minutes' moderate), yet walking did not change much in participants undergoing ERSs. Though walking and light activities are associated with improvements in all-cause mortality, these seem to be greatest again at the lower end of the dose-response curve (Kelly et al. 2014) and, at an equal volume, MVPA is associated with greater benefits (Saint-Maurice et al. 2018). It could therefore be viewed as positive that MVPA increased in patients undergoing ERSs. Increases in MVPA even in small amounts have been shown to be associated with reductions in all-cause mortality (Jefferis et al. 2018). Jefferis et al. (2018) reported each 10-minute increase in MVPA per day resulted in a 10% reduction in all-cause mortality risk. O'Donovan et al. (2018) have recently reported that inclusion of vigorous activity has an even stronger impact upon cardiovascular disease mortality risk, and participants in this present study showed increases in vigorous activity, which may still yield significant health benefits beyond the scope of our timeframe. Further, there was ~1 hour reduction in sitting time *per week* across participants. However, recent data shows that reducing sitting time point estimates of ~30 minutes *per day* are be considered clinically meaningful (Peachey et al., 2018).

It is important to consider length of scheme as a factor which could influence changes in physical activity. In a recent systematic review (Rowley, et al. 2018), it was found that longer length schemes (20+ weeks) improved adherence to physical activity prescribed over the course of the scheme. This research emphasises on the importance of increasing length of schemes. Indeed, it may be that if longer schemes where present in the database for analysis these may reveal greater physical activity increases compared with shorter schemes. Although other research by Webb, et al. (2016) suggests shorter schemes can be effective as it was found that after completing an 8-week ERS, categorical IPAQ scores significantly increased.

There are several limitations with the current database (Steele et al., 2019) that are worthy of note and these partially extend to the data analysis here. Considering physical activity levels specifically, use of self-reported outcomes, is a potential issue. IPAQ is of course a subjective measure and was not designed for examination of change in physical activity levels and this could mean it does not well reflect participants' actual changes in physical activity (Lee, et al. 2011). Though, recent work has suggested that perceptions of physical activity levels, even independently of actual physical activity levels, are strong predictors of all-cause mortality (Zahrt and Crum 2017). Although this study reviewed the effects of ERSs on change in physical activity, it does not consider the reasons for why participants chose to attend an ERS. Indeed, many factors influence uptake (Birtwistle et al. 2018) and it seems likely would influence engagement throughout also. Some participants may have attended due to their own motivation to improve their health conditions, whereas, other participants may have only attended because their GP advised them to. A future study could review the reasoning behind individuals' uptake in schemes, along with recorded adherence to physical activity or self-report physical activity through IPAQ. This could also be captured by schemes within the database as it is developed. Lastly, similarly to the health and wellbeing outcomes, there was considerable heterogeneity across schemes with respect to the changes observed.

CONCLUSION

These results represent the initial findings from first analysis of the National Referral Database considering physical activity levels. The analyses performed here were with the intention of considering broadly "do we observe a change in physical activity in people who are undergoing ERSs?" and the findings suggest that significant changes in total MET-minutes/week do occur. Participants in the ERSs assessed here were however predominantly 'moderately active' at baseline and remained so post-ERS. Thus, it is not clear the degree to which the changes observed are meaningful or not. Considering the heterogeneity of results across schemes also, future work, including that afforded by this database, should be focused upon determining where best practice exists (i.e. what works best for which population).

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regarding the statistical approaches taken to analysing the data presented here.

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