Research Report

Title: Life-course partnership history and midlife health behaviours in a population-based birth cohort.

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ABSTRACT

Background: Marital and partnership history is strongly associated with health in mid and later life. However the role of health behaviours as an explanatory mechanism remains unclear. The aim of this study was to investigate prospective associations between life-course partnership trajectories (taking into account timing, non-marital cohabitation, remarriage and marital transitions) and health behaviours measured in midlife.

Methods: We analysed data from the British National Child Development Study (NCDS), a prospective cohort study which includes all people born in one week of March 1958 (N=10226). This study included men and women with prospective data on partnership history from age 23 to 42-44 and health behaviours collected at ages 42-46 (2000-2004). Latent class analysis was used to derive longitudinal trajectories of partnership history. We used multivariable regression models to estimate the association between midlife health behaviours and partnership trajectory, adjusting for various early and young adult characteristics.

Results: After adjustment for a range of potential selection factors in childhood and early adulthood, we found that problem drinking, heavy drinking and smoking were more common in men and women who experienced divorce or who had never married or cohabited. Women who married later had a lower prevalence of smoking and were less likely to be overweight than those who married earlier. Overall marriage was associated with a higher body mass index. Individuals who never married or cohabited spent less time exercising.

Conclusion: Some aspects of partnership history, such as remaining unpartnered and experiencing divorce are associated with more smoking and drinking in midlife, whereas marriage is associated with midlife weight gain. Despite these offsetting influences, differences in health behaviours probably account for much of the association between partnership trajectories and health found in previous studies.

What is already known about the subject?

In many settings being married is associated with better long-term health outcomes than being formerly married or never married. A consideration of life-course partnership history (rather than just current marital status) is important. The extent to which health behaviours are patterned by partnership biography, and their role as an explanatory mechanism in the association with health status remains unclear.

What this study adds

Longitudinal partnership trajectories (particularly experience of divorce, cohabitation and being never partnered) are associated with a range of unhealthy behaviours in mid-life. Differences in health behaviours probably account for much of the association between partnership trajectories and health. Attempts to prevent or modify harmful health behaviours should take account of social factors such as partnership.

INTRODUCTION

Many studies conducted in different countries and time periods have found that being married is associated with better long-term health outcomes and lower mortality than being unmarried or formerly married[1-4]. Typically studies consider current marital status but a measure of longitudinal marital history/biography, which takes into account union timing, multiple transitions and non-marital unions, is important for understanding the development of poor health over the life-course [5-9]. Health disparities according to partnership are commonly attributed to a combination of health selection, health protection and crisis-induced factors [10-12], but the precise mechanisms linking partnership and health are not well understood. Studies of cause-specific mortality patterns or specific health conditions have provided clues to disease aetiology [13, 14], showing that the unmarried are more likely to die of external causes, neoplasms and circulatory disease. A recent study using the 1958 British Birth Cohort found that those who had never cohabited or married had worse measures of inflammatory and haemostatic markers, higher prevalence of metabolic syndrome and lower respiratory function [9].

The extent to which health behaviours might explain these differences in disease risk has been investigated in previous studies but results have been inconclusive. Studies show that the unmarried have less favourable risk profiles[13], and marital transitions precipitate changes in drinking, smoking and diet [15-17]. However, partnership may have potentially offsetting influences on different health behaviours. For example, those in married or cohabiting relationships tend to have healthier behaviours in terms of smoking, harmful alcohol use, and exercise [18, 19], but married individuals are more likely to be overweight or obese [16, 17]. Moreover, aspects of health such as weight gain and smoking are correlated within spouses [20] suggesting the beneficial effects of relationships are conditional on individual traits and patterns of assortative mating. In addition, associations may be moderated by gender or age [4, 21, 22]. Sedentary behaviour is commonly found to be a risk factor for poor health independent of physical activity, however the association with partnership is inconsistent [23].

In this study we explore how health behaviours vary between individuals with different life-course partnership histories. We build on previous research which summarised marital/cohabitation status over a 21-year period to investigate associations with health biomarkers in midlife [9]. In this study our aim is to investigate the associations between life-

course partnership trajectories and a wide range of self-reported and objectively measured health behaviours at ages 42-46.

METHODS

Data

Data come from the British National Child Development Study (NCDS), a birth cohort study that comprises all people born in Britain during a single week in March 1958. The 18,558 cohort members initially enrolled have been followed up regularly from birth into middle age[24]. To derive partnership status trajectories we used four sweeps of the NCDS, 1981 (N= 12,537), 1991 (N= 11,469), 2000 (N = 11,419) and 2002-4 (N = 8018), when study members were aged 23, 33, 42 and 44-46 years respectively. To control for possible selection into partnership trajectories, we used data from earlier sweeps conducted between 1958 and 1981 (when cohort members were aged 0-23 years). The analytic sample included participants with at least 3 valid responses on cohabitation and marriage indicators and complete information on the background confounders (5256 women and 4970 men). The NCDS (1958 birth cohort) has ethical approval from various bodies in the UK for all the available data sweeps that were used in this study.

Measures

Partnership status

We used binary indicators representing whether a participant was married or living with a non-marital partner at each measurement wave. Each of the four measurement waves is thus represented by two indicators (one for marital status and one for cohabitation). We infer divorce/separation from an individual reporting being married at one point in time and not married at the next. Those who become widowed are also included in this group, however these were very few (68 participants at age 44 reported their status as widowed, <1% of the analytical sample). We also included in the model information on whether participants had been remarried by age 44 (see Appendix Table 1).

Health behaviours in midlife

Alcohol use and physical activity were self-reported and weight, height and waist-hip ratio were measured by a nurse at ages 44-46 (2002-04 sweep). Smoking was self-reported at ages 33 and 42 (1991 and 2000 sweep). We used two indicators of harmful alcohol use: the Alcohol Use Disorders Identification Test (AUDIT) [25], in which the recommended cut-off of 8 identifies problem drinking, and an ordinal measure of frequency of heavy episodic drinking (HED) with categories never, less than monthly, monthly or weekly. HED was defined as consuming 6 or more standard drinks on one occasion. Smoking was classified into never smoked, ex or occasional smoker, and current smoker. We also used a variable indicating the total years of regular smoking from ages 23 to follow-up at age 42.

Physical activity was measured using a modified version of the EPIC Physical Activity Questionnaire (EPAQ2) questionnaire which asked about frequency and time spent in a range of leisure activities, work activities, and active travel [26]. We derived two summary measures of physical activity. The first measure was total hours per week in moderate or vigorous activities (those with a metabolic equivalent of 3 or more [27]). The second measure was weekly hours of sedentary activity (sitting and doing light activities at work, watching TV and using computers). The proportion of respondents with complete and plausible values was 63.3% for physical activity and 78.1% for sedentary behaviour.

We dichotomised body mass index (BMI) into 25 or more vs. less (i.e. being overweight or obese versus normal or underweight), and waist/hip ratio (WHR) was dichotomised using the recommended cut-offs indicating a substantially increased risk of metabolic complications (0.85 for women, 0.90 for men) [28]. To identify co-occurrence, we constructed a summary index indicating the number of poor health behaviours out of six (current smoking, AUDIT score >8, BMI>=25, lowest quintile for physical activity, highest quintile for sedentary behaviour, and raised WHR).

Childhood and young adult characteristics

We included several measures from early life and young adulthood (to age 23) likely to be associated with selection into partnership and later life health behaviours. We adjusted for early life socioeconomic position using a latent summary of serious financial hardship during the last year at age 11, access to household amenities at age 11, paternal social class at age 7, number of people per room at age 7, housing tenure at age 7 and paternal weekly net pay at age 16 (details of this derivation have been published elsewhere)[9]. Health centre attendance during the previous year at age 16, disability at age 16 and height at age 7 were used as

indicators of health status in earlier life. Parental divorce by age 16 was used as an indicator of family disruption, and behavioural problems at age 16 were measured using the Rutter behaviour index. We also included variables measured at age 23: educational attainment, self–rated health, depression, employment status, presence of long standing disability and height (men only). We adjusted for general cognitive ability measured at age 11. Finally we adjusted for self-reported health behaviours prior to partnership: smoking at age 16 and 23, and alcohol use, BMI, and physical activity at age 23. All measures were reported by the cohort member or their parent except height at age 7 which was measured by a medical examination. Descriptive statistics are available in Appendix Tables 2 and 3.

Statistical modelling

We used Latent Class Analysis (LCA) to derive a longitudinal typology of partnership status. LCA is an approach which can be viewed as an evidence-based approximation that improves a researcher's ability to identify, summarize, and communicate complex patterns in longitudinal data [29] that has been used in a range of applications [30, 31]. Within LCA, longitudinal trajectories can be inferred from patterns on observed indicators of marital status and cohabitation measured over time. There were 325 unique response patterns for men and 316 in women. LCA was used to summarise these patterns by creating longitudinal trajectories; their derivation have been described in detail in an earlier publication[9].

We used the derived longitudinal typologies to investigate the association between partnership trajectories and a range of health-related behaviours in midlife: alcohol use, smoking, BMI and physical activity. We fitted multivariable regression models for each health behaviour in midlife, and included as covariates the latent class allocation for partnership trajectory, and the other control variables (childhood and young adult characteristics as described above). We include a sample of the Mplus model code as supplementary material. Number of hours of physical activity and sedentary activity were log-transformed to normalise their distribution before using in linear regression models. Total years of regular smoking was modelled using negative binomial regression due to the large number of zeros in the distribution. The other measures were modelled either using logistic regression (AUDIT score, BMI≥25 and raised WHR) or ordinal logistic regression (frequency of HED, smoking, and behaviour index).

Selection bias, in the form of incomplete or missing data, is almost ubiquitous in the observational setting of the NCDS and it is well known that unbiased estimates cannot be obtained without properly addressing the implications of incompleteness. We employed the Full Information Maximum Likelihood (FIML) method which is naturally incorporated into the generalised latent variable modelling framework [32]. In this full likelihood context model parameters and standard errors are estimated directly from the available data; under the assumption that Missingness is at Random (MAR) and that the models are correctly specified [33]. In our analyses assuming MAR means that all the variables that may plausibly be responsible for the missing data mechanism are complete and are included in the model as explanatory variables or intermediate outcomes. These variables are the early life and young adult measures included as covariates and shown in Appendix Tables 2 and 3. We believe that our approach is reasonable since it has been shown that socio–economic position and age are the main drivers of selection due to attrition in population surveys in the UK [34, 35]. All models were estimated with the Mplus 7 [36] software, with the Robust Maximum Likelihood estimator (MLR) and Monte Carlo integration.

RESULTS

The latent class modelling resulted in selection of 6-class models for both men and women although the prevalence and composition of the classes differed by gender. Full details of the specification of these models (information criteria, likelihood based tests the classification/allocation quality) have been previously described [9]. Figures 1 and 2 show the probabilities of marriage, cohabitation and remarriage in the six classes for men and women. For men, Class 1 is the most prevalent (N=3073, 61.8%) and is characterised by those who married by their 20's or early 30's and remained married. Class 2 (N=411, 8.3%) comprises men married by their 20's or early 30's, but later divorced, with increasing cohabitation but little remarriage by their 40's. Class three (N = 373, 7.5%) includes men most of whom cohabited from their late 20's or early 30's onwards but never married. The fourth class (N = 467, 9.4%), comprises men that typically cohabitated in their early 30's, married in their mid or late 30's, and remained married. Class 5 (N = 94, 1.9%) includes men who divorced in their mid to late 30's but later remarried, with some cohabitation in between. Finally the sixth class (N = 553, 11.1%) consists almost exclusively of men that never married or cohabited.

[Figures 1 and 2 about here.]

Among women, the most prevalent class (N = 2209, 42%) comprises those who married by their early 20's and remained so up to age 44. The second class (N= 1215, 23.1%) includes women who married later (in their late 20's or early 30's) and remained married. Class 3 (N = 429, 8.1%) is characterised by women that never married or married by their 20's and subsequently separated, and who were more likely to cohabit from their early 30's onwards. To the fourth class (N = 294, 5.6%) is allocated women who married and subsequently divorced in their 20's or early 30's, cohabited, then remarried. Women allocated to the fifth class (N = 457, 8.7%) married by their 20s or early 30s but divorced in their mid to late 30's, with some later cohabiting or remarrying. The sixth class (N = 652, 12.4%) is almost entirely comprised of women that never married or cohabited.

Table 1: Distribution of health behaviours in midlife, men and women, 1958 British Birth cohort

		MEN (N=4,970)		WOMEN (N=5,256)	
		N	**%**	**N**	**%**
AUDIT score [a]	<8	3,071	65.8	4,059	86.1
	8 or more	1,594	34.2	653	13.9
Frequency of HED [a]	Never	1,011	23.0	2,056	48.0
	Monthly or less	1,269	28.9	1,347	31.5
	Monthly	619	14.1	366	8.6
	Weekly	1,490	34.0	513	12.0
Smoking [b]	Never smoked	2,020	44.9	2,136	46.6
	Ex-or occasional smoker	1,400	31.1	1,321	28.8
	Current smoker	1,076	23.9	1,126	24.6
Years regular smoking 23-42	mean (SD)	4387	5.9 (0.12)	4647	5.7 (0.12)
BMI [a]	<25	1,140	24.9	2,027	43.8
	25 or more	3,445	75.2	2,598	56.2
Waist/hip ratio [a]	<0.90/0.85	1,421	30.7	3,496	74.9
	>=0.85/0.90	3,208	69.3	1,174	25.1
Hours moderate/vigorous physical activity per week [a]	mean (SD)	2873	15.4 (16.5)	2953	9.4 (11.4)
Hours sedentary behaviour per week[a]	mean (SD)	3632	44.2 (20.4)	3693	17.7
Index of poor health behaviours (0-6)	mean (SD)	2701	2.4 (1.1)	2652	1.7(1.1)

[a] Measured at age 44-46 [b] Measured at age 42

Table 1 shows the distribution of health behaviours in midlife. Approximately a third of men reported problem drinking (AUDIT score>8) compared to 14% of women, and heavy episodic drinking was more frequent in men. Just under a quarter of men and women were current smokers. The prevalence of overweight (BMI>=25) and raised WHR was higher in men than women. On average men did more hours of physical activity per week but also spent longer in sedentary activities than women. Exploratory analyses showed that health and health behaviours to age 23 were associated with subsequent partnership trajectories (see Appendix Table 4).

Table 2: Odds ratios/incident rate ratios and 95% confidence intervals for alcohol use at age 44-46, smoking at age 42, and years of regular smoking according to partnership trajectories

MEN (N=4,970)	**AUDIT score >=8**	**Frequency of heavy episodic drinking (ordinal)**	**Smoking (ordinal)**	**Years of regular smoking (age 23-42)**
	OR (95 % CI)	OR (95 % CI)	OR (95 % CI)	IRR (95 % CI)
Class 1: Married in 20's/early 30's, married once (REF)	1.00	1.00	1.00	1.00
Class 2: Divorced at late 30's not remarried	**1.32(1.07-1.82)**	**1.21(1.01-1.63)**	**1.86(1.46-2.72)**	**0.24(0.19-0.32)**
Class 3: Cohabiting, not married	**1.52(1.23-2.12)**	**1.27(1.04-1.73)**	**1.55(1.22-2.24)**	**0.30(0.24-0.40)**
Class 4: Married in mid/late 30's, married once	1.18(0.97-1.62)	1.02(0.86-1.34)	1.08(0.86-1.53)	**0.09(0.03-0.19)**
Class 5: Divorced in 30's, later remarried	1.33(0.89-2.51)	**1.55(1.10-2.63)**	1.22(0.78-2.49)	0.01(-0.11-0.20)
Class 6: Never married or cohabited	**1.41(1.16-1.89)**	1.16(0.97-1.55)	**1.67(1.34-2.37)**	**0.37(0.31-0.46)**
WOMEN (N=5,256)				
Class 1: Married in early 20's, married once (REF)	1.00	1.00	1.00	1.00
Class 2: Married in late 20's/early 30's, married once	1.18(0.94-1.68)	0.97(0.84-1.22)	**0.70(0.59-0.92)**	**-0.15(-0.19--0.09)**
Class 3: Cohabiting, not married	1.21(0.91-1.91)	1.19(0.98-1.61)	**1.67(1.31-2.46)**	**0.14(0.10-0.20)**
Class 4:Divorced in 20's/early 30's, cohabited or remarried	1.17(0.83-1.99)	1.13(0.91-1.59)	**1.46(1.09-2.30)**	**0.08(0.03-0.16)**
Class 5: Divorced in mid/late 30's, not remarried	**1.75(1.37-2.59)**	**1.54(1.27-2.08)**	**1.57(1.23-2.29)**	**0.25(0.21-0.32)**
Class 6: Never married or cohabited	**1.32(1.03-1.96)**	1.21(1.01-1.59)	**1.28(1.04-1.76)**	**0.11(0.08-0.17)**

Notes

Adjusted for early life socio-economic position (latent summary of financial hardship during the last year at age 11, access to household amenities at age 11, paternal social class at age 7, number of people per room at birth, housing tenure at age 7 and paternal weekly net pay at age 16), health centre attendance during the last year at age 16, disability at age 16, height at age 7, cognitive ability at 11, parental divorce at age 16, behaviour score (age 16), educational attainment at 23, social class at 23, housing tenure at 23, net family income at 23, self-rated health at 23, depression at 23, employment status at 23, presence of long standing disability at 23, height at 23 (men only) ; earlier measures of health-related behaviours- smoking at ages 16 and 23, alcohol use frequency at age 23, exercise frequency at age 23, BMI at age 23

Results in bold font are statistically significant at the 5% level.

Table 2 shows the estimated ORs or IRRS and confidence intervals for the associations between the longitudinal partner status typologies described above and drinking and smoking outcomes in midlife . Smoking and heavy drinking were more common in unmarried men. Men who got divorced in their late 30's (class 2), cohabited (class 3) or who never married or cohabited (class 6) were more likely to be problem drinkers in midlife when compared to the reference group (men who married in their 20s or early 30s and remained married, class 1). Heavy episodic drinking was more common among men who divorced or cohabited (class 2, 3 and 5). The odds of being an ex or current smoker were significantly higher for men who divorced in their late 30's (class 2), cohabited (class 3) or who never partnered (class 6), and these men had the most years of regular smoking, suggesting they were least likely to quit between ages 23 and 42.

Among women, those who had divorced in their mid to late 30's (class 5) had higher odds of problem drinking (OR 1.75 (1.37-2.59)) and more frequent heavy episodic drinking (OR 1.54 (1.27-2.08)) compared to the reference group (those who married in their early 20's and remained married, class 1). Women who had never married or cohabited (class 6) also had higher odds of problem drinking. Women who got married later (in their late 20s or 30s, class 2) had 30 percent lower odds of smoking and fewer years of regular smoking when compared with women who married earlier. All of the other classes for women (cohabiting, divorced, and never married or cohabited) had significantly higher odds of smoking compared to the reference group.

Table 3 shows the results of regression models for the associations between physical activity, weight, the health behaviour index and the longitudinal partner status typologies. Men in class 2 (divorced and not remarried) were more physically active compared to the reference group (men who married in their 20s or early 30s and remained married, class 1), and spent fewer hours of sedentary time per week. Among women there were no associations between physical activity and partnership status. Women in class 3 (cohabiting in their 30's) and class 6 (never married or cohabited) spent more hours per week in sedentary behaviours when compared with the reference group. Associations with BMI and partnership were similar in men and women. Overall getting married later or not at all was associated with lower odds of being overweight in midlife. There were no significant associations between partnership trajectory and waist/hip ratio. In men, experiencing divorce (whether they remarried or later cohabited or not- class 2 and class 5) was associated with having a greater number of poor health behaviours (from an index of 6).

Table 3: Odds ratios/regression coefficients and 95% confidence intervals for physical activity, BMI and WHR at age 44-46, and index of poor health behaviours according to partnership trajectories

Class	**Hours physical activity per week**	**Hours sedentary time per week**	**BMI>=25 (ref: <25)**	**Raised WHR**	**Index of poor health behaviours (ordinal)**
	B (95 % CI)	B (95 % CI)	OR (95 % CI)	OR (95 % CI)	OR (95% CI)
MEN (N=4,970)					
Class 1: Married in 20's/early 30's, married once (REF)	0.00	0.00	1.00	1.00	1.00
Class 2: Divorced at late 30's not remarried	**0.29(0.08-0.62)**	**-0.08(-0.14-0.01)**	0.94(0.73-1.39)	1.17(0.93-1.66)	**2.00(1.58-2.52)**
Class 3: Cohabiting, not married	-0.14(-0.41-0.29)	-0.05(-0.10-0.04)	0.73(0.56-1.08)	1.12(0.89-1.60)	1.30(1.01-1.69)
Class 4: Married in mid/late 30's, married once	-0.09(-0.25-0.15)	0.03(-0.02-0.11)	0.93(0.73-1.35)	1.01(0.82-1.38)	1.06(0.86-1.31)
Class 5: Divorced in 30's, later remarried	-0.50(-1.12-0.47)	-0.12(-0.25-0.08)	1.66(0.94-4.04)	1.42(0.91-2.82)	**1.81(1.15-2.85)**
Class 6: Never married or cohabited	**-0.31(-0.50-0.00)**	**-0.09(-0.15-0.00)**	**0.56(0.44-0.80)**	1.06(0.87-1.45)	1.10(0.88-1.36)
WOMEN (N=5,256)					
Class 1: Married in early 20's, married once (REF)	0.00	0.00	1.00	1.00	1.00
Class 2: Married in late 20's/early 30's, married once	-0.14(-0.27-0.07)	-0.03(-0.08-0.04)	**0.71(0.6-0.93)**	0.96(0.81-1.27)	0.86(0.73-1.03)
Class 3: Cohabiting, not married	-0.08(-0.27-0.21)	**0.09(0.02-0.20)**	0.71(0.56-1.05)	0.92(0.73-1.33)	0.99(0.77-1.27)
Class 4:Divorced in 20's/early 30's, cohabited or remarried	0.06(-0.15-0.39)	0.02(-0.05-0.14)	0.76(0.58-1.17)	0.85(0.63-1.34)	1.00(0.75-1.32)
Class 5: Divorced in mid/late 30's, not remarried	0.02(-0.15-0.28)	0.06(0.00-0.15)	0.70(0.56-1.00)	0.93(0.74-1.32)	1.07(0.85-1.33)
Class 6: Never married or cohabited	-0.04(-0.22-0.24)	**0.13(0.07-0.22)**	0.80(0.64-1.11)	1.14(0.93-1.56)	0.89(0.72-1.11)

Notes

Adjusted for early life socio-economic position (latent summary of financial hardship during the last year at age 11, access to household amenities at age 11, paternal social class at age 7, number of people per room at birth, housing tenure at age 7 and paternal weekly net pay at age 16), health centre attendance during the last year at age 16, disability at age 16, height at age 7, cognitive ability at 11, parental divorce at age 16, behaviour score (age 16), educational attainment at 23, social class at 23, housing tenure at 23, net family income at 23, self-rated health at 23, depression at 23, employment status at 23, presence of long standing disability at 23, height at 23 (men only) ; earlier measures of health-related behaviours- smoking at ages 16 and 23, alcohol use frequency at age 23, exercise frequency at age 23, BMI at age 23

Results in bold font are statistically significant at the 5% level.

We also fitted nested regression models which compared the unadjusted estimates with those adjusted for different groups of confounders (results not shown). For smoking and drinking, the most substantial changes to the associations occurred when we added measures of smoking or drinking at age 23. For the other health behaviour outcomes, there was very little change.

DISCUSSION

The behavioural risk factors smoking, alcohol use, high BMI and physical inactivity together account for the vast majority of disease burden in the UK [37] and a better understanding of life-course social determinants of these is important to devise strategies for reducing the burden of preventable morbidity and mortality. In this study life-course partnership trajectories were prospectively associated with harmful health behaviours in midlife, even after adjustment for a range of socio-economic, psychosocial and health related factors in childhood and early adulthood. The patterns varied by somewhat by gender and the health behaviour considered, but overall being divorced, or having never married or cohabited was associated with poorer outcomes. Problem drinking, heavy drinking and smoking were more common in men and women who divorced in their 30's or those who had never married or cohabited. In general marriage (and remarriage in men) was associated with having a higher BMI, consistent with previous research [16]. Later marriage in women was associated with less chance of smoking and being overweight. Physical activity was less clearly patterned by partnership history, although men and women who had never entered a partnership exercised less often and for less time. Men who divorced in their 30's but did not remarry had higher levels of physical activity compared to men who remained married. That partnership had opposite, potentially offsetting, associations with smoking, drinking, BMI and physical activity means that the co-occurrence of poor health behaviours was only statistically significant for divorced men.

The associations between partnership history and health behaviours are partly consistent with the patterns found with objectively measured biomarkers in our previous study [9] and other studies of health and mortality [1-7, 38], and suggest that health behaviours explain at least some of the association between partnership history and health. Never partnered and divorced individuals exhibited the worst health in terms of drinking and smoking and this is in line with raised levels of hemostatic biomarkers and worse respiratory functioning found in this cohort[9]. The main exceptions were that smoking and heavy drinking were more common among divorcees and cohabiters, but this was not reflected in poorer measures on

inflammatory and hemostatic biomarkers. Potential explanations for this could be reporting bias by marital status for health behaviours, or that the harmful effect of drinking and smoking in the divorced and cohabiters could be offset, for at least some health markers, by lower prevalence of overweight and weight gain.

Previous studies have suggested that the health benefits of marriage are greater for men than women partly because men's health-related behaviours are influenced to a greater extent by social control from wives [39]. In this study the association between partnership and health behaviours was broadly similar in men and women for smoking, drinking and BMI, however as the prevalence of some behaviours (such as heavy drinking) was much higher among men, the absolute impact of marriage pattern would be greater. The 'social control' thesis did not appear to operate to the same extent for cohabiting relationships. This could be related to other factors such as childbearing or lifetime SES (which were not included here because on the causal pathway) or because those choosing cohabitation rather than marriage have a different type of relationship; this deserves further analysis. Remarried people had similar profiles to those in first marriages for some health behaviours (smoking and BMI in men, and physical activity) which is consistent with previous studies and suggests that the some of the negative effects of mid-life marital disruption are short term.[22].

The contribution of this study is our consideration of a 21-year longitudinal partnership trajectory which includes marriage, cohabitation and remarriage in explaining health behaviour inequalities in midlife, which has been shown to be superior to current marital status [5, 7, 8]. In addition we were able to include many prospective measures of health, socio-economic and psychosocial factors which may influence selection. Our measures of health behaviours were collected using validated instruments for problem drinking and physical activity, prospectively measured smoking history, and objective measures for adiposity. The limitations of this study were that many of our outcome measures and covariates, and reports of marriage and cohabitation were self-reported and the possibility of reporting bias influencing our findings cannot be excluded. We did not have information on partnership status between follow-up occasions so there is a possibility of unaccounted marital transitions. As in any observational study there is always the chance of unknown, and therefore unaccounted for, confounders. Attrition within the cohort study and high non-response for some items – particularly physical activity – meant that we did not have complete data and rely on the (theoretically untestable) MAR assumption when estimating the models. The relationship between health behaviours and partnership status is likely to be

dynamic, so further research could explicitly model this interaction. Previous research has shown that many health behaviours are concordant between partners [20], but unfortunately we could not investigate this issue using these data as information on partners was lacking. Health behaviours constitute only one of several potential mechanisms linking partnership and health, and the contribution of differing patterns of social support, wealth, and fertility (some of which could operate as mediators) need to be considered to understand the total health effect in midlife.

The study provides evidence that life-course partnership history is associated with patterns of midlife health behaviours, which likely accounts for some of the differences in health status found previously. However, this is a relatively young cohort, and longer follow-up is required to fully assess the impact of partnership on health outcomes. The partnership behaviour in our study occurred from 1981 to 2002, but it is important to consider our results within the context of changing patterns of partnership for these and subsequent cohorts in the UK, especially increases in the incidence and duration of premarital cohabitation [40]. Moreover as cohabitation becomes more normalised and less 'deviant' the association with some unhealthy behaviours could diminish. In this study our aim was to better understand the health benefits of partnership in general, but in addition our results highlight the excess public health risk associated with remaining single or becoming separated, which appears to operate mainly through excessive alcohol use and smoking. This suggests a need for a greater awareness on the part of health professionals that some individuals may need additional social or psychological support to maintain or develop healthy habits, avoid drinking heavily and quit smoking. It also raises a concern for health and health care planning as life course partnership trajectories continue to change.

Figures.

Figure 1. Longitudinal typologies of probability of marriage (dotted grey line) and cohabitation (solid black line) in men.

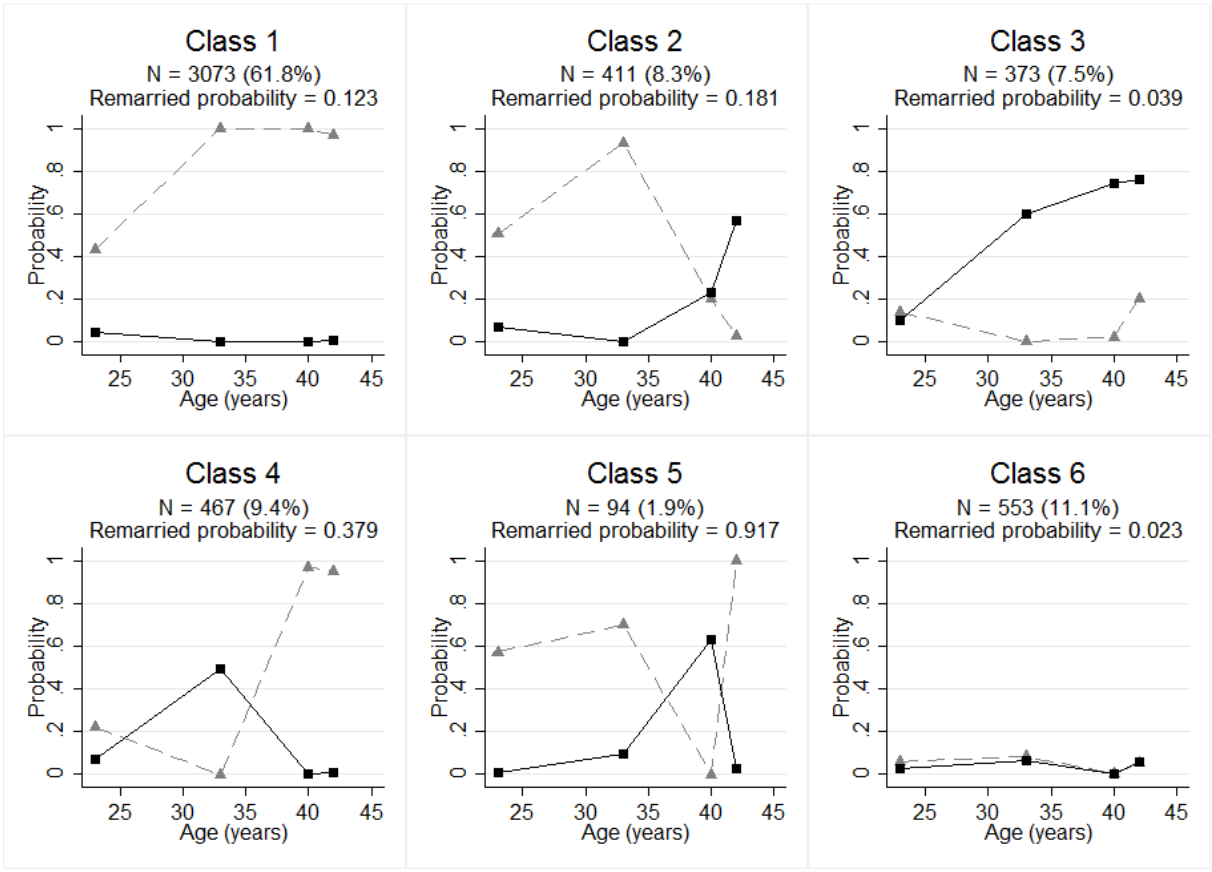
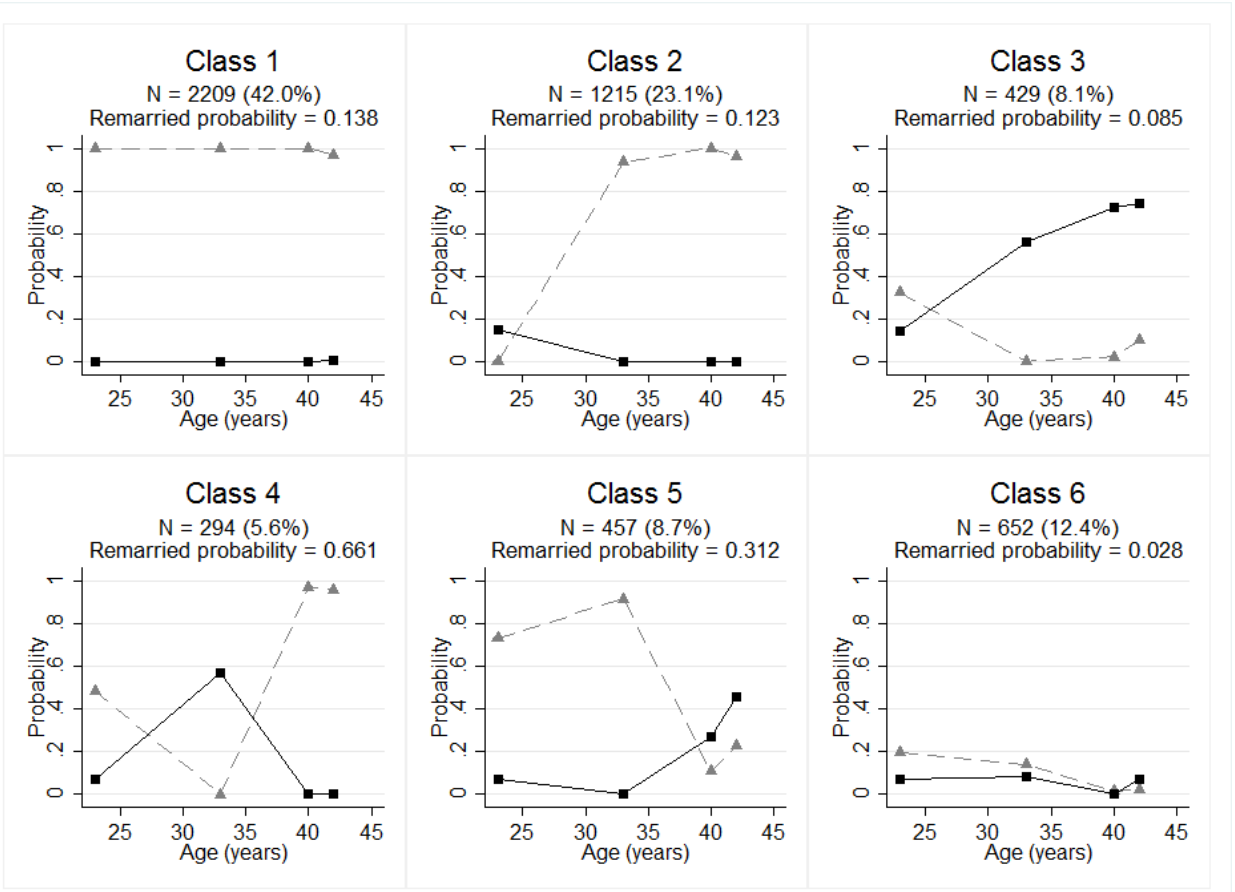


Figure 2. Longitudinal typologies of probability of marriage (dotted grey line) and cohabitation (solid black line) in women.



Notes for both figures:
Figures 1 and 2 based on data and figures originally published in the American Journal of Public Health [9]

Appendix Tables

Table 1: Distribution of married and non-marital cohabitation status in 1981, 1991, 2000 and 2002-04.

	Married		**Cohabiting**	
	Men N (%)	**Women N (%)**	**Men N(%)**	**Women N(%)**
1981 (23 years)	2179 (34.8)	3409 (54.4)	338 (5.4)	451 (7.2)
1991 (33 years)	3701 (69.0)	4063 (72.1)	579 (10.8)	541 (9.6)
2000 (42 years)	3946 (70.6)	4095 (71.1)	533 (9.5)	514 (8.9)
2002-04 (44-46 years)	3303 (70.8)	3262 (69.2)	569 (12.2)	570 (12.1)
Remarried by 42	517 (9.2)	655 (11.3)		

Table 2: Descriptive statistics of all covariates included in the models (Men) (N=4970)

		N	%			N	%
Financial hardship at 11	Yes	372	9	Parental divorce at 16	Yes	145	3.2
	No	3771	91		No	4378	96.8
	missing	827			missing	447	
Paternal social class at 7	i	261	6.2	Smoking at 16	Never smoked	2443	64.7
	ii	675	16		0-29 cigarettes per week	605	16.0
	iii non-ma	436	10.3		30+ cigarettes per week	731	19.3
	iii manual	1904	45		missing	1191	
	iv non-ma	81	1.9	Depression at 23	Not depressed	4259	96.5
	iv manual	647	15.3		Depressed	153	3.5
	v	226	5.3		missing	558	
	missing	740		Long standing illness at 23	Yes	205	4.6
Housing tenure at 7	Owner	1936	44.6		No	4216	95.4
	Other	2402	55.4		missing	549	
	missing	632		Self-rated health at 23	excellent	2155	48.8
Paternal weekly net pay at 16	0-`4	6	0.3		good	1916	43.3
	`5-`9	6	0.3		fair	321	7.3
	`10-14`	15	0.8		poor	28	0.6
	`15-`19	56	2.9		missing	550	
	`20-`24	242	12.4	Unemployed at 23	Yes	410	21.0
	`25-`29	482	24.7		No	1527	78.3
	`30-`34	468	24		missing	3033	
	`35-`39	290	14.9	Housing tenure at 23	Owner	1071	52.0
	`40-`44	175	9		Other	979	48.0
	`45-`49	83	4.3		missing	2920	
	`50-`59	69	3.5	Smoking at 23	Never smoked	1297	28.8
	`60 plus	60	3.1		Ex-occasional smoker	1440	32.0
	missing	3018			Current smoker	1760	39.2
Access to household amenities	sole use of	3628	83.9		missing	473	
	sole use of	263	6.1	Drinking frequency at 23	Never drinks	131	2.9
	sole use of	202	4.7		Special occasions only	271	6.0
	shared no	233	5.4		Less than weekly	398	8.9
	missing	644			1-2 times per week	2251	50.1
Education at 23	no qualific	463	11		Most days	1443	32.1
	cse 2-5/eq	493	11.7		missing	476	
	O level/eq	1428	34	Physical activity frequency at 23	5+ times per week	405	9.0
	A level/equ	991	23.6		3-4 times per week	530	11.8
	high qual/r	393	9.3		1-2 times per week	968	21.6
	degree/hig	437	10.4		2-3 times last 4 weeks	500	11.1
	missing	765			once last 4 weeks	318	7.1
Social class at 23	manual	2125	61		None last 4 weeks	1,770	39.4
	non-manu	1367	39		missing	479	
	missing	1478		Partnership trajectory	Class 1	3073	16.6
Health centre attendance at 16	no	1404	38.8		Class 2	411	2.2
	yes, once	990	27.4		Class 3	372	2.0
	yes, twice	576	15.9		Class 4	467	2.5
	yes, 3 time	268	7.4		Class 5	94	0.5
	yes, 4 time	125	3.5		Class 6	553	3.0
	yes, 5+ tim	194	5.4		missing	0	
	yes, don't l	58	1.6		N	Mean	SD
	missing	1355		Height at 7	4118	1.2	0.0
Disability at 16	Yes	260	7.4	Behaviour score at 16	3679	3.8	3.7
	No	3234	92.6	Cognitive ability at 11	4271	44.2	15.6
	missing	1476		Height at 23	4398	1.8	0.1
				BMI at 23	4418	23.0	2.8
				Net household income at 23	4498	7.1	3.4

Table 3: Descriptive statistics of all covariates included in the models (Women) (N=5256)

		N	%			N	%
Financial hardship at 11	Yes	455	10.4	Parental divorce at 16	Yes	191	4.0
	No	3935	89.6		No	4597	96.0
	missing	866			missing	468	
Paternal social class at 7	i	259	5.8	Smoking at 16	Never smo	2710	66.5
	ii	703	15.6		0-29 cigare	830	20.4
	iii non-ma	481	10.7		30+ cigare	533	13.1
	iii manual	2021	44.8		missing	1183	
	iv non-ma	80	1.8	Depression at 23	Not depre	4255	89.9
	iv manual	712	15.8		Depressed	476	10.1
	v	260	5.8		missing	525	
	missing	740		Long standing illness at 23	Yes	183	3.8
Housing tenure at 7	Owner	2022	43.6		No	4560	96.2
	Other	2619	56.4		missing	513	
	missing	615		Self-rated health at 23	excellent	2009	42.4
Paternal weekly net pay a	0-`4	3	0.1		good	2276	48.0
	`5-`9	3	0.1		fair	419	8.8
	`10-14`	14	0.7		poor	38	0.8
	`15-`19	53	2.6		missing	514	
	`20-`24	280	13.7	Unemployed at 23	Yes	279	14.4
	`25-`29	486	23.8		No	1649	84.9
	`30-`34	491	24.0		missing	3328	
	`35-`39	273	13.4	Housing tenure at 23	Owner	1844	55.0
	`40-`44	212	10.4		Other	1454	45.0
	`45-`49	94	4.6		missing	1958	
	`50-`59	60	2.9	Smoking at 23	Never smo	1625	33.7
	`60 plus	75	3.7		Ex-occasio	1319	27.4
	missing	3212			Current sm	1878	39.0
Access to household ame	sole use of	3811	82.7		missing	434	
	sole use of	283	6.1	Drinking frequency at 23	Never drin	266	5.5
	sole use of	246	5.3		Special oc	1044	21.6
	shared no	267	5.8		Less than v	803	16.7
	missing	649			1-2 times p	2200	46.1
Education at 23	no qualific	601	13.1		Most days	488	10.1
	cse 2-5/eq	680	14.8		missing	455	
	O level/eq	1799	39.2	Physical activity frequency	5+ times p	170	3.5
	A level/equ	570	12.4		3-4 times p	191	4.0
	high qual/r	525	11.4		1-2 times p	724	15.0
	degree/hig	416	9.1		2-3 times l	405	8.4
	missing	665			once last 4	307	6.4
Social class at 23	manual	1072	27.9		None last 4	3,024	62.7
	non-manu	2776	72.1		missing	435	
	missing	1408		Partnership trajectory	Class 1	2209	11.9
Health centre attendance	no	1166	30.4		Class 2	1215	6.6
	yes, once	978	25.6		Class 3	429	2.3
	yes, twice	659	17.2		Class 4	294	1.6
	yes, 3 time	346	9.0		Class 5	457	2.5
	yes, 4 time	206	5.4		Class 6	652	3.5
	yes, 5+ tim	402	10.5		missing	0	
	yes, don't l	73	1.9		N	Mean	SD
	missing	1426		Height at 7	4362	1.2	0.1
Disability at 16	Yes	206	5.5	Behaviour score at 16	3901	4	3.5
	No	3536	94.5	Cognitive ability at 11	4547	46.3	15.1
	missing	1514		BMI at 23	4748	22.2	3.2
				Net household income at 2	4822	7.2	3.5

Table 4: Estimated multinomial logistic relative risk ratios and 95% confidence intervals for classes of partnership trajectories ages 23-45, according to health behaviours at age 23

	Partnership trajectory age 23-45 (latent classes)				
	Class 2 (ref: Class 1)	**Class 3 (ref: Class 1)**	**Class 4 (ref: Class 1)**	**Class 5 (ref: Class 1)**	**Class 6 (ref: Class 1)**
Health behaviours at age 23	RRR (95 % CI)	RRR (95 % CI)	RRR (95 % CI)	RRR (95 % CI)	RRR (95 % CI)
MEN (N=4,970)					
Drinking frequency at age 23 (ordinal)	0.92 (0.84-1.00)	**1.32 (1.18-1.48)**	**1.11 (1.00-1.21)**	**0.84 (0.72-0.98)**	0.96 (0.89-1.04)
Smoking at age 23 (ordinal)	**1.21 (1.07-1.34)**	**1.19 (1.05-1.34)**	0.99 (0.89-1.09)	0.90 (0.73-1.12)	**0.79 (0.72-0.87)**
Physical activity frequency at age 23 (ordinal)	1.04 (0.99-1.10)	1.03 (0.97-1.09)	**0.92 (0.87-0.96)**	0.95 (0.86-1.05)	**1.09 (1.04-1.14)**
BMI at age 23 (continuous)	**0.96 (0.93-0.99)**	0.97 (0.93-1.00)	0.99 (0.96-1.01)	0.95 (0.89-1.02)	0.98 (0.95-1.01)
WOMEN (N=5,256)					
Drinking frequency at age 23 (ordinal)	**1.41(1.32-1.51)**	**1.23 (1.12-1.34)**	1.09 (0.98-1.20)	0.99 (0.91-1.07)	1.05 (0.98-1.12)
Smoking at age 23 (ordinal)	0.98 (0.92-1.06)	**1.53(1.37-1.71)**	1.07 (0.94-1.22)	**1.17 (1.05-1.30)**	0.98 (0.90-1.08)
Physical activity frequency at age 23 (ordinal)	**0.85 (0.82-0.89)**	0.95 (0.89-1.00)	0.96 (0.89-1.03)	**1.11 (1.04-1.19)**	0.96 (0.91-1.00)
BMI at age 23 (continuous)	**0.95 (0.94-0.98)**	0.98 (0.95-1.01)	0.99 (0.96-1.02)	0.98 (0.95-1.00)	1.02 (1.00-1.05)

Notes

Drinking frequency (age 23) self reported as 'never drinks/special occasions only/less than weekly/1-2 times per week/most days'. Smoking at age 23 self reported as never smoked/ex-occasional smoker/current smoker. Physical activity at age 23 self reported as 5+ times per week //3-4 times per week /1-2 times per week /2-3 times in last 4 weeks / once in last 4 weeks /none in last 4 weeks

Men, Class 1= Married in 20's/early 30's, married once Class 2= Divorced at late 30's not remarried Class 3= Cohabiting, not married Class 4= Married in mid/late 30's, married once Class 5= Divorced in 30's, later remarried Class 6= Never married or cohabited

Women, Class 1: Married in early 20's, married once, Class 2: Married in late 20's/early 30's, married once, Class 3: Cohabiting, not married, Class 4:Divorced in 20's/early 30's, cohabited or remarried, Class 5: Divorced in mid/late 30's, not remarried, Class 6: Never married or cohabited

Adjusted for early life socio-economic position (latent summary of financial hardship during the last year at age 11, access to household amenities at age 11, paternal social class at age 7, number of people per room at birth, housing tenure at age 7 and paternal weekly net pay at age 16), health centre attendance during the last year at age 16, disability at age 16, height at age 7, cognitive ability at 11, parental divorce at age 16, behaviour score (age 16)

Results in bold font are statistically significant at the 5% level.

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