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Make time for physical activity or you may spend more time sick!

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"Make time for physical activity or you may spend more time sick! "

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Abstract

This work estimates the association between various types of physical activities and physical health, mental health and health service utilization. Specifically, we consider participation in housework, manual, walking, sports/exercise and total physical activities to a moderate level. We view this as an important contribution given that governments usually recommend a total level of activity that their citizens should achieve to be healthy, rather than a particular activity per se. Our results suggest that participation in any of these activities predicts a lower probability of poor health roughly to the same level. For mental health, our estimates highlight that those who participate in (and do more of) *any* activity have better mental health when compared to those who do not. The associations are higher for women. The associations are also higher for manual activities and sports/exercise when compared to other activities. The analysis also reveals some lower utilization of in-patient, out-patient visits and GP services among individuals who are moderately physically active.

Keywords: Physical activity, mental health, physical health, health service utilization.
JEL Classification: I0, I12, I18, J18.

Introduction and Background

It is generally accepted that weight gain is the result of an imbalance between calories in and calories out. Therefore, physical inactivity can directly lead to weight gain. There have been many empirical studies that support this hypothesis (for a review see Fogelholm and Kukkonen-Harjula, 2000 and Wareham, Van Sluijs and Ekelund, 2005; other empirical studies include Rashad, 2007 and Lakdawalla and Philipson, 2007). Even more studies have considered explanations as to why some individuals do more exercise than others (Johansson et al., 1988, Steenland, 1992, Catlin, Simoes, & Brownson, 2003; Giles-Corti, Macintyre, Clarkson, Pikora, & Donovan, 2003 and Sallis et al., 2009). However, relatively less attention has been paid to whether physical activity can augment health outcomes beyond weight. This work therefore empirically assesses whether physical activity can predict both physical and mental health.

We contribute to the existing literature by estimating the association between various types of physical activities, and general and mental health. Specifically, we consider housework, manual, walking, sports/exercise and total physical activities. We view this as an important contribution given that governments usually recommend a total level of activity that their citizens should achieve to be healthy. They do not however, discriminate between these types of activity. For example, in Britain, it is recommended that, to stay healthy, adults do 150 minutes of moderate-intensity activity each week. This equates to five sessions of 30 minutes where a person is working at an intensity that raises their heart rate and they break a sweat. This suggests that all activities done to this intensity provide similar benefits with respect to augmenting health. Given we are motivated by a belief that those who are physically inactive are also sicker, we also assess whether these physical activities can predict various types of health care utilisation. Towards this end, we consider primary care, outpatient and inpatient visits.

While the major focus of the literature so far has been on physical activity and weight, some work has also been done with respect to other health outcomes. Broadly, physical inactivity has been linked to a higher risk of death both in general and from particular diseases (Kohl, 2001; Wannamethee et al, 1998 and Oguma et al, 2002). These links appear to be graded (Erikssen, 2001), in the sense that doing ‘a little

more' activity could significantly reduce a person's risk of death. Additionally, the risk of type 2 diabetes has been shown to be lower for the physically active (Helmrich et al, 1991; Manson et al, 1992), with physical activity also being fruitful in disease management (Gregg et al, 2003 and Wei et al, 2000). A number of review studies also point to a correlation between a number of cancers and physical activity (Lee, 2003; Thune and Furberg, 2001 and Shephard and Futhcher 1997). Other health concerns that have been linked to physical activity include osteoporosis (Berard et al, 1997) and musculoskeletal issues (Warburton et al, 2001).

Often neglected in the literature are the psychological benefits from being physically active. Noteworthy in this literature is Gomez-Pinilla (2008) who suggests that sports have a positive effect on mental health. While the amount of exercise that is optimal for improving mental health is still under investigation (Carek et al. 2011), it has been generally accepted that physical activity elevates mood and energises individuals (Stephens 1988; Biddle 2002). Those that engage in high levels of physical activity have been shown to have a better level of overall wellbeing (Biddle and Ekkekakis 2005; Cerin et al. 2009; Edwards et al. 2005). Further, it has been illustrated that an individual can modify their wellbeing by purposefully pursuing activities with this outcome in mind (Lyubomirsky et al. 2005; Sylvester et al. 2012). Additionally, studies to date have provided evidence that higher levels of activity augment mental health. In particular, it has been shown that activity can decrease the symptoms of depression (Teychenne et al. 2008) and anxiety (Ströhle 2009; Carek et al. 2011), as well as the risk of developing mental health problems in the first place (Jonsdottir et al. 2010). Physical activity has also been shown to have benefits for those suffering from high stress levels (Mata et al. 2010; Puterman et al. 2010; Ouellette Kobasa et al. 1985) and severe mental illnesses like bipolar disorder (see Wright et al. 2009 for a review).

To the best of our knowledge there is no work so far that considers the association between physical activity levels and a general measure of self reported physical health. The pathway here is clear given the discussion above- physical inactivity increases the risk of many adverse health events and taken together it is intuitive that there is an impact on general health status. More importantly, unlike most previous work we consider *more than one type* of physical activities. An exception here is

Lordan and Pakrashi (2013) who investigate how different types of activity correlate with weight. In this case, they use clinically measured adiposity (BMI) and central obesity (waist circumference), and consider the same types of physical activity as we do: housework, manual, walking and sports/exercise done to a moderate level of intensity. In particular, the authors find that it is brisk walking that has the most predictive power when it comes to weight. Additionally, they find evidence of an association with sports/exercise; however the associations for manual and housework are not robust.

Returning to our hypothesis, there are a number of reasons why different activities can predict mental health and physical health differently. As discussed in Lordan and Pakrashi (2013), certain activities may simply be better than others in augmenting health. Additionally, as discussed governments generally recommend that a person is active to a certain level of intensity. In Britain this is raising your heart rate and breaking a sweat. This may be easier to achieve with certain activities as opposed to others, however individuals may not be aware of this and believe that they are meeting the recommended targets. Equally, they may misperceive what these specified levels of intensity mean. Additionally, upon the completion of certain activities individuals may feel they can legitimately over-indulge. This is in line with previous studies, which highlight that individuals who walk or exercise more are also more likely to eat (Bovet et al, 2009). Finally, people with better physical or mental health may be more likely to self-select into particular types of activities. This makes it difficult to assess a casual impact, however it will still highlight to the government groups what activity may be doing better in terms of health outcomes. Overall, a finding that certain physical activities are better at augmenting physical and mental health can lead to a policy recommendation that this activity is worth increasing by individuals in society, in an effort to assess if the gains are indeed causal. This is particularly true if participation in certain activities are associated with lower costs for the National Health Services (NHS). Additionally, differences in the associations between a particular physical activity type and our health outcomes suggest that there is scope for education policies surrounding what is the desired level of physical exertion within a certain activity group.

In what follows, the next section describes our data and the main variables in our analysis. This is followed by our methodology, and a section that documents our results. Finally, the paper concludes.

Data:

The annual Health Survey for England (HSE) is a household level survey that combines information collected through a face-to-face interview, self-completion questionnaire and a medical examination undertaken by a trained nurse. The prevalence of physical activity among adults is measured by reports of adult participation in various types of physical activity. The key variables of interest are i) days of 30+ mins of heavy housework (for example it includes moving heavy furniture, walking with heavy shopping, scrubbing floors), ii) days of 30+ mins of heavy manual activities (which includes digging, felling trees, chopping wood and moving heavy loads), iii) days of 30+ mins of walking at a fast or brisk pace and iv) days of sports or exercise for 30+ minutes (swimming, cycling, working out at a gym, dancing, , running/jogging, football/rugby, badminton/tennis, squash and exercises including press-up, sit-ups and back exercises) in the last 4 weeks. Finally, we sum the four physical activity variables putting equal weight on each of the four variables to get the total days active for 30+ minutes in the last 4 weeks. This variable is of particular interest as it captures whether the type of physical activity undertaken really matters for health and mental health outcomes. All the variables considered in this paper aim to capture an individual's participation in activities where they have raised a heart rate and are perspiring.

In particular, of interest to this work are the health surveys for the years 1999, 2002, 2003, 2004, 2006 and 2008 where consistent questions regarding participation in various physical activities were posed. The questions were slightly reframed in 2006 and 2008 but still measure the same extent of physical activities. Additionally, our results are robust to the inclusion or exclusion of these years. Unfortunately, physical activity questions were not considered in 2009 or 2010, which are the most recent surveys available. Still, the benefits from physical activity are unlikely to have changed since 2008. Finally, for the purpose of our analysis we only consider respondents who are aged 16 years and over. Therefore the results here may not be generalizable to children.

We use a subjective report of physical health which is derived from the response of an individual to the following question, 'How is your health in general? Would you say it was very good, good, fair, bad or very bad?' The health variable takes values between 1 and 5, with 5 being the worst possible health. The conclusions of this work are robust to re-casting this variable into a binary outcome representing good/bad health.

Figure 1 illustrates the correlation between general health and the total days being physically active in the last four weeks, separately for males and females. The illustration depicts that those who are active are indeed healthier, with the correlation being remarkably stable across gender. The gains to physical activity are largest in the first two sessions; although gains continue to be reaped, albeit at a diminishing rate, up to about day twelve. This translates into being active three times a week for 30+ minutes.

Mental Health:

For mental health we use the 12-item version of the General Health Questionnaire (GHQ). This is a commonly used self-reported measure of mental health and consists of questions regarding the respondent's emotional and behavioral/psychosocial health over the past few weeks. The GHQ 12 thus captures mental health problems that are current in an individual's life. The 12 items in the GHQ are: ability to concentrate, sleep loss due to worry, perception of role, capability in decision-making, whether constantly under strain, problems in overcoming difficulties, enjoyment of day-to-day activities, ability to face problems, whether unhappy or depressed, loss of confidence, self-worth, and general happiness. For each of the 12 items, the respondent indicates on a four-point scale the extent to which they have been experiencing a particular symptom. For example, the respondent is asked 'have you recently felt constantly under strain?' to which they can respond: not at all, no more than usual, rather more than usual, much more than usual. The GHQ scoring method (0-0-1-1) was chosen over the simple Likert scale of 0-1-2-3, as this method eliminates biases, which might result from respondents tending to choose responses 1 and 4 or 2 and 3, respectively (Goldberg & Williams, 1988). This scoring technique has also been found to be

directly related to the severity of psychiatric illness (Goldberg and Huxley, 1980) and has been proved to be better at predicting depression when compared to other scaling tests (Goldberg, 1985). This is therefore the best form of the GHQ to speak to clinical meaningfulness.

Figure 2 illustrates the correlation between mental health and the total days being physically active by gender. As with physical health, it looks like those those who are active have better mental health. The illustration also highlights that women have poorer mental health scores when compared to men. The gains to mental health do flatten however, suggesting that the largest gains are to be achieved within five sessions in a four-week period.

Health Care Utilization:

Assuming that those who are physically active are also in better health, it follows that they utilise fewer health care services, all else being equal. This implies they should cost the NHS less. To explore this we utilise three questions in the HSE survey. The first asks the respondent if in the last two weeks they have had any visit to a primary care practitioner. The second and third questions ask the respondent to respond if they have been hospitalised as i) an out-patient or ii) an in-patient in the last year. We therefore consider the association between our physical activity measures and these measures of health care utilization. In this case, all three outcomes are binary variables. That is, the responses are yes/no and coded as 1/0. While health and mental health questions were consistently asked during the years 1999, 2002, 2003, 2004, 2006 and 2008, responses on general practitioner and hospital visits were only recorded during the years 1999/2002 and 1999 respectively. Therefore, given the small samples we are working with, we present the results with some caution.

3. Methods

Our objective is to quantify the relationship between a number of measures of physical activity and physical and mental health. To isolate the impact of physical activity we control for other factors that may determine physical and mental health. That is, we estimate:

$$h_{it} = \alpha_j + \beta_1 X_{it} + \gamma P_{it} + \theta S_k + \lambda \tau_t + \varepsilon_{it} \quad (1)$$

where, h_{it} is the health outcome of individual i (from household j) in year t; and ε_{it} is the individual specific error term which is non-systematic and varies across individuals. The parameter of interest in this paper is therefore γ associated with P_{it}, which measures the extent of physical activity of the individual i in year t.

The individual and household level characteristics that we control for in this analysis are age, age squared, gender, household size, household size squared, marital status (married, separated, divorced, widowed, cohabiting and single), body mass index, ethnicity (white, Asian, mixed, black and the other group), area of residence (Northeast, Northwest, Yorkshire, West-Midlands, East-Midlands, East England, London, Southeast, and Southwest), log household income (in thousand pounds in 2005 prices), education (we control from whether a respondent has completed an A level, which implies that they stayed in secondary level education until approximately 18 years, and are likely to have gone on to third level education), region of residence (urban, town/fringe or rural region) and employment status (employed, unemployed, retired and 'other economically inactive'). Finally, we include year (τ_t) and seasonal (S_k) fixed effects.

Equation 1 allows us to estimate the association between our activity measures and health, conditional on our explanatory variables. However, individuals have many characteristics that are difficult to observe. For example, my personality may lend itself to me being a couch potato or equally a dedicated marathon runner. Therefore, we also present a second set of estimates that net out household fixed effects. That is, to the extent that certain unobservable traits are common across households we control for them. These traits include personalities; given the tendency that people choose to marry or cohabit with people like themselves (Wilson, 2002; Nakosteen and Westerlund, and Zimmer, 2005). They also include eating and drinking habits that are common within the household. Additionally, these effects capture in more detail the effect of neighborhoods whose facilities can make it easier or harder to be physically active (for example walkability (Sallis et al, 2009) or incidence of social disorder (Burdette and Hill, 2008). The disadvantage of including these effects is that they

also net out physical activity patterns that are common within the household. This may therefore bias downward the association between physical activity and health outcomes, underestimating the true association. When our control variables vary within the household we retain them in our fixed effects models. Specifically, these are age, age squared, gender, marital status (only really varies when there are three or more adults in the house), body mass index, ethnicity (only varies in mixed ethnicity households), education and employment status. Descriptive statistics for our key variables can be found in Table 1.

Alongside, the results shown above, for robustness we also consider a falsification test. This relies on replacing our dependent variables with other health outcomes that physical activity should not predict. In this respect we consider Type 1 diabetes and eye complaints (which include astigmatism, night blindness, color blindness and squint eyes). The idea is that being physically active should not augment or deteriorate these outcomes (beyond freak accidents in the case of eye complaints). Additionally, it helps us rule out the possibility that the results may be owed to the unhealthy not exercising. Therefore, we should find that the associations are not significant, which gives some comfort to our results not being spurious.

4. Results:

The estimates from our general and mental health regressions are depicted in Table 2. The first two columns are the individual regression results by males and females for our physical health measure. These are estimated by OLS and we control for the variables outlined above. The third column documents the results from the household level fixed effects model. The first point to note is that all of the activities we consider have a positive association with self -reported physical health. That is, they augment an individual's physical health. For example, the results suggest that for every day that 30+ minutes of heavy housework is carried out, general health improves by 0.011 units. To put it another way, completing 10 days of housework at this level results in an improvement of 0.1 units on the 1 to 5 physical health scale.

For physical health, the coefficients for males and females are relatively similar in magnitude across the range of activities, as are the intra gender differences. For women the highest gains to physical health are from incorporating heavy manual

activities into their day for 30 minutes or more. For men, the largest is from carrying out sports/exercise. It is noteworthy however the coefficient on total physical activities is -0.015 for females and -0.016 for males. The difference between these two coefficients and those attached to , manual activities, , and sports/exercise are not statistically significant. Additionally, the fixed effects models are relatively stable when compared to the OLS results. This suggests that selection effects do not drive the predictive power of activities with respect to physical health common within households.

The fourth and fifth columns are the individual regression results by males and females for our mental health outcomes. The sixth column documents the results from the household fixed effects models. For mental health, the intra gender differences are greater both across activities and between genders. It is noteworthy that the association between all activities and mental health is always higher for females. For example, heavy housework augments mental health by 0.019 units for females in comparison to 0.008 units for men. In other words, completing 10 days of heavy housework results in an improvement of 0.2 units for females compared to a 0.08 units for males with respect to their GHQ 12 score. Additionally, the fixed effects models are less stable when compared to those of physical health. For example, the fixed effects coefficient of -0.012 for manual activities suggests that the male and female estimates were upward biased. The activity with the highest payoff with respect to mental health is heavy manual for both males and females. This is followed by sports/exercise.

Overall, the associations for total activities are significant and suggest that mental health is augmented if an individual participates, with higher returns being accrued as the extent of participation increases. Additionally, the associations with respect to total physical activities are stable both intra gender and when household fixed effects are included. Together they suggest that for every 30+ minutes of activity an individual participates in they augment their mental health by 0.02 units.

Turning to Table 3, we find that the associations between total physical activity and health care utilization range between 0.002 and 0.001. Additionally, many of these are not significant. Overall, the results suggest that those who walk brisk/fast utilize less

primary care services, out-patient and in-patient visits. These differences are small but significant. For example, for all three services, participating in brisk/fast walking for 30+ minutes for every day (20 days) in the last four weeks (28 days) suggests approximately a 4%-6% reduction in the probability of using any of these services over the last year. Overall, the correlations suggest that total physical activities lowers the incidence of primary care utilization for males by 4% in the last two weeks. For females, incidence of outpatient visits and inpatient visits are about 4% significantly lower over a one-year period. The marginal effects emanating from the fixed effects models are relatively stable; however they are not significant with respect to outpatient visits.

Finally, Table 4 presents the results from our falsification tests. The idea here is to rule out the possibility of a spurious result emanating from the fact that those with any health issue may be unable to participate in physical activity. In this case we consider Type 1 diabetes and eye complaints, under the assumption that having either of these health concerns is not a direct result of a lack of physical activity. As expected the correlations in all cases are zero.

Conclusions:

We have estimated the association between various types of physical activities, physical health and mental health. Specifically, we considered participation in housework, manual, walking, sports/exercise and total physical activities for 30+ minutes over the last four weeks and its ability to predict physical and mental health. We view this as an important contribution given that governments usually recommend a total level of activity that their citizens should achieve to be healthy, rather than a particular activity per se.

Encouragingly, with respect to physical health, our results suggest that participation in any of the activities considered here predicts a lower probability of poor health roughly to the same level. In other words, those who do 30+ minutes of sports/exercise daily have similar gains when compared to those that do 30+ minutes of heavy manual activities daily. Of course, a limitation here is that our measure of physical health is subjectively reported and it may be that individuals with a certain level of activity consistently report a certain level of health. Therefore, future research

could repeat our analysis using objective measures of individual health as outcomes. As discussed, Lordan and Pakrashi (2013) find differences in the predictive power of the activities considered here when it comes to BMI and waist circumference. In particular, the authors find that those who brisk walk are most likely to have a healthy weight. They do not find consistent results for heavy manual or housework, however the results do imply that sports/exercise and total activities can predict the likelihood of a person being overweight or obese.

For mental health, our estimates highlight that those who participate in (and do more of) *any* activity have better mental health as measured by the GHQ score than those who do not. Interestingly, the associations are always higher for women. If we tentatively take this as casual, the results imply that females have more to gain with respect to mental health from being active. This warrants further investigation. The associations for mental health also vary to a larger degree than those of physical health. In particular, the association is largest for both males and females engaged in heavy manual activities, with sports/exercise having the second largest association. We cannot disentangle whether these differences are owed to individuals who currently carry out sports/exercise and manual work simply having higher mental health to begin with or whether this is a casual effect, however the fixed effects results give some weight to the fact that a direct effect is indeed there. If this is the case, it may be that those engaging in housework and brisk walking (with the lowest association) could benefit from substituting to the other two activities when it comes to mental health, however data that allows a more causal analysis is required before this recommendation is made. Additionally, we do not find any real difference in terms of mental health, and given that Lordan and Pakrashi (2013) indicate that brisk walking and sports/exercise do most of the 'heavy lifting' in terms of explanatory power for weight, we are more inclined to lean towards sports/exercise if any recommendation is to be made.

Our resource utilization analysis is limited by the couple of years of data we have available, however the analysis reveals some lower utilization of in-patient, outpatient visits and GP services. This may infer a knock on effect from poorer mental health and physical health, and higher costs for the NHS. Interestingly, it is those who walk for fitness that have the largest and most significant association. This may be linked to

the lower association that brisk walking has with both BMI and waist circumference (Lordan and Pakrashi, 2013). Of course, this study has the advantage that their outcomes are based on nurse gathered weight and height. Our data on mental health is self-reported. Therefore, going forward the association between clinically diagnosed depression and physical activity is worth exploring. In addition, our work relies on data from a retrospective observational study. Hence, we cannot eliminate that reverse causality is driving our results. Therefore future work could consider panel data, or indeed an instrumental variable approach to be certain of a causal result.

Overall, our work suggests that individuals who do any of the activities considered here have better physical and mental health. Of course, it is worth remembering that all our physical activity measures suggest a level of exertion whereby a person's heart rate is up and they are sweating. Therefore, gains may be lower or none at all for lower levels of exertion. In general, when it comes to being active national governments normally recommend to their citizens a total number of minutes, a level of exertion but not an activity type. Our work suggests that while this will not make much of a difference to physical health outcomes, it may matter for mental health outcomes.

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Table 1: Summary Statistics

Variables of Interest	No of Observations	Mean Value	St Dev.	Min	Max
Health Outcome Variables					
Self Assessed General Health	59797	2.002	0.925	1	5
Mental Health GHQ Score	55914	1.391	2.570	0	12
Visited GP in last 2 weeks	11400	0.140	0.347	0	1
Hospitalized as Outpatient in last year	7789	0.321	0.467	0	1
Hospitalized as Inpatient in last year	7789	0.096	0.295	0	1
Physical Activity Variables					
Days of 30+ min Heavy Housework	59806	2.505	4.900	0	28
Days of 30+min Heavy Manual	59806	1.017	3.330	0	28
Days of 30+ min brisk or fast walking	59806	3.734	7.901	0	28
Days of 30+ min sports/exercise activities	59806	3.476	6.596	0	28
Days of 30+ min total physical activities	59806	9.512	10.097	0	28

Table 2: Estimates for general and mental health

	General Health			Mental Health		
	Male	Female	Fixed Effects	Male	Female	Fixed Effects
Heavy housework	-0.011***	-0.011***	-0.017***	-0.008*	-0.019***	-0.030***
	(0.002)	(0.001)	(0.001)	(0.005)	(0.003)	(0.004)
Heavy manual activities	-0.013***	-0.019***	-0.011***	-0.020***	-0.029***	-0.012**
	(0.001)	(0.002)	(0.002)	(0.003)	(0.007)	(0.005)
Brisk or fast walking	-0.011***	-0.012***	-0.010***	-0.012***	-0.013***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
Sports/exercise	-0.017***	-0.017***	-0.013***	-0.017***	-0.024***	-0.015***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)
Total physical activities	-0.016***	-0.015***	-0.015***	-0.017***	-0.021***	-0.021***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)

Note: All activity measures relate to days active for 30+ minutes or more in the last 4 weeks. We report the regression coefficients for the physical activity variables only. *, ** and *** denote significance at .10, .05 and .01 levels, with clustered standard errors in parentheses. The following controls are included: age, adjusted age squared, gender, household size, household size squared, body mass index, marital status (single, married, separated, divorced, widowed, and cohabitees), ethnic group (white, mixed, asian, black and others), individual has Alevel, economic status (employed, unemployed, retired, economically inactive), area of residence, region of residence, log real income (in thousand pounds in 2005 prices), year and seasonal fixed effects.

Table 3: Estimates for health resource utilization

	Primary Care			Outpatient visits			Inpatient visits		
	Male	Female	Fixed Effects	Male	Female	Fixed Effects	Male	Female	Fixed Effects
Heavy Housework	0.001	0.000	-0.001	-0.003	-0.003	-0.006***	-0.002	-0.000	-0.003*
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
Heavy Manual	-0.001	-0.008***	-0.003	0.003	-0.000	0.003	-0.001	-0.002	-0.001
	(0.001)	(0.003)	(0.002)	(0.002)	(0.005)	(0.003)	(0.001)	(0.003)	(0.002)
Brisk or Fast Walking	-0.002**	-0.003***	-0.003**	-0.003***	-0.002*	-0.002*	-0.002***	-0.002***	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Sports/Exercise	-0.002***	-0.001	-0.002*	-0.000	-0.002	0.001	0.000	-0.004***	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Total physical activities	-0.002***	-0.001	-0.002**	-0.001	-0.002**	-0.002	-0.001	-0.002***	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)

Note: All activity measures relate to days active for 30+ minutes or more in the last 4 weeks. We report the regression coefficients for the physical activity variables only. *, ** and *** denote significance at .10, .05 and .01 levels, with clustered standard errors in parentheses. The following controls are included: age, adjusted age squared, gender, household size, household size squared, body mass index, marital status (single, married, separated, divorced, widowed, and cohabitees), ethnic group (white, mixed, asian, black and others), individual has Alevel, economic status (employed, unemployed, retired, economically inactive), area of residence, region of residence, log real income (in thousand pounds in 2005 prices), year and seasonal fixed effects.

Table 4: Estimates for falsification tests

	OLS Regressions		Fixed Effect Regressions	
	Diabetes Type I	Eye Complaints	Diabetes Type I	Eye Complaints
Heavy housework	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Heavy manual activities	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Brisk or fast walking	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Sports/exercise	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Total physical activities	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)

Note: All activity measures relate to days active for 30+ minutes or more in the last 4 weeks. We report the regression coefficients for the physical activity variables only. *, ** and *** denote significance at .10, .05 and .01 levels, with clustered standard errors in parentheses. The following controls are included: age, adjusted age squared, gender, household size, household size squared, body mass index, marital status (single, married, separated, divorced, widowed, and cohabitees), ethnic group (white, mixed, asian, black and others), individual has Alevel, economic status (employed, unemployed, retired, economically inactive), area of residence, region of residence, log real income (in thousand pounds in 2005 prices), year and seasonal fixed effects.

Figure 1: General Health by total days of physical activities and gender

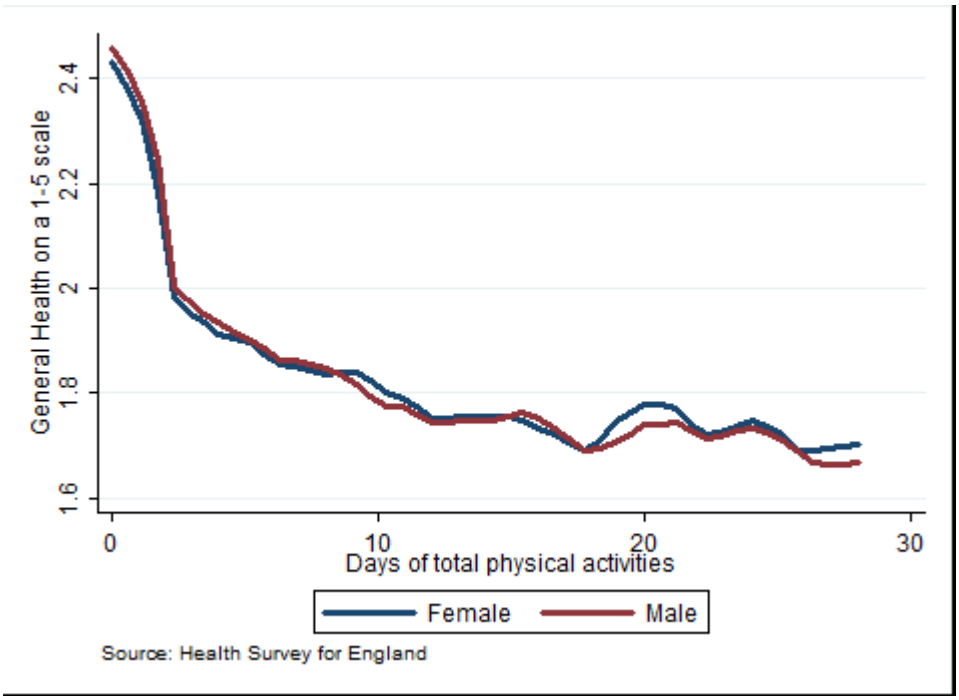

Figure 2: Mental Health by total days of physical activities and gender