

Family structure and physical activity: a life-course analysis

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Abstract

Over the life course physical activity fluctuates and decreases in midlife and early old age. We seek to understand this trend studying how life course events affect the level of physical activity focusing on family structure. We hypothesise that one of the reasons why engagement in physical activity declines is related to time availability and time management. Changes in family structure can reduce the time that individuals have for themselves, and therefore engage in physical activity. We use data from the National Children Development Study to investigate whether changes in marital and parental status, as well as looking after own parents influence changes in level of physical activity using a fixed effects model, controlling for a number of time-varying variables, including health. Results show that prevalence of physical activity fluctuates from early to late adulthood and is lowest at the latest observation time point (age 55). Family structure was weakly associated with physical activity, with those married/cohabiting or looking after their parents being more likely inactive.

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Introduction

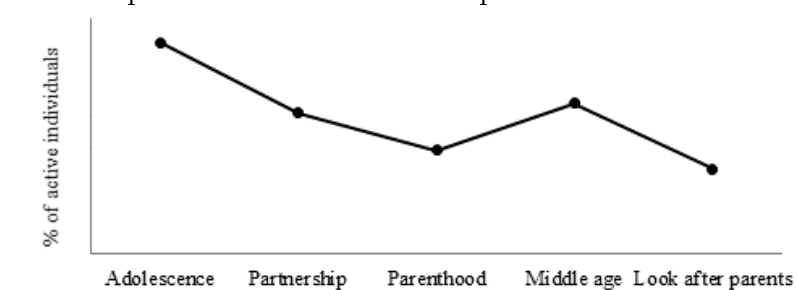
It is well known that regular physical activity (PA) contributes to the primary and secondary prevention of several chronic diseases and is associated with a reduced risk of premature death [1]. A bidirectional relationship between activity and depressive symptoms has also been found, being more persistent during adult life and going in the direction from activity to depressive symptoms [2]. Despite the beneficial effects of PA are widely known, a large proportion of population does not meet PA recommendations, for example in England in 2016, only 66 percent of men and 58 percent of women aged 19 and over met the recommended PA levels [3]. The same report shows that the proportion meeting the activity guidelines among both sexes generally fell with age, and, conversely, the proportion of individuals classed as inactive increased with age. This phenomenon has already been reported in literature [4–6].

Understanding why PA level changes across the life course may provide useful insight for the targeting of population based interventions to promote PA and sport practice. Most of research on changes in PA in adulthood has focused on life transitions between adolescence and early adulthood, while events occurring in mid and late adulthood remain almost unexplored.

A previous systematic review on life-changing events and participation in PA identified five broad life-change categories: change in employment status, in residence, in physical status, in intimate relationships and change in parental status [7]. In this study, we focus on how events related to family structure and relationships affect PA over the life course.

Results from previous research present inconsistent associations between marital status and physical activity levels. Most cross-sectional studies have shown a negative association between PA and being married or cohabiting [8–11]. Prospective studies are fewer, and have produced conflicting evidence. Findings produced using the Australian Longitudinal Study of Women’s Health (ALSWH) suggested a higher risk of inactivity among married women, compared with those who remained single [12–14]; a Swedish study found men cohabiting exposed to a higher risk of being physically inactive in adulthood compared to those being single [15]. Ortega et al. [16] used the Aerobics Center Longitudinal Study (ACLS) which tracked changes in fitness in almost 9,000 men and women between 1987 and 2005 in Texas, and found that the transition to being married was associated with a modest reduction in PA, while divorce was associated with a modest increase in fitness levels in men. Compared to marriage, research on the association between parenthood and PA has found a clearer relationship between having children and/or becoming a parent and PA. Existing research has largely focused on mothers, and relied heavily on cross-sectional designs and self-report measures. The majority of studies found that childbearing was associated with decreased PA, and parents with dependent children are more inactive than non-parents [12–15, 17]. The present study contributes to literature and introduces a novel key element considering multiple events related to family structure occurring from early to mid-late adulthood, assessing their association with PA from age 33 to age 55, therefore considering a follow up of 22 years, to the best of our knowledge, one of the longest available. Previous prospective studies have considered various lengths of the adult lifespan, but not an equally long follow up, for example King et al. [18] focused on participants aged 25 to 75 years old,

Figure 1: Example of life transitions and prevalence of active individuals



while Brown and Trost [14] and Bell and Lee [8] examined a sample of 18 to 23 year olds. All studies have interpreted family structure only in terms of marital and parental status. The other element of novelty is that we introduce another event likely to occur in mid-late adulthood, that is looking after own parents or in-laws when they get older and become less independent, extending the concept of family structure by considering both upward and downwards bonds.

We hypothesise that one of the reasons why people may not engage or reduce their engagement in PA has to do with time availability and time management. Being in a relationship can change individual time allocation, perhaps by spending more time with the partner rather than exercising. Having and raising children may limit the time a parent has for his/herself, and therefore the hours that can be spent doing PA. When children grown up and become more independent, often parents can allocate the time that they used to spend for child care for themselves. When individuals reach mid-late adulthood, often their parents begin to get older and be less autonomous, and therefore individuals' time allocation to leisure time PA is likely to change and reduce. The graph below illustrates a hypothetical trend in PA in correspondence to life-course events related to family structure, according to the time availability hypothesis. A similar representation of changes in PA was hypothesised by Ortega et al. [16] and tested in relation to transitions in marital status.

Material and methods

Data

We use data from the National Children Development Study (NCDS – 1958 British birth cohort). NCDS follows the lives of an initial 17,415 people who were born in England, Scotland and Wales in a single week of March 1958. From its original focus on the circumstances and outcomes of birth, the 1958 study has broadened in scope and covers many aspects of the health, educational, and social development of cohort members as they passed through childhood and adolescence and reach adult age. Participants have been followed-up by parental interview and examination at ages 7, 11, and 16 years and by cohort member interview at 23, 33, 42, 46, 50 and 55 years. At 44–45 years, the first biomedical assessment in adulthood was conducted by a research nurse visiting the home. An exhaustive description

of NCDS is available elsewhere [19].

Our analytic sample included all NCDS participants still alive at age 55 (n deaths= 1,659) and who have not migrated (n emigrants= 1,2086), corresponding to 15,613 observations. Analysis was based on data collected at ages 33, 42, 50 and 55.

Outcome

Physical activity

PA measures were harmonised to be comparable across NCDS sweeps. At ages 33, 42, 50 and 55 respondents were asked whether they do any regular exercise and if so how often they take part in any exercise activity. Those engaging in physical activities at least once a week were considered active. The choice of selecting “at least once a week” as a cut-off point was mostly depending on data availability and comparability across sweeps. NHS guidelines for adults aged 19-64 suggest 150 minutes of moderate activity per week, but our data do not allow to capture specific frequency and intensity. As a sensitivity analysis we used an alternative cut-off point to dichotomize physical activity corresponding to two times per week, and we also treated PA as continuous.

Exposure

Family structure

Family structure is the exposure of interest and represents a composite structure comprising three co-existing components, likely to occur at different stages of the life-course. (a) Marital status: classified into three categories distinguishing those single and never being married, married or re-married or cohabiting, and separated/divorced or widowed. (b) Number of children: we considered all natural, adoptive and step children that respondents reported to have and distinguished between children living in household or outside the household. We believe it is important to make this distinction for two reasons. First, given our hypothesis on time allocation and its effect of PA, living with children or not can have different implications on individual’s time allocation. Second, in a longitudinal study, the relationship with children changes over time, and living with children or not can capture the different stages of this relationship. (c) Helping own parents and in-laws: parental care was measured using two indicators. At ages 50 and 55, respondents were asked about how many hours per week they spent helping their parents or partner’s parents and whether they provided their help in specific activities, such as giving them lifts in their car, shopping for them, ironing or cleaning, doing house repairs etc. Both variables took a value of 0 if individuals did not look after parents or in-laws and in case their parents or in-laws were not alive anymore.

Confounders

When studying the relationship between PA and family structure, we controlled for a number of time-varying factors likely to affect both. We considered respondent’s mental and physical health, measured respectively as self-reported psychological distress expressed through a 9-point Malaise scale, and self-reported longstanding illness or disability

measured by a yes/no question on whether respondent has any longstanding illness or disability. We also controlled for the age of the children living in the household and outside the household, as the amount of time a parent spent to look after his/her children is likely to change depending on children’s age. Finally, we included as confounders also current smoking status, body mass index (BMI), socioeconomic status, classified according to the 1990 Standard Occupational Classification and family net income on a log scale. When studying the relationship between PA and parental care, we considered the same set of confounders and also adjusted for marital status and number of children in and outside household.

Analytic Methods

The association between PA and family structure was studied in two separate models, first for marital status and number of children, then for parental care. In the first case, we have four time points from age 33 to age 55, in the second case we only considered age 50 and age 55. In both analyses, we used a fixed effects linear probability model. Fixed-effects models used within-person variation over multiple periods of time for the estimation. Specifically, participation in physical activity at the current interview (t) was compared to the average physical activity of the person over multiple waves to identify the effect of independent variables on changes in physical activity [20]. As a sensitivity analysis, we use OLS for the pooled sample controlling for time of interview and additional time invariant confounders.

Missing Data

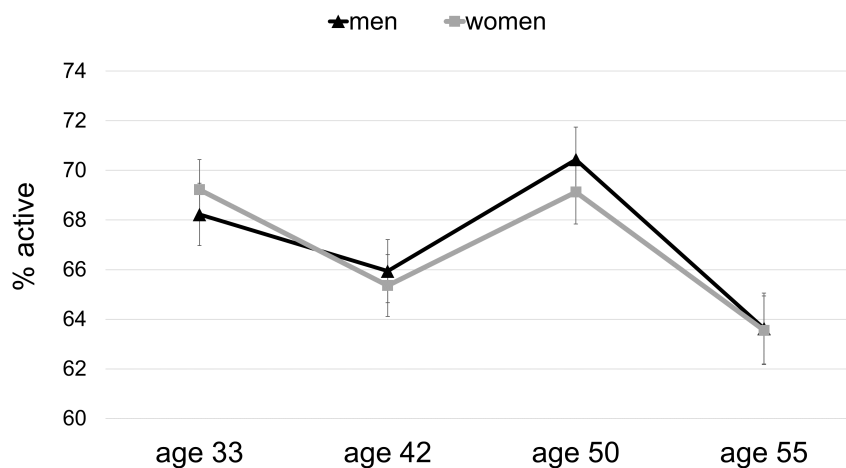
As every longitudinal study, NCDS is subject to loss at follow up resulting in individual non-response as well as item non-response. To address the problems descending from incomplete or missing data of having a smaller sample, incomplete histories, and lower statistical power, and consequent biased [21], we impute our sample to its original size. We employed multiple imputations with chained equations assuming missingness at random (MAR). To maximize the plausibility of MAR, we include in the model the most important predictors of missingness as well as baseline variables with complete records and likely to affect the outcomes. Descriptive statistics presented in the next session are based on complete case analysis, while analytical results on multiple imputation (linear probability fixed effects model from complete case analysis is reported in the appendix).

Results

Descriptive results

In Table 1 and Figure 2, we present descriptive statistics of family structure components and PA from age 33 to 55 years. Percentages of active respondents fluctuate over time in agreement with the hypothesised trend presented in figure 1. The dynamic of marital status from age 33 to age 55 sees the proportion of single/never married individuals decreasing over time and proportions of divorced/separated or widowed increasing. Mean number of children in household increases from age 33 to 42 and then drops, while mean number of children living outside household increases continuously as participants get older. Both PA

Figure 2: Trends in PA from age 33 to age 55, by sex



and family structure characteristics are similar between men and women. Finally, from age 50 to 55, we observe an increase in parental care, with more hours spent to look after own parents and partner’s parents, especially for women, and higher proportions of participants reporting engagement in activities to help their parents, especially among men.

Table 1: Descriptive statistics of family structure, from age 33 to 55 years by sex

	Age 33		Age 42		Age 50		Age 55	
	Men	Women	Men	Women	Men	Women	Men	Women
Marital status (N ^a)	5,236	5,524	5,357	5,605	4,757	4,914	4,431	4,702
% single	15.4	10.2	10	7.4	8.4	6.1	7.7	5.9
% married/remarried	79	81	80.9	80.1	80.5	78.3	83.3	78.8
& sep/divorced/widowed	5.7	8.8	9.1	12.6	11.1	15.6	9	15.3
Children in HH (N ^a)	5,341	5,610	5,388	5,630	4,758	4,916	4,428	4,702
% at least 1 child in HH	61.5	75.3	70.4	80.1	59	59.7	46	43.3
mean N children in HH	1.2 (1.16)	1.6 (1.17)	1.5 (1.21)	1.7 (1.13)	1.1 (1.09)	1.0 (1)	0.7 (0.93)	0.6 (0.83)
Children out HH (N ^a)	5,341	5,610	5,388	5,630	4,758	4,916	4,416	4,695
% at least 1 child out HH	9	2	11.9	18.1	51.1	56.4	67.6	72.8
mean N children out HH	0.2 (0.53)	0.03 (0.22)	0.2 (0.57)	0.3 (0.59)	1.0 (1.2)	1.0 (1.13)	1.4 (1.31)	1.5 (1.28)
Help to parents/in-laws (N ^a)					4,052	4,057	4,421	4,698
Any activity					38.1	28.4	54.4	46.7
Hours per week (N ^a)					3,213	3,348	3,787	4,067
					2.3 (5.35)	3.0 (6.58)	2.8 (5.83)	3.3 (7.48)

^a Numbers and proportions come from selected sample with complete records for each specific variable. Standard error in brackets ()

Analytical results

In Table 2 we present results from the linear probability fixed effect model for marital and parental status. The first set of results pertains to the whole sample, pooling men and women. Those married/cohabiting were found to be 6.6 percent less likely to exercise regularly compared to single never married, and those divorced, separated or widowed 4 percent

less likely (significance at 10 percent). The number of children in household was also associated with lower probability of being active, although the magnitude of the association was smaller compared to marital status, for each extra child living in household the likelihood of being active declined by 2.4 percent. Health conditions and health related behaviour (smoking) were strongly associated with PA, in the expected directions, i.e. having long-lasting illness and psychological distress decrease the probability of being active, with the effect being largest for smoking. Looking at the analysis done separately for men and women, the results are substantially similar. We found that the negative effect of being married was larger among men than women (0.07 (95% CI -0.117; -0.027) compared to 0.06 (96% CI -0.111; -0.009)) and being divorced, separated or widowed had a negative effect only in women, while the number of children living in household were were associated with lower level of PA slightly more strongly among men than women (-0.026 with 95% CI -0.044; -0.008, and -0.02 with 95% CI -0.039; -0.001).

In Table 3 we report the results of the association between helping parents and in-laws on PA. The main finding is a general lack of association between any of the variables included in the model. Although considerable changes in prevalence of active participants and increase in proportions of respondents reporting they looked after their parents or in-laws emerged from the descriptive statistics, this does not seem to have an association based on our multi-adjusted fixed effect model.

Discussion

The aim of this study was to examine changes in PA during adulthood from age 33 to age 55 and explore the association that events related to changes in family structure and responsibilities have on activity levels.

The initial descriptive results illustrated a fluctuating trend of the proportion of active participants, ranging from 63 to 70 percent, with highest percentages observed at ages 33 and 50 and lowest at age 55. Trends were similar between men and women. Proportions of active participants observed at ages 33 and 42 are in line with data collected in England in the Active Lives Survey for the period 2015-16, while percentages at later ages are higher in NCDS. The trend observed in NCDS data corresponded to our hypothesised trend. Our findings indicate that being married or cohabiting reduces the chance of being active by around 6.5 percent, both for men and women. This is in line with most of literature [8–10, 12, 16]. It is also in agreement with the hypothesis of change in time availability and preference in time allocation, such that the social and domestic responsibilities of marriage and cohabitation decrease the available time for PA. Another mechanism, potentially concurring in the same or opposite direction, is the effect of partner’s habits on own habits [18, 22]. We could not explore this path because respondents were not asked questions on the engagement in PA of their partner.

While in agreement with the time allocation hypothesis as well as some of existing literature, the finding of lower PA level among respondents in a stable partnership seems discordant with the widely accepted evidence that marital status is positively associated with individuals’ health [23–25]. To understand and interpret this counterintuitive result, we looked

Table 2: Fixed effect model for the association between marital and parental status with physical activity, from age 33 to 55

	Men & Women	Men	Women
Married	-0.0664*** (-0.103 - -0.030)	-0.0718*** (-0.117 - -0.027)	-0.0596** (-0.111 - -0.009)
Sep/divorced/widowed	-0.0406* (-0.081 - 0.0002)	-0.0268 (-0.080 - 0.026)	-0.0505* (-0.102 - 0.001)
N children in HH	-0.0235*** (-0.038 - -0.009)	-0.026*** (-0.044 - -0.008)	-0.020** (-0.039 - -0.001)
Age oldest child in HH	0.00212 (-0.0004 - 0.005)	0.00304* (-0.0006 - 0.007)	0.00134 (-0.002 - 0.005)
Age youngest child in HH	-0.00375** (-0.007 - -0.0002)	-0.00430* (-0.009 - 0.0002)	-0.00327 (-0.008 - 0.001)
N children outside HH	-0.00923 (-0.036 - 0.017)	-0.014 (-0.043 - 0.015)	-0.00381 (-0.034 - 0.026)
Age oldest child outside HH	-0.00133 (-0.009 - 0.007)	-0.00115 (-0.010 - 0.007)	-0.00138 (-0.010 - 0.008)
Age youngest child out HH	0.00194 (-0.007 - 0.011)	0.000963 (-0.008 - 0.010)	0.00303 (-0.007 - 0.013)
Having illness/disability	-0.0310*** (-0.044 - -0.018)	-0.0315*** (-0.049 - -0.014)	-0.0304*** (-0.049 - -0.012)
Malaise	-0.0326*** (-0.051 - -0.0141)	-0.0305** (-0.058 - -0.003)	-0.0338*** (-0.057 - -0.011)
BMI	-0.00734*** (-0.010 - -0.005)	-0.00725*** (-0.010 - -0.004)	-0.00750*** (-0.010 - -0.005)
Being a smoker	-0.0759*** (-0.097 - -0.055)	-0.0744*** (-0.105 - -0.044)	-0.0770*** (-0.103 - -0.051)
Income (log)	0.0006 (-0.006 - 0.007)	0.00334 (-0.005 - 0.012)	-0.00268 (-0.01 - 0.006)
Social class (cont)	0.00206*** (0.0009 - 0.003)	0.00210** (0.0005 - 0.004)	0.00190** (0.0004 - 0.003)
Age 42	0.041 (-0.018 - 0.100)	0.0476 (-0.022 - 0.117)	0.0287 (-0.039 - 0.097)
Age 50	0.0969** (0.003 - 0.191)	0.107** (0.003 - 0.211)	0.0799 (-0.026 - 0.186)
Age 55	0.0389 (-0.082 - 0.160)	0.0509 (-0.083 - 0.185)	0.0185 (-0.115 - 0.152)
Observations	62452	31684	30768
Number of id	15613	7921	7692

*** p<0.01, ** p<0.05, * p<0.1; 95% confidence interval in brackets ()

Table 3: Fixed effect model for the association between PA and helping parents and in-laws, from age 50 to 55

	Men & Women	Men	Women
Hours helping parents/in-laws	-0.00162* (-0.004 - 0.0002)	-0.00282* (-0.006 - 4.30e-05)	-0.000769 (-0.004 - 0.002)
Married	0.0103 (-0.116 - 0.137)	-0.0253 (-0.187 - 0.137)	0.0751 (-0.158 - 0.308)
Sep/divorced/widowed	0.0209 (-0.111 - 0.153)	-0.0437 (-0.215 - 0.128)	0.109 (-0.133 - 0.351)
N children in HH	-0.00872 (-0.037 - 0.019)	-0.0370* (-0.081 - 0.007)	0.0111 (-0.028 - 0.050)
N children outside HH	-0.012 (-0.036 - 0.012)	-0.0497** (-0.090 - -0.009)	0.0173 (-0.017 - 0.052)
Having illness/disability	-0.0252** (-0.049 - -0.0018)	-0.013 (-0.046 - 0.020)	-0.0364** (-0.070 - -0.003)
Malaise	-0.00756 (-0.039 - 0.024)	-0.0291 (-0.077 - 0.019)	0.00753 (-0.035 - 0.050)
Being a smoker	-0.0566** (-0.107 - -0.006)	-0.0359 (-0.111 - 0.039)	-0.0801** (-0.152 - -0.008)
BMI	-0.00524*** (-0.009 - -0.001)	-0.00412** (-0.008 - -3.89e-05)	-0.00698** (-0.013 - -0.001)
Income (log)	-0.01000** (-0.020 - -0.0001)	0.000184 (-0.014 - 0.014)	-0.0203*** (-0.03 - -0.007)
Age 55	-0.0733*** (-0.090 - -0.057)	-0.0642*** (-0.088 - -0.041)	-0.0807*** (-0.104 - -0.057)
Observations	16,630	8,310	8,320
Number of id	9,771	4,875	4,896

*** p<0.01, ** p<0.05, * p<0.1; 95% confidence interval in brackets ()

at the association between marital status, BMI and smoking (results not shown). In both cases, we found no difference between single and married participants, but those married were less likely to smoke and having higher BMI compared to those divorced/separated and widowed individuals. This would suggest that the benefit that being in a stable partnership has on health may act through mechanisms different from physical activity. For example social support in sharing stressful events, adopting healthier behaviours in terms of smoking habits, as well as health seeking behavior.

The influence of parenthood was studied distinguishing children living in and outside the household, which has never being explored before. The rationale behind this distinction came from the time management hypothesis. Young children living in household may require parental supervision and therefore change parents' time allocation. Children not living with the parent may require different supervision, often not on a daily basis. At older ages, the implication and meaning of a child living in or outside the household are substantially different, and for this reason we considered two models, including and not including age of the oldest child in and outside household. We found that the higher the number of children living in household the lower the probability of being active, but this was true only for men, not in women, and the magnitude of the association was quite small.

Finally, we considered the life-course event of helping parents and in-laws on PA. In this case, we only considered late adulthood, from age 50 to age 55. We found that helping parents and in-laws did not change physical activity levels in adults. In the analysis constrained to two observation points only, no components of family structure were found to be associated with PA. It will be therefore crucial to extend the analysis to older ages when the data will become available to understand whether the lack of association is partly due to the few year observation window in the analysis or it only means that changes in the provision of help to parents has a small or null effect in late adulthood.

In conclusion, results of this work suggest that some events related to family structure occurring in adulthood are likely to be associated with physical activity. Over the life course individuals experience a number of events that are fundamental for their wellbeing and fulfillment; being married as well as having children are known to be related to greater happiness and subjective wellbeing [26]. Nevertheless they appear to have a negative association with the level of activity in adulthood. Previous studies [27] have shown that early engagement in sport activities in youth is very important for maintenance of physical activeness in adult life. Stressing the importance of running active life since very early ages and involving parents in this process would help individuals to maintaining their activity level over the life-course and deal with life transitions without them being detrimental to PA. Encouraging parents to take part in outdoor activities with their children would represent an effective intervention beneficial to both parts, and potentially having positive effect in the immediate and longer term.

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