



The gendered impact of Covid-19 on health behaviours and mental health: Evidence from the UK

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ABSTRACT

The purpose of this paper is to assess whether the COVID-19 pandemic affected the health behaviours of men and women differently, and to estimate whether the associations between health behaviours and mental health differed by gender. By employing nationally representative panel data (UKHLS) and a difference-in-differences strategy, we provide evidence that the pandemic adversely affected health behaviours among women more than men in the UK. Compared to men, women were 3.2 percentage points less likely to adopt a healthy lifestyle and reported 0.09 fewer healthy behaviours (corresponding to 7.0 per cent of a standard deviation) during the pandemic. These changes are primarily driven by smaller improvements rather than absolute declines in health behaviours for women compared to men. The changes in health behaviours among women appear to persist over time when lockdown policies were relaxed. Importantly, we find that the pandemic considerably weakened the protective effect of health behaviours on mental health for women but not for men. For women, adopting a healthy lifestyle was strongly correlated with mental health before the pandemic, but this relationship was no longer significant during the pandemic. This loss in significance corresponds to a 0.61-points decline in the GHQ-12 Likert score, equivalent to 10.5 per cent of a standard deviation. However, we observe a partial return of the protective effect of health behaviours on mental health once lockdown measures had eased.

1. Background

Health behaviours play an important role in health and wellbeing. In particular, diet, alcohol consumption, and physical activity are closely linked to physical and mental functioning, morbidity, and mortality. For example, evidence from the UK Biobank reports that engagement in healthy behaviours is associated with increased life expectancy by up to 7.6 years for women and 6.3 years for men (Chudasama et al., 2020). A significant body of evidence demonstrates that the consumption of fruits and vegetables (Conner et al., 2017; Mujcic and Oswald, 2016; Ocean et al., 2019), limited alcohol consumption (Mentzakis et al., 2016), and physical activity (Rethorst, 2019) can improve mental health and buffer against clinical levels of distress. However, despite the benefits of health behaviours, a significant proportion of the population reports poor health behaviours (Scholes and Gebert, 2019).

In general, women tend to report healthier dietary choices, lower alcohol consumption, and less physical activity compared to men (Wardle et al., 2004; Kritsotakis et al., 2016). These differences may

stem from social norms - women experience greater social pressure to pay more attention to their weight and consequently dietary choices while men experience greater pressure to engage in behaviours that are considered more 'masculine' such as sports, drinking, and meat consumption (Courtenay, 2000; Connell, 2012; Fleming and Agnew-Brune, 2015). There is considerably less systematic evidence on gender differences in the protective effect of health behaviours on mental health. Prior studies show that women experience greater psychological damage from alcohol consumption but results are unclear as to whether women gain more psychological benefits than men from physical activity and a healthy diet (Green et al., 2004; Hailemariam et al., 2021).

In this paper, we first investigate whether the pandemic had a different effect on the health behaviours of women and men. Second, we consider whether changes in health behaviours during the pandemic led to poorer mental health among women. These effects could have been driven by gender differences in exposure and vulnerability to stressors during the COVID-19 pandemic. Based on the stress process model, exposure and vulnerability to stressors are influenced by structural

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contexts such as demographic characteristics, socioeconomic status, and social roles (Pearlin, 1989). Our study analyses the effects of the pandemic in the context of gender which is a social structure that imposes a greater burden on women via social norms and expectations, for example through greater household and caring responsibilities. This burden was likely amplified during the COVID-19 pandemic, potentially leading to poorer health behaviours and declines in the protective effect of these behaviours on mental health among women (Risman, 2011).

First, in terms of exposures, women with children shouldered more responsibilities during the pandemic with regard to housework, homeschooling, and caregiving for children and the elderly (Cheng et al., 2021; Oreffice and Quintana-Domeque, 2021; Cohen et al., 2021; Sevilla and Smith, 2020), potentially reducing the time and energy to invest in or maintain health behaviours. Even under normal circumstances, the stresses of unpaid domestic labour and informal caregiving can be harmful to health behaviours, physical health, and psychological well-being (Zwar et al., 2020; Stansfeld et al., 2014; Mochari-Greenberger and Mosca, 2012). In addition to physical unpaid labour, evidence shows that women engaged more in cognitive labour during the pandemic and that this burden was associated with lower wellbeing (Petts and Carlson, 2023). Cognitive labour captures all of the behind-the-scenes work that is needed for a family to function effectively, including anticipating needs, identifying options for meeting those needs, deciding among options; and monitoring the results (Daminger, 2019). Evidence also shows that women were more compliant with COVID-19 restrictions, likely further increasing the cognitive labour they experienced in mitigating the health consequences of the pandemic for their family and themselves (Galasso et al., 2020).

Second, in terms of vulnerability, women experienced greater levels of psychological distress than men especially during the initial stages of the pandemic (Daly et al., 2022; Etheridge and Spantig, 2022). This gender gap in psychological distress was particularly pronounced among younger women, and largely driven by experiences of loneliness and social isolation. The higher levels of distress experienced by women may have led to poorer health behaviours; indeed, higher levels of stress, anxiety, and depressed mood during the pandemic were associated with higher fat diets, smoking, alcohol consumption, and reduced exercise (Van Laren et al., 2023). Differences in how men and women value and engage in social relationships may have contributed to higher levels of loneliness and distress among women (Belle, 1991). Social restrictions during the pandemic reduced opportunities for affiliation and social support which likely impacted women to a greater extent. In summary, the significant pressures faced by women during the pandemic due to greater caring and family responsibilities, cognitive labour, and psychological distress may have attenuated the relationship between health behaviours and mental health. This could be driven by a reduction in health behaviours but also a decline in the protective effect of health behaviours on mental health for women compared to men.

In terms of existing evidence regarding changes in diet, physical activity, and alcohol consumption during the pandemic, previous studies in the UK typically find significant heterogeneity, in that, some groups adopt more positive or the same behaviours while others shift to negative behaviours (Braithwaite et al., 2022; Garnett et al., 2021; Jackson et al., 2021; Herle et al., 2021; McAtamney et al., 2021; Mitchell et al., 2022; Naughton et al., 2021; Robinson et al., 2021; Solomon-Moore et al., 2022; Bu et al., 2021) While most of these studies investigate changes in health behaviours in the first few months of the pandemic, studies that look at later periods find that individuals report a lower consumption of fruits and vegetables (Dicken et al., 2022), reduced physical activity (Mitchell et al., 2022), and limited changes in alcohol consumption (Hardie et al., 2022). The likelihood of exhibiting poorer health behaviours during the pandemic is generally associated with being female (e.g., Dicken et al., 2022; Garnett et al., 2021; Naughton et al., 2021), having a lower socioeconomic status (e.g., Braithwaite et al., 2022), and poorer pre-pandemic health behaviours (e.g., Naughton et al., 2021; Robinson et al., 2021). Individuals who report

higher levels of stress, boredom, loneliness, and distress are also more likely to report poorer health behaviours (e.g., Dicken et al., 2022; McAtamney et al., 2021). Many of these studies are based on particular time periods or particular samples, exclude objective measures of health behaviours prior to the pandemic, and do not assess the protective effect of health behaviours on mental health. Prior studies have also documented a significant link between pre-pandemic mental health/health behaviours and mental health and health behaviours during the pandemic (Russell et al., 2023; Villadsen et al., 2023). However, studies have not yet systematically assessed gender differences in the impact of the pandemic on the protective effect of health behaviours on mental health.

2. Current study

Based on this theoretical background, we hypothesize that the pandemic adversely affected the health behaviours and psychological benefits derived from these behaviours of women more than men. To test these hypotheses, we employ nationally representative data from the Main Study of the UK Household Longitudinal Survey (UKLHS) and a difference-in-differences framework. The data employed in our main analysis covers interviews conducted between January 2015 and May 2021, covering all major lockdown periods in the UK. Importantly, we use a comprehensive set of information on health behaviours and construct a summary indicator of a healthy lifestyle that allows us to compare the overall set of choices made by men and women on their health behaviours during the pandemic. The specific health behaviours we analyse are the number of days respondents consume fruits and vegetables, quantity of fruits and vegetables consumed in a day, frequency of alcohol consumption, frequency of alcohol binge-drinking, and amount of physical activity. Based on these variables, we derive the number of positive health behaviours reported and a 'healthy lifestyle' indicator which equals to 1 if a respondent reports more than four positive behaviours. These variables enable us to assess aggregate effects associated with the health behaviours captured in the dataset. Mental health is measured using the clinically validated General Health Questionnaire-12 (GHQ-12).

The rest of the paper is organised as follows. Section 3 details the data used in the study, provides information on the main measures used in the analysis, and outlines the econometric methodology applied. It also includes descriptive statistics. Section 4 presents the main results and robustness checks. Section 5 presents a discussion of the findings and Section 6 concludes.

3. Methods

3.1. Data

We use nationally representative data from the United Kingdom Household Longitudinal Study (UKHLS), also known as Understanding Society (University of Essex, 2023). This dataset consists of the Main Study which is available from January 2009 to May 2021 as well as the COVID-19 Study which is available from April 2020 to September 2021. The dataset contains high quality longitudinal information on socio-economic characteristics, health behaviours, and attitudes, primarily from individuals aged 16 and over, based on approximately 40,000 households from across the UK. One of the largest surveys of its kind, it is designed to ensure that ethnic minorities are adequately represented. Beginning in 2009–2010 (Wave 1), households have been visited every year to capture changes in circumstances over time. The 'Main Study' interviews are carried out face-to-face in respondents' homes by trained interviewers or through an online self-completion survey. The 'COVID-19' surveys were largely conducted online.

We employ data from Waves 7 (2015–2017), 9 (2017–2019), and 11 (January 2019 to May 2021) of the Main Study in our main analyses. We exclude data from the other waves as the health behaviour variables are

not collected in these waves. To capture changes during the pandemic, we compare data from Wave 11 (March 2020 to May 2021) against data from Waves 7 to 9. The primary reason for using data from the Main Study as opposed to the COVID-19 study is to adequately capture changes in health behaviours and their associations with mental health throughout key periods of the pandemic. In the COVID-19 Study, questions on fruits and vegetables intake are asked in July 2020 and January 2021, while questions on alcohol consumption and physical activity are asked in April 2020, May 2020, September 2020, and January 2021. As our health behaviour variables are only collected simultaneously in January 2021, we can only derive an overall measure of health behaviour for this particular month during which the incidence of COVID-19 cases was particularly high and stricter lockdown measures were in place in the UK (Institute for Government, 2022). Therefore, employing data from the COVID-19 Study restricts the interpretation of results to events that occurred during these periods. Nevertheless, we assess the sensitivity of our results to using data from the COVID-19 study. In presenting our results, we refer to analyses conducted based on March 2020–May 2021 (from the Main Study) and April 2020–January 2021 (from the COVID-19 Study) data as ‘during the pandemic’, acknowledging that these periods capture varying levels of COVID-19 infections and social restrictions in the UK. In additional analyses, we assess outcomes using a new wave of UKHLS Main Study data, Wave 13, which largely covers periods when the COVID-19 crisis attenuated in severity. Including data from Wave 13, covering interviews conducted during January 2021 to May 2023, in the main analyses would confound the effects of the pandemic and the energy crisis that began in 2021 (National Energy Action, 2024). Therefore, we exclude Wave 13 data from our main analysis.

Key measures of health behaviours

Consumption of fruits and vegetables

Respondents completed questions on the frequency of consuming fruits and vegetables in Waves 2, 5, 7, 9, and 11 and on the quantity of consumption in Waves 7, 9 and 11. Participants are asked “Including tinned, frozen, dried and fresh fruit, on how many days in a usual week do you eat fruit?” and “Including tinned, frozen, and fresh vegetables, on how many days in a usual week do you eat vegetables? Do not include potatoes, crisps, or chips”. Responses are captured on a four-point scale (1 = Never, 2 = 1–3 days, 3 = 4–6 days, 4 = Everyday). If respondents report eating fruits and vegetables during the week, then they are asked questions on their quantity of consumption. Specifically, respondents are asked “On the days when you eat fruit, how many portions (e.g., an apple, an orange, some grapes) do you eat?” and “On the days when you eat vegetables, how many portions (i.e., three heaped tablespoons) do you eat? Please do not include potatoes.” Respondents provided a continuous response to these questions.

We collapse these responses into three binary variables: the number of days a respondent consumes fruit in a week, the number of days a respondent consumes vegetables in a week, and the number of servings of fruits and vegetables per day. The first two variables are coded so that “1” captures consuming fruits and vegetables at least four days in a week and “0” otherwise. The third variable is coded so that “1” captures consuming at least 5 servings of fruits and vegetables a day and “0” otherwise, based on the ‘five-a-day’ recommendation from the WHO (WHO, 1990). Finally, as this last variable is based on a question that is asked only to respondents who report consuming fruits and vegetables per week, we capture respondents who report no consumption during the week as consuming no servings of fruits and vegetables.

Physical activity

Respondents are asked questions about their physical activity (moderate and/or vigorous activities and walking) in Waves 7, 9, and 11. Respondents are first asked to provide information on the number of days they engage in moderate and/or vigorous activities (excluding walking) for at least ten minutes at a time in the last seven days. Respondents are told that “Moderate activities include those that make you breathe somewhat harder than normal and may include carrying light

loads, bicycling at a regular pace, or doubles tennis” and “vigorous activities include those that make you breathe much harder than normal and may include heavy lifting, digging, aerobics, or fast bicycling”. Respondents who indicate that they are physically active for ten minutes or more on at least one day are also asked how much time they spent being physically active for each activity type, in a combination of hours and minutes on one of those days. Additionally, respondents are asked to provide information on the number of days they walked for at least ten minutes in the last week. Respondents are told that “This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure”. Respondents who indicate that they have walked for at least ten minutes or more on at least one day are also asked how much time they spent walking, in a combination of hours and minutes on one of those days. Currently, the WHO’s physical activity guidelines recommend at least 600 metabolic equivalent task (MET) minutes a week (World Health Organization, 2010). Although these guidelines exclude walking, we include walking as part of physical activity in our analyses as individuals may have substituted walking for other types of exercise or sports that were no longer feasible due to social restrictions during the pandemic (Hunter et al., 2021).

We collapse responses to the above questions into a binary variable based on the WHO’s recommended 600 MET minutes of moderate and/or vigorous activities per week. To obtain MET minutes, minutes spent in vigorous activities are multiplied by 8 and minutes spent in moderate activities are multiplied by 4. For simplicity, we consider walking as a ‘moderate’ activity and multiply weekly time spent walking by 4 to obtain the equivalent MET minutes. As the ‘time spent on physical activity and walking’ variables are based on questions that are only asked if a respondent confirms that they have engaged in physical activity or walked on at least one day per week, we include respondents who report no physical activity in the “0” category which denotes activity less than the recommended 600 MET minutes.

Consumption of alcohol

Respondents completed the AUDIT-C in Waves 7, 9, and 11. Respondents are asked “Thinking about the past 12 months, how often do you have a drink containing alcohol?” and responses are captured on a five-point scale (1 = Never, 2 = Monthly or less, 3 = 2–4 times per month, 4 = 2–3 times per week, 5 = 4+ times per week). The AUDIT-C also includes a question on the frequency of heavy episodic alcohol use, defined for women/men as drinking 6/8 or more units on a single occasion. Specifically, respondents are asked “How often have you had 6 or more units (if female)/8 or more units (if male), on a single occasion in the last year?”. Respondents are told that “By a unit we mean ½ a pint of beer, a glass of wine or a single measure of spirit or liquor”. Response options are: 1=Never, 2 = Less than monthly, 3 = Monthly, 4 = Weekly, and 5 = Daily or almost daily. We recode the ‘frequency of consumption’ variable so that “1” captures drinking less than 2–3 times per week and ‘the occasions of binge-drinking’ variable so that “1” captures binge-drinking less than weekly. Note, these variables are coded so that “1” captures healthier behaviour, consistent with how fruits and vegetables intake and physical activity are coded. As these variables are based on questions that are only asked if a respondent confirms that they have had an alcoholic drink in the past 12 months, we include respondents who report no consumption in the “0” categories.

Healthy lifestyle index

Following previous studies, we include a ‘healthy lifestyle index’ to understand the aggregate effects associated with the health behaviours detailed above (Shaw and Agahi, 2012). As individuals are likely to report a mix of healthy and unhealthy behaviours, the effect of a positive health behaviour in one domain may offset the effect of a poorer health behaviour in another domain. Thus, it is difficult to interpret the coefficient on a single health behaviour without taking other health behaviours into account. Focusing on the ‘healthy lifestyle index’ addresses this issue and concerns around multiple hypothesis testing. We employ both the continuous and cut-off measure in our analyses. The

continuous measure is derived by summing the number of healthier options reported by each respondent so that each behaviour is weighted equally. This measure could range from 0 (no healthy behaviours) to 6 (all healthy behaviours). The cut-off measure is defined so that “1” captures respondents who score positively on most of the items (i.e., four or more) and “0” otherwise.

Mental health

Respondents completed the 12-item version of the General Health Questionnaire (GHQ-12) in every wave of the Main Study. In the GHQ-12, respondents are asked questions about their general happiness, confidence, and their capacity to face problems, overcome difficulties, make decisions, and enjoy normal day to day activities. The questionnaire asks respondents to evaluate their wellbeing with respect to ‘usual’ and thus provides a reference point against which respondents evaluate their current feelings. Each item of the GHQ is answered on a 4-point Likert scale which is rescaled in the dataset from 0 (least distressed) to 3 (most distressed). Our measure is derived from the Likert index which sums the scores from these items to yield a total score between 0 and 36 with higher scores indicating worse mental health. The GHQ-12 score is highly correlated with standardised clinical interviews assessing the presence of clinical levels of distress (Goldberg et al., 1997).

All the variables used in the main analyses are listed in Table 1. After accounting for missing values, we have a total of 75,174 observations corresponding to 40,734 respondents. Based on Table 1, over 60 per cent of respondents report consuming fruits at least four days in a week, over

Table 1
The estimation sample by key characteristics across waves.

	Wave 7 (2015–2017)	Wave 9 (2017–2019)	Wave 11 (March 2020–May 2021)
Female	55.7%	55.4%	56.0%
Age	49.3 years	50.6 years	50.7 years
White	78.8%	80.1%	72.4%
Has at least a higher education qualification	39.9%	41.8%	46.4%
Region			
England	78.6%	77.8%	90.1%
Northern Ireland	6.1%	6.6%	0.3%
Scotland	8.7%	8.9%	5.8%
Wales	6.6%	6.7%	3.8%
More days fruit consumed	65.5%	63.3%	62.8%
More days vegetables consumed	77.9%	75.3%	74.3%
More servings of fruits and vegetables	43.2%	52.1%	53.4%
Limited frequency of alcohol consumption	43.3%	42.5%	46.3%
Limited frequency of binge-drinking	76.7%	78.0%	83.5%
More physical activity	80.7%	82.5%	76.6%
Number of health behaviours	3.6 (1.3)	3.7 (1.4)	3.7 (1.3)
At least four health behaviours	63.2%	65.1%	66.1%
GHQ-12 Likert Score	10.9 (5.5)	11.3 (5.6)	12.0 (5.7)
GHQ-12 Caseness Score	1.7 (3.0)	1.8 (3.1)	2.2 (3.2)
Presence of psychological distress	22.2%	22.9%	29.4%
N - Observations	34,902	30,628	9,644

Notes: Sample is restricted to individuals aged 18 and above. The binary health behaviour variables are defined as follows: fruit consumed at least 4 days a week vs. less than; vegetables consumed at least 4 days a week vs. less than; at least 5 servings of fruits and vegetables a day vs. less than, alcohol consumed less than 2–3 times a week vs. more than; binge-drinking less than weekly vs. more than; at least 600 MET minutes of physical activity vs. less than; and at least four health behaviours vs. less than. The presence of psychological distress is assessed based on a cut-off score of 3 and above on the GHQ-12. Standard deviations are provided in parentheses for continuous variables.

70 per cent report consuming vegetables at least four days a week, and over 40 per cent report consuming at least 5 servings of fruits and vegetables a day. As a benchmark, the 2018 Health Survey for England reports that close to 30 per cent of respondents consumed at least 5 servings of fruits and vegetables a day. In terms of alcohol consumption, less than 50 per cent of respondents report consuming alcohol less than 2 to 3 times per week and almost 80 per cent report binge-drinking less than weekly. These values are comparable to those obtained from the Health Survey for England. As for physical activity, approximately 80 per cent of respondents achieved at least 600 MET minutes of exercise in a week. This is higher than the estimate provided by the Health Survey for England which reports that just over 70 per cent of respondents are physically active (NHS England, 2018). The higher estimate in our data is likely driven by the inclusion of walking as a physical activity. Most respondents in our sample report a healthy lifestyle. About 20 per cent of respondents report the presence of psychological distress (GHQ Caseness score equal to or greater than 3 out of 12) before the pandemic with a significant increase in incidence during the pandemic, consistent with prior studies (Daly et al., 2022).

In Table 2, we compare unadjusted means by gender, for the health behaviour and psychological distress variables, before and during the pandemic. Consistent with other studies (NHS England, 2018; Etheridge and Spantig, 2022), women report better health behaviours and worse mental health than men. For example, before the pandemic, 70 per cent of women reported at least four health behaviours compared to 56.7 per cent of men. Despite changes in health behaviours during the pandemic, women are still more likely than men to report better ‘levels’ of health behaviours than men.

Table 2
A comparison of outcome variables before and during the pandemic by gender.

	Women		Men	
	Before the pandemic	During the pandemic	Before the pandemic	During the pandemic
More days fruit consumed	68.6%	65.8%	59.3%	59.0%
More days vegetables consumed	79.1%	76.3%	73.6%	71.7%
More servings of fruits and vegetables	50.7%	56.2%	43.2%	49.9%
Limited frequency of alcohol consumption	49.5%	52.1%	34.7%	38.9%
Limited frequency of binge-drinking	82.5%	86.8%	70.7%	79.3%
More physical activity	79.1%	74.6%	84.7%	79.2%
Number of health behaviours	4.1 (1.3)	4.1 (1.3)	3.7 (1.3)	3.8 (1.3)
At least four health behaviours	70.0%	70.5%	56.7%	60.5%
GHQ-12 Likert Score	11.6 (5.8)	12.6 (5.9)	10.5 (5.1)	11.2 (5.4)
GHQ-12 Caseness Score	2.0	2.6	1.4	1.8
Presence of psychological distress	25.7%	34.6%	18.6%	22.8%
N - Observations	36,414	5404	29,116	4,240

Notes: Sample is restricted to individuals aged 18 and above. The binary health behaviour variables are defined as follows: fruit consumed at least 4 days a week vs. less than; vegetables consumed at least 4 days a week vs. less than; at least 5 servings of fruits and vegetables a day vs. less than, alcohol consumed less than 2–3 times a week vs. more than; binge-drinking less than weekly vs. more than; at least 600 MET minutes of physical activity vs. less than; and at least four health behaviours vs. less than. The presence of psychological distress is assessed based on a cut-off score of 3 and above on the GHQ-12. Standard deviations are provided in parentheses for continuous variables.

3.2. Empirical strategy

To study the differential effect of the COVID-19 pandemic on health behaviours by gender, we begin with a basic difference-in-differences (DID) model. In this model, health behaviours are regressed on an indicator for whether the respondent is female, an indicator for the COVID-19 time period (March 2020 to May 2021), and the interaction of these two variables. The coefficient on the interaction term shows the gender differences in the effect of the pandemic on health behaviours.

Specifically, we estimate the following equation:

$$Y_{it} = \delta_i + \delta_2 \text{Female}_i + \delta_3 (\text{Female}_i * \text{COVID}_t) + \delta_4 X_{it} + m_t + \varepsilon_{it} \quad (1)$$

X_{it} captures controls for ethnicity, region, age, and educational attainment. To remove seasonal effects in health behaviours, we also take account of month effects (m_t), thus comparing outcomes at the month-level. Importantly, to attribute estimated gender differences to the COVID-19 pandemic, we assume that the health behaviours of women and men would have evolved in the same way in the absence of the pandemic (parallel trends assumption). We also assume that any gender differences in reporting of health behaviours either remain constant over time or evolve in the same manner and that the sample composition of women and men remains the same over time, except for any changes in the observed variables.

Given that we only observe the full sample of respondents in two waves prior to the pandemic, we exclude the formal test for pre-trends as there is a high likelihood that it may confound statistical noise for 'actual' pre-trends (Miller, 2023). Implementing the formal test based on interview year instead of wave may also introduce bias as the UKHLS sample is interviewed over two years for one wave of data i.e., the sample is not fully observed in one interview year. To account for the effect of potential pre-trends on our results, we also estimate results from DID models that account for gender-specific linear trends by including an interaction term between gender and (continuous) interview year (Miller, 2023; Mendolia et al., 2022). Figure S1 in the Supplementary Materials provides plots of the evolution of the health behaviour and mental health variables over time by gender.

Further, we estimate DID models with a gender and age interaction, to allow for gender-differences in the evolution of health behaviours as respondents get older, and with individual fixed effects to account for the effects of any time-invariant factors. Our key coefficient of interest is δ_3 . A negative coefficient on δ_3 captures declines in health behaviours among women and/or improvements among men during the pandemic.

The second part of our analysis investigates whether the pandemic affected the protective effect of health behaviours on mental health, differentially for women and men. In this analysis, we estimate separate regressions by gender. Specifically, we regress mental health on health behaviours, an indicator for the COVID-19 pandemic, and an interaction of these two variables as follows:

$$MH_{it} = \beta_1 + \beta_2 HB_{it} + \beta_3 (HB_{it} * \text{COVID}_t) + \beta_4 X_{it} + m_t + \gamma_i + \mu_{it} \quad (2)$$

We control for ethnicity, region, age, and educational attainment as well as account for month fixed effects and individual fixed effects. Following other studies that investigate the relationship between mental health and health behaviours (Mujcic and Oswald, 2016; Ocean et al., 2019), this specification analyses the change-on-change relationship between health behaviours and mental health while accounting for any time-invariant omitted confounders such as childhood and family circumstances as well as personality traits. Our key coefficients of interest are β_2 , which captures the relationship between mental health and health behaviours before the pandemic, and $\beta_2 + \beta_3$, which captures this relationship during the pandemic. The effect of the pandemic on this

relationship i.e., the difference in this relationship before and during the pandemic, is captured by β_3 . For Specification 1 and 2, we restrict our sample to respondents aged at least 18 years old and cluster standard errors at the individual level.¹ In the individual fixed effects estimations, we rely on a sample of respondents ($N = 27,697$) observed more than once in the data.

4. Results

4.1. Main analyses: What is the effect of the COVID-19 pandemic on health behaviours and the protective effect of these behaviours on mental health by gender?

Before focusing on differences in health behaviours by gender, we present results of the overall effect of the pandemic on health behaviours in Panel A of Table 3 based on the main DID model. Results show that the effect of the pandemic on the number of health behaviours and whether an individual reports a majority of health behaviours is not statistically significant at the 1% level. In terms of particular health behaviours, individuals report a statistically significant decrease in the number of days fruits and vegetables are consumed and physical activity. On the other hand, individuals report a significant increase in the servings of fruits and vegetables on a typical day and lower alcohol consumption. These results are consistent with prior studies described previously (Mitchell et al., 2022; Dicken et al., 2022; Hardie et al., 2022). At the overall level, declines in particular health behaviours and improvements in others offset each other resulting in no significant changes.

Panel B of Table 3 provides results on the effect of the pandemic by gender. The coefficient on 'Pandemic' shows the effect of the pandemic on males, the coefficient on 'Female' shows the effect of being female on health behaviours before the pandemic, and the interaction term describes the additional effect of the pandemic for females compared to men. Consistent with Table 2, women report a higher consumption of fruits and vegetables, less alcohol consumption, and lower physical activity resulting in better overall health behaviours compared to men before the pandemic. For men, the pandemic is associated with a significant decline in the number of days fruits and vegetables are consumed and physical activity but improvements in servings of fruits and vegetables and alcohol consumption which results in better overall health behaviours. For females, we see a larger decline in the number of days fruits are consumed and higher alcohol consumption compared to men. When aggregated, this results in poorer changes in health behaviours compared to men during the pandemic. Full results for Table 3 including coefficients for the control variables are available in Table S1 in the Supplementary Materials.

Next, we discuss the differential effect of the pandemic by gender in greater depth. Fig. 1 presents results on the differential effect of the pandemic on health behaviours by gender from four DID models which are estimated separately for each outcome. Based on Panel A which presents estimates of the main DID model, women were 3.2 percentage points less likely to report at least four health behaviours (i.e., a healthy lifestyle) and reported 0.09 fewer health behaviours compared to men during the pandemic. Both these effects are significant at the 1 per cent level. We observe a significant decrease in the consumption of fruits by 2.2 percentage points (significant at the 5 per cent level), increase in the frequency of alcohol consumption by 1.8 percentage points (significant at the 5 per cent level), and increase in binge-drinking occasions by 4.3 percentage points (significant at the 1 per cent level) compared to men.

The effects observed for the likelihood of adopting a healthy lifestyle and number of health behaviours are robust to the inclusion of gender-specific trends (Panel B), gender-age interaction (Panel C), and individual fixed-effects (Panel D). Gender differences in specific health

¹ Results are similar when heteroskedasticity robust standard errors are used in the individual fixed effects models. Results are available upon request.

Table 3
The effect of the pandemic on health behaviours on the full sample and by gender.

	More days fruit consumed	More days vegetables consumed	More servings of fruits and vegetables	Limited frequency of alcohol consumption	Limited frequency of binge drinking	More physical activity	At least four health behaviours	Number of health behaviours
<i>Panel A: The effect of the pandemic on health behaviours on the full sample</i>								
Pandemic	-0.032*** (0.005)	-0.030*** (0.004)	0.044*** (0.005)	0.023*** (0.005)	0.043*** (0.004)	-0.053*** (0.004)	-0.002 (0.005)	-0.005 (0.013)
<i>Panel B: The effect of the pandemic on health behaviours by gender</i>								
Pandemic	-0.019*** (0.007)	-0.026*** (0.007)	0.050*** (0.008)	0.033*** (0.007)	0.067*** (0.006)	-0.059*** (0.006)	0.016** (0.007)	0.046** (0.020)
Female	0.094*** (0.004)	0.056*** (0.004)	0.074*** (0.004)	0.146*** (0.005)	0.120*** (0.004)	-0.059*** (0.003)	0.133*** (0.004)	0.430*** (0.012)
Pandemic*	-0.022** (0.010)	-0.007 (0.009)	-0.011 (0.010)	-0.018** (0.009)	-0.043*** (0.008)	0.010 (0.009)	-0.032*** (0.010)	-0.091*** (0.025)
Female								
Number of observations	75,174	75,174	75,174	75,174	75,174	75,174	75,174	75,174

Notes: Sample includes 40,734 respondents and is restricted to respondents aged 18 and above. Panel A presents coefficients from OLS models that regress health behaviours on a pandemic indicator and adjust for sex, age, educational attainment, region, and month fixed effects. Panel B presents estimated coefficients on the pandemic and female indicators and interaction of these variables based on the main DID model adjusting for ethnicity, age, educational attainment, region, and month fixed effects. The binary health behaviour variables are defined as follows: fruit consumed at least 4 days a week vs. less than; vegetables consumed at least 4 days a week vs. less than; at least 5 servings of fruits and vegetables a day vs. less than, alcohol consumed less than 2–3 times a week vs. more than; binge-drinking less than weekly vs. more than; at least 600 MET minutes of physical activity vs. less than; and at least four health behaviours vs. less than. Standard errors are clustered at the individual level. *, **, *** indicates significance at the 10, 5 and 1 percent levels respectively.

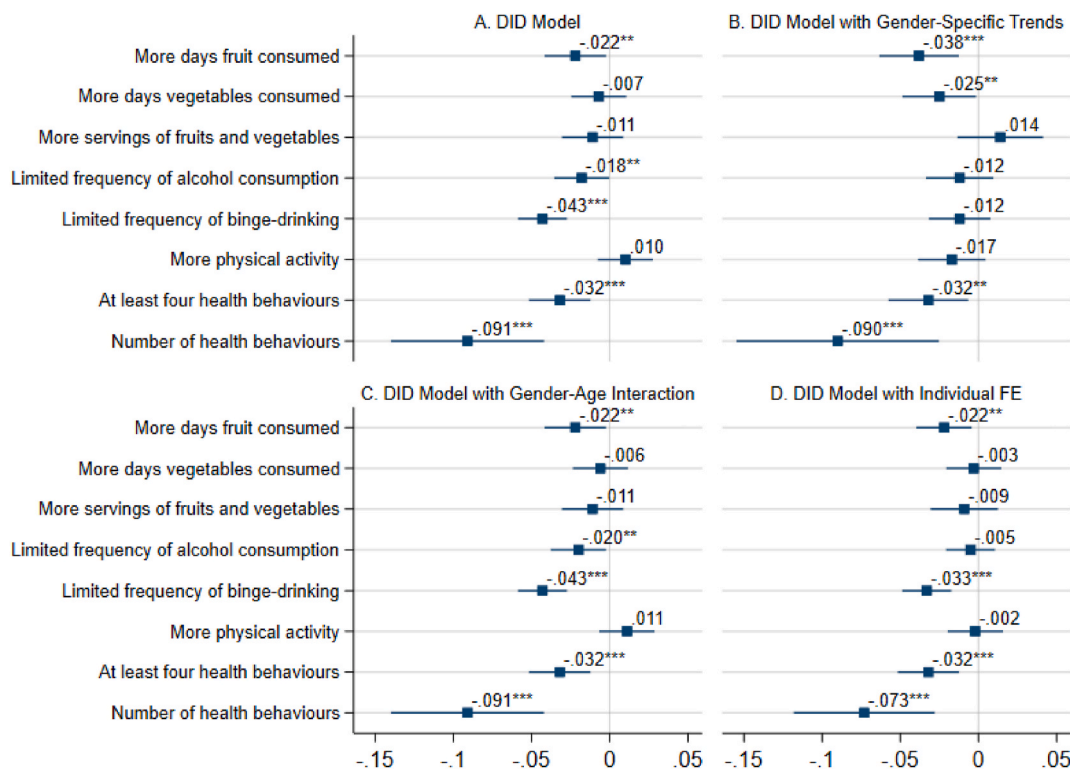


Fig. 1. Gender differences in pandemic effects on health behaviours.

Notes: Sample includes 40,734 respondents and is restricted to respondents aged 18 and above. The figure presents estimated coefficients on the interaction between female and pandemic indicators from DID models and corresponding 95 per cent confidence intervals. The DID models adjust for ethnicity, age, educational attainment, region, and month fixed effects. The binary health behaviour variables are defined as follows: fruit consumed at least 4 days a week vs. less than; vegetables consumed at least 4 days a week vs. less than; at least 5 servings of fruits and vegetables a day vs. less than, alcohol consumed less than 2–3 times a week vs. more than; binge-drinking less than weekly vs. more than; at least 600 MET minutes of physical activity vs. less than; and at least four health behaviours vs. less than. Standard errors are clustered at the individual level.

*, **, *** indicates significance at the 10, 5 and 1 percent levels respectively.

behaviours are largely consistent, although some differences emerge once gender-specific trends are controlled for. Additionally, we assess the stability of the main results when employing data from the COVID-19 Study of UKHLS. Results are available in [Figure S3](#) in the

Supplementary Materials. Consistent with results in [Fig. 1](#), women reported worse changes in health behaviours during the pandemic compared to men, albeit with some differences in the direction and magnitude of the coefficients for particular health behaviours.

Figure S2 (B) in the Supplementary Materials first provides the overall effect of the pandemic on the relationship between mental health and health behaviours and shows a decline in the protective effect of health behaviours on mental health. The next step is to estimate the effect of the pandemic on the protective effect of health behaviours on mental health by gender. Figs. 2 and 3 present results based on individual fixed effects models estimated separately for each outcome variable and stratified by gender of the respondent. The first column of results in Figs. 2 and 3 shows the associations between mental health and health behaviours before the pandemic. The second column shows the associations between mental health and health behaviours during the pandemic. These are obtained by summing the coefficients on the health behaviour variables and the interaction between these variables and the pandemic indicator. The third column presents the differences in coefficients between column one and two and associated significance values.

Based on Fig. 2, there is a large statistically significant relationship between health behaviours and mental health, among women, before the pandemic. We observe this relationship for all the health behaviour measures except for the frequency of alcohol consumption. In terms of the overall health behaviour measures, adopting a healthy lifestyle is associated with a 0.61-points decline in the GHQ-12 Likert score and each incremental health behaviour is associated with a 0.34-points decline in the score, both significant at the 1 per cent level. However, during the pandemic, the associations between most of these health behaviour measures and mental health weaken or disappear, except for the frequency of alcohol consumption and binge-drinking. Notably, the association between mental health and the healthy lifestyle indicator completely disappears during the pandemic. The loss of this relationship corresponds to a loss of 10.5 per cent of a standard deviation in the GHQ-12 Likert score.² The association between mental health and the number of health behaviours reported decreases in magnitude by 0.18 points (corresponding to 3.1 per cent of a standard deviation) but remains statistically significant at the 5 per cent level.

While the associations between better mental health and lower alcohol consumption increase during the pandemic, it is notable that women reported worse changes in alcohol consumption compared to men during the pandemic. If changes in health behaviours during the pandemic were driving these findings, we would expect to see a weakening of the link between mental health and health behaviours only for behaviours that worsened for women during the pandemic. Thus, these findings regarding mental health may not only be due to changes in health behaviours, but possibly also an actual reduction in the psychological benefits of health behaviours among women during the pandemic.

Based on Fig. 3, we also see a strong statistically significant relationship between health behaviours and mental health among men before the pandemic, albeit to a lesser extent than for women. During the pandemic, the associations between mental health and health behaviours are generally stable in magnitude. However, except for limited frequency of binge-drinking, these differences are not statistically significant. Thus, while the pandemic is associated with a lower protective effect of health behaviours on mental health for women, this protective effect remains unchanged for men. Notably, while the protective effect of overall health behaviours is stronger for women before the pandemic, it is stronger for men during the pandemic. For example, during the pandemic, each incremental health behaviour is associated with a 0.16-points decline (significant at the 5 per cent level) in the Likert score for women but is associated with a 0.24-points decline (significant at the 1 per cent level) for men. In sum, we see smaller gains in health behaviours and lower psychological benefits from these behaviours for women

² This estimate is calculated based on pre-pandemic values available in Column 2 of Table 2. Specifically, the difference before and during the pandemic is divided by 5.8 and multiplied by 100.

compared to men during the pandemic.

As a further supplementary analysis, we evaluate how results in Figs. 2 and 3 change when employing data from the COVID-19 Study. Results are available in Figures S4 and S5 in the Supplementary Material and show a less pronounced decline in the protective effect of health behaviours on mental health among women, potentially because the data is now restricted to particular time points during the pandemic.

In order to gauge potential mechanisms underlying our results, we re-estimate Specification 1 and 2 with a more detailed list of covariates. The additional contemporaneous covariates include partnership status, household income, employment status, household size, presence of children aged 15 and below in the household, physical functioning based on the SF-12 questionnaire, personality traits based on the Big-5 questionnaire, experience of loneliness, and presence of psychological distress (psychological distress is excluded for Specification 2).³ Following other studies, we focus on these variables as they likely influenced the risk of poorer outcomes during the pandemic (e.g., Etheridge and Spantig, 2022). These covariates are potentially endogenous, in that they may have increased exposure to COVID-19 and/or the effects of the pandemic. Albeit not causal, these results provide some indication as to which factors contribute to poorer health behaviours and a decline in the protective effect of these behaviours on mental health among women. For brevity, we restrict these analyses to the number of health behaviours and whether a respondent reports a majority of health behaviours. Results are available in Table S2 and S3 in the Supplementary Materials.

Based on Table S2, respondents who are unemployed, have a larger household, report higher levels of extroversion and neuroticism, feel greater loneliness, and report the presence of psychological distress tend to report significantly worse health behaviours. Respondents who report higher household income, are married or live as a couple, are retired, have children in the household, and report greater openness tend to have better health behaviours. Importantly, the adverse effect of the pandemic on changes in health behaviours among women is robust to the inclusion of these controls. In Table S3, female respondents who are unemployed, report worse physical health, and experience greater loneliness are more likely to report worse mental health. The importance of loneliness is large in both cases and supports previous findings on the role of social support in buffering against distress during the pandemic (Etheridge and Spantig, 2022; Johnston et al., 2020). While previous studies document the impact of the pandemic on increased childcare and household responsibilities (Cheng et al., 2021; Oreffice and Quintana-Domeque, 2021), we find limited evidence that these factors contributed to poorer health behaviours and a lower protective effect of health behaviours among women.

We also evaluate the sensitivity of our results to using the GHQ-12 Caseness score and indicator variables. Results are available in Figures S6 to S9 in the Supplementary Material and confirm our main results. In particular, the corroborating evidence from using the GHQ-12 cut-off score highlight that the reduction in the protective effect of health behaviours on mental health for women during the pandemic has significant clinical implications on broader psychological distress.

An important challenge to our results is potential reverse causation and whether poorer mental health among women during the pandemic results in worse health behaviours. As discussed previously, women experienced greater levels of psychological distress compared to men during the pandemic (Etheridge and Spantig, 2022). This could have led to poorer health behaviours to cope with and alleviate distress. To gauge

³ The Big-5 questionnaire was only fielded in Wave 3 of the Main UKHLS survey. To address the issue of missing values, we first apply backwards and forwards filling before imputing further missing values based on the average mean in the sample. We do not impute missing values for the other variables. Thus, the inclusion of these additional controls results in a modest loss in sample size.

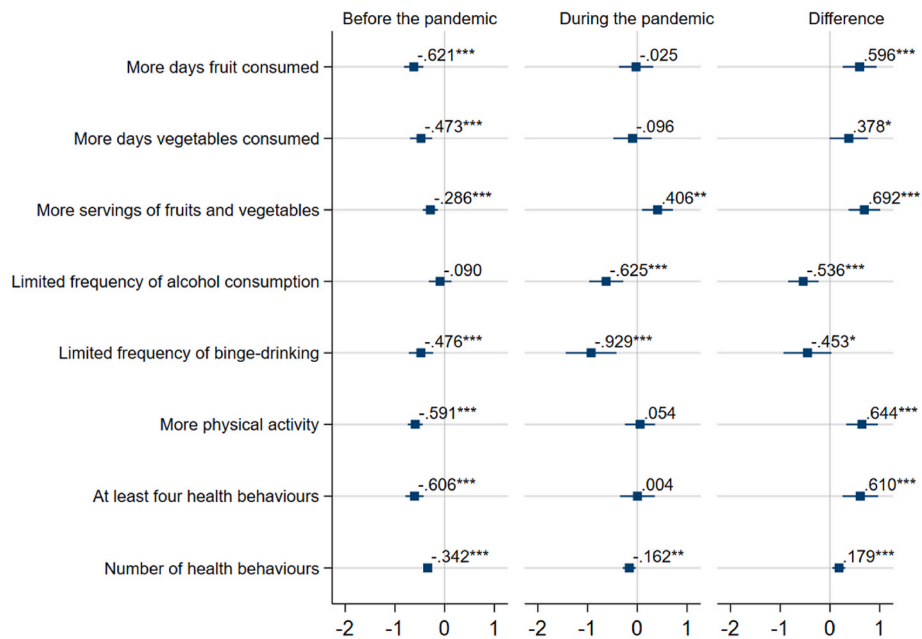


Fig. 2. The protective effect of health behaviours on mental health among women.

Notes: Sample includes 22,460 female respondents and is restricted to respondents aged 18 and above. The figure presents estimated coefficients on the interaction between health behaviours and pandemic indicators from DID models and corresponding 95 per cent confidence intervals. The binary outcome variables are compared as follows: fruit consumed at least 4 days a week vs. less than; vegetables consumed at least 4 days a week vs. less than; at least 5 servings of fruits and vegetables a day vs. less than, alcohol consumed less than 2–3 times a week vs. more than; binge-drinking less than weekly vs. more than, at least 600 MET minutes of physical activity vs. less than; and at least four health behaviours vs. less than. The DID models adjust for ethnicity, age, educational attainment, region, month fixed effects, and individual fixed effects. Results reflect rounding adjustments. *, **, *** indicates significance at the 10, 5 and 1 percent levels respectively.

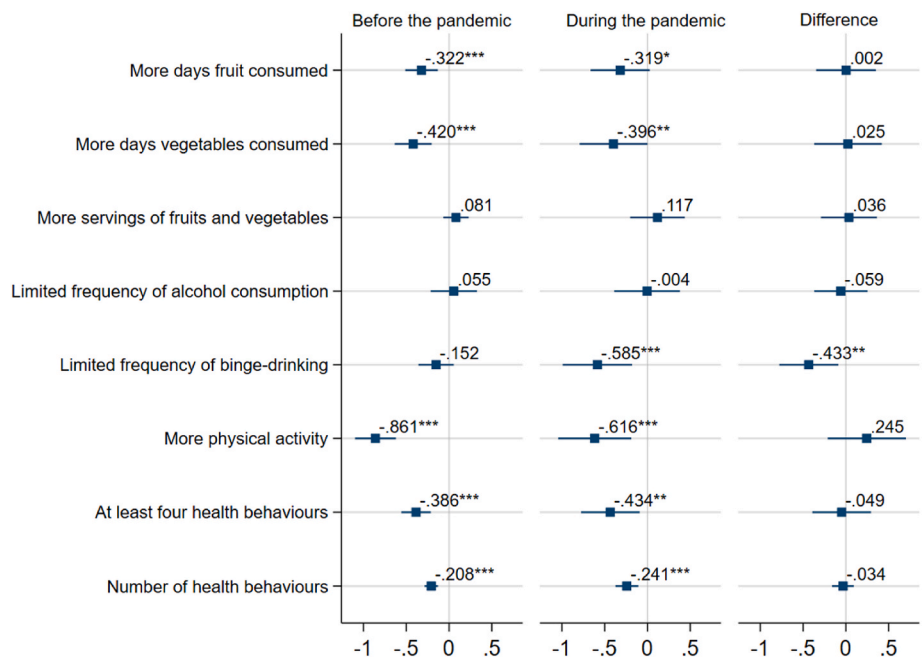


Fig. 3. The protective effect of health behaviours on mental health among men.

Notes: Sample includes 18,274 male respondents and is restricted to respondents aged 18 and above. The figure presents estimated coefficients on the interaction between health behaviours and pandemic indicators from DID models and corresponding 95 per cent confidence intervals. The models adjust for ethnicity, age, educational attainment, region, month fixed effects, and individual fixed effects. The binary health behaviour variables are defined as follows: fruit consumed at least 4 days a week vs. less than; vegetables consumed at least 4 days a week vs. less than; at least 5 servings of fruits and vegetables a day vs. less than, alcohol consumed less than 2–3 times a week vs. more than; binge-drinking less than weekly vs. more than, at least 600 MET minutes of physical activity vs. less than; and at least four health behaviours vs. less than. Standard errors are clustered at the individual level. Results reflect rounding adjustments. *, **, *** indicates significance at the 10, 5 and 1 percent levels respectively.

the extent to which this might affect our results, we stratify Specification 1 (base DID model) by individuals who report and do not report psychological distress based on the GHQ-12 cut-off measure. Results are provided in Figure S10 in the Supplementary Materials. The pandemic is associated with significantly worse changes in health behaviours among women compared to men, only for respondents without psychological distress. Among individuals without psychological distress, women report 0.12 fewer health behaviours and are 4.2 percentage points less likely to report a healthy lifestyle (significant at the 1 per cent level) compared to men. The lack of a significant effect on health behaviours among women with psychological distress indicates that the effect of the pandemic on health behaviours is not purely driven by higher psychological distress. This is also supported by earlier results, in Table S2, showing that poorer changes in health behaviours among women remain significant even after controlling for distress and loneliness levels. Our main findings are also robust when walking is excluded from our physical activity measure. Results are available in Figures S11 to S13 in the Supplementary Materials.

4.2. Additional analyses: Do these findings persist beyond May 2021?

Finally, we evaluate whether our findings persist beyond May 2021. Specifically, we include Wave 13, covering interviews conducted during January 2021–May 2023. Most of the fieldwork was completed from June 2021 onwards. While the World Bank officially declared an end to the COVID-19 pandemic on May 5, 2023, social restrictions in the UK were largely lifted from May 2021 onwards. Therefore, outcomes captured in Wave 13 can be considered as an extension of our existing analysis by assessing the persistence of these effects at a time with the COVID-19 crisis was attenuated to a considerable extent. However, Wave 13 data also captures possible effects of the energy crisis which began in 2021 in the UK (National Energy Action, 2024) and the interpretation of these results is limited.

To implement this new analysis, we include data from Wave 13 in

our ‘pandemic’ periods together with data from Wave 11. Based on Fig. 4, we see that the adverse changes in health behaviours for women compared to men are exacerbated when our analyses cover data until May 2023. In the main model, women are 4.5 percentage points less likely to report a majority of healthy behaviours and report 0.121 fewer health behaviours compared to men. Our results are fairly consistent when controlling for gender-specific trends, gender age interactions, and individual fixed effects. The larger magnitudes observed here compared to results in Fig. 1 provide evidence that the adverse changes in health behaviours among women persisted.

As shown in Fig. 5, the protective effect of health behaviours on mental health appears to show signs of recovery among women when later stages of the pandemic are taken into account. While the relationship between the healthy lifestyle index and mental health attenuates across the two periods, the coefficient of -0.49 in the pandemic period is now statistically significant (in contrast to the coefficient in Fig. 2). In addition, relative to Fig. 2, the relationship between the number of health behaviours and mental health appears stronger, with the pre-post difference also now significant at the 10 percent level. However, in terms of specific health behaviours, a more nuanced picture emerges: a protective effect in terms of the number of days fruits and vegetables are consumed returns, but not for servings of fruit and vegetables, whilst the protective effect of physical activity is also now evident, with a statistically significant value of -0.57 . For both alcohol variables however, there is now a reduction of the protective effect, with lower coefficient values (relative to Fig. 2), for both consumption and binge drinking, with the relationship between lower alcohol consumption and better mental health declining between the two periods with the difference significant at the 10 percent level.

For men however, the findings shown in Fig. 6 are comparable to results in Fig. 3, with the magnitudes of the relationships between health behaviours and mental health more stable before and during the pandemic. The one exception is binge drinking, with men now appearing to gain less psychological benefits from reduced binge-drinking, with

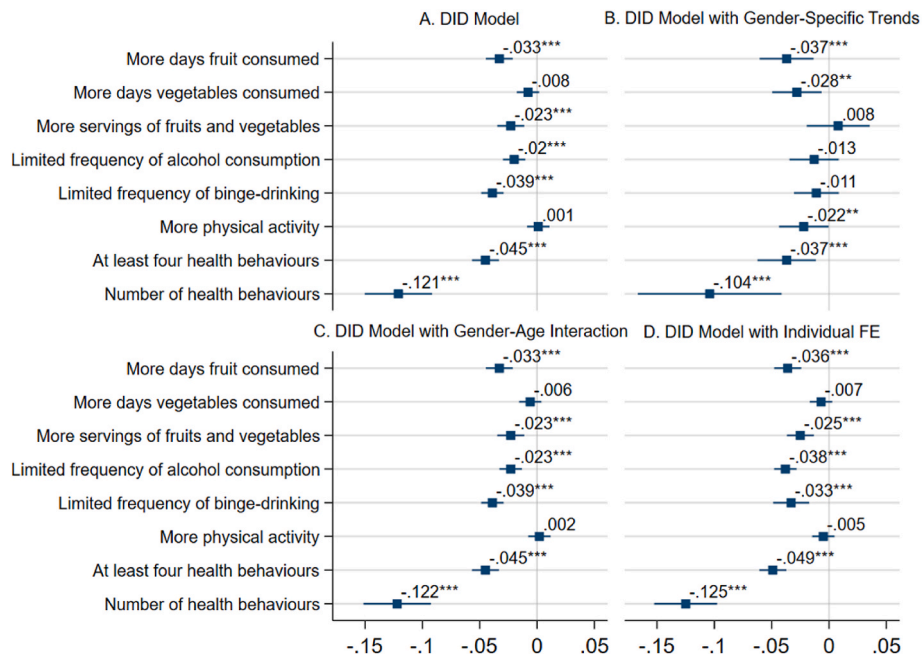


Fig. 4. Gender differences in pandemic effects on health behaviours comparing 2017–2019 and March 2020–May 2023.

Notes: Sample includes 42,960 respondents and is restricted to respondents aged 18 and above. The figure presents estimated coefficients on the interaction between female and pandemic indicators from DID models and corresponding 95 per cent confidence intervals. The DID models adjust for ethnicity, age, educational attainment, region, and month fixed effects. The binary health behaviour variables are defined as follows: fruit consumed at least 4 days a week vs. less than; vegetables consumed at least 4 days a week vs. less than; at least 5 servings of fruits and vegetables a day vs. less than; alcohol consumed less than 2–3 times a week vs. more than; binge-drinking less than weekly vs. more than; at least 600 MET minutes of physical activity vs. less than; and at least four health behaviours vs. less than. Standard errors are clustered at the individual level. *, **, *** indicates significance at the 10, 5 and 1 percent levels respectively.

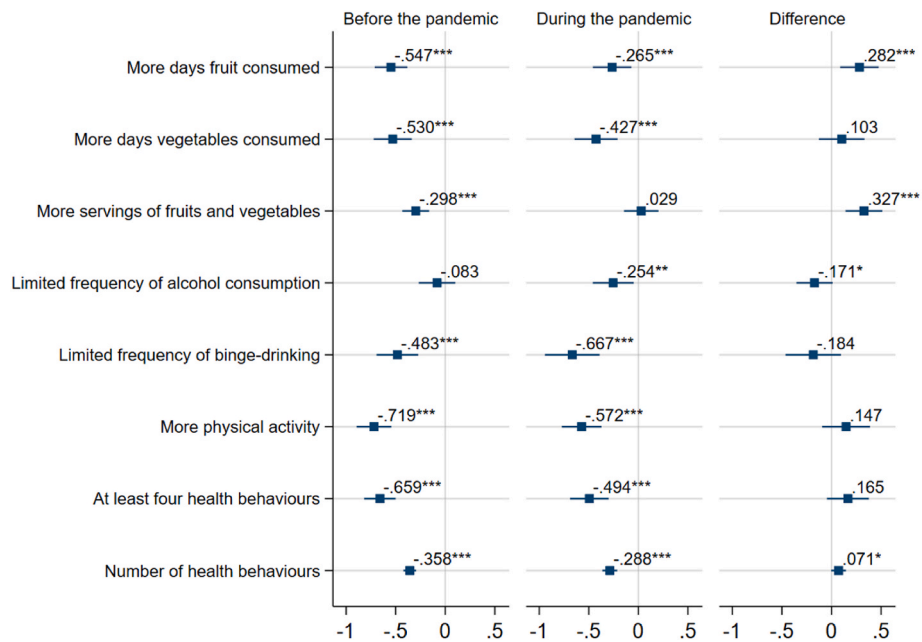


Fig. 5. The protective effect of health behaviours on mental health among women.

Notes: Sample includes 23,545 female respondents and is restricted to respondents aged 18 and above. The figure presents estimated coefficients on the interaction between health behaviours and pandemic indicators from DID models and corresponding 95 per cent confidence intervals. The binary outcome variables are compared as follows: fruit consumed at least 4 days a week vs. less than; vegetables consumed at least 4 days a week vs. less than; at least 5 servings of fruits and vegetables a day vs. less than, alcohol consumed less than 2–3 times a week vs. more than; binge-drinking less than weekly vs. more than, at least 600 MET minutes of physical activity vs. less than; and at least four health behaviours vs. less than. The DID models adjust for ethnicity, age, educational attainment, region, month fixed effects, and individual fixed effects. Results reflect rounding adjustments. *, **, *** indicates significance at the 10, 5 and 1 percent levels respectively.

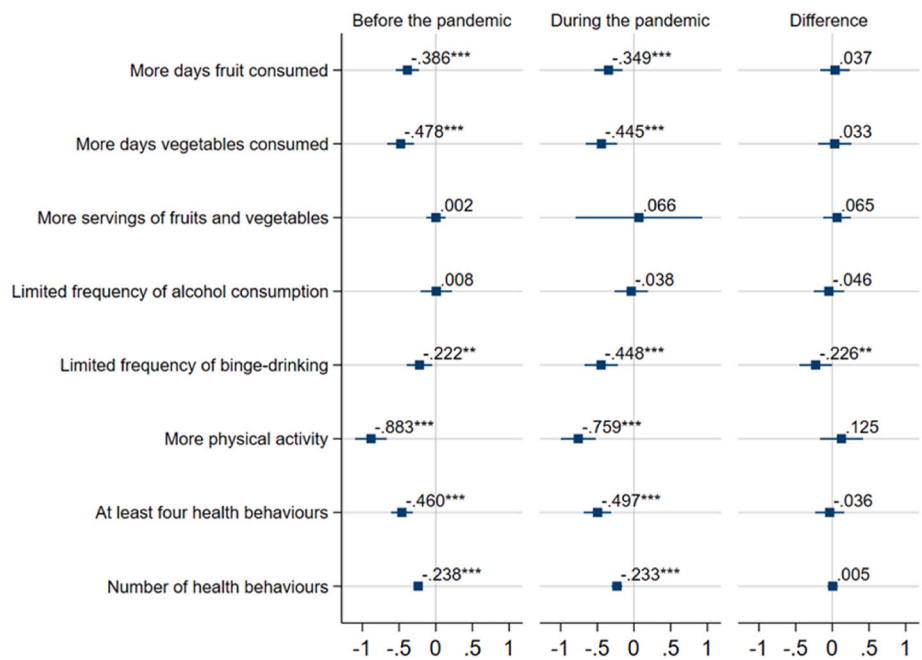


Fig. 6. The protective effect of health behaviours on mental health among men.

Notes: Sample includes 19,415 male respondents and is restricted to respondents aged 18 and above. The figure presents estimated coefficients on the interaction between health behaviours and pandemic indicators from DID models and corresponding 95 per cent confidence intervals. The binary outcome variables are compared as follows: fruit consumed at least 4 days a week vs. less than; vegetables consumed at least 4 days a week vs. less than; at least 5 servings of fruits and vegetables a day vs. less than, alcohol consumed less than 2–3 times a week vs. more than; binge-drinking less than weekly vs. more than, at least 600 MET minutes of physical activity vs. less than; and at least four health behaviours vs. less than. The DID models adjust for ethnicity, age, educational attainment, region, month fixed effects, and individual fixed effects. Results reflect rounding adjustments. *, **, *** indicates significance at the 10, 5 and 1 percent levels respectively.

a coefficient value of -0.45 , lower in absolute value compared to the coefficient value of -0.59 reported in Fig. 3.

5. Discussion

We hypothesized that women would report poorer health behaviours on average and derive less psychological benefits from these behaviours compared to men during the pandemic. The main findings largely confirm this hypothesis: relative to men, women reported significantly larger adverse changes in health behaviours and derived less psychological gains from healthy behaviours compared to men during the pandemic. However, it is also important to note that the former is mainly driven by greater improvements in the health behaviours of men compared to women during the pandemic. In terms of changes in health behaviours, women are less likely to report a healthy lifestyle by 3.2 percentage points and report 0.09 (7 per cent of a standard deviation) fewer healthy behaviours compared to men during the pandemic. These effects persist when gender-specific trends, gender-age trends, and individual fixed effects are controlled for. Furthermore, these effects are still observed even when a more detailed list of covariates including household income, employment status, and family characteristics are accounted for. While factors such as household income, unemployment and household size contribute to changes in health behaviours, the contribution of the experience of loneliness is particularly high.

Importantly, we also observe that the pandemic is associated with a weakening of the protective effect of health behaviours on mental health for women, but not for men. For women, before the pandemic, adopting a healthy lifestyle is associated with a 0.61-points decline in the GHQ-12 Likert score and each additional health behaviour is associated with a 0.34-points decline in the score. However, during the pandemic, the association between mental health and the healthy lifestyle indicator completely disappears while the association between mental health and the number of health behaviours decreases significantly. The weakening of the protective effect of health behaviours on mental health is largely driven by declines in the protective effect of fruit and vegetable consumption as well as physical activity. In contrast, the association between mental health and overall health behaviours remains unchanged for men. For women, the experience of loneliness, unemployment, and poor physical health contribute to a weaker link between mental health and health behaviours. The importance of the experience of loneliness as a potential contributor in explaining the relationships investigated in this paper is consistent with prior research documenting the role of social support in buffering against greater levels of distress experienced during the pandemic (Etheridge and Spantig, 2022; Johnston et al., 2020).

This paper has some limitations. The use of individual fixed effects models removes any bias arising from unobserved time-invariant factors that might influence both the outcome and explanatory variable of interest, for example, the influence of family background and childhood experiences. However, there are also likely to be important unobserved factors, relating to both mental health and health behaviours, which vary over time. The inclusion of fixed effects does not deal with this issue, and thus estimates of the effect of health behaviours on mental health from fixed effects models may still be biased. It is difficult to state the direction of this bias with any certainty. The persistence of adverse changes in women's health behaviours even after accounting for a detailed list of covariates highlights the role of other factors that could not be accounted for. For example, we lack information on variables that measure key psychological constructs such as resilience, hope, sense of coherence, and self-compassion that may have differentially affected the health behaviours and link with mental health of women (for e.g., Yildirim and Arslan, 2022; da-Silva-Domingues et al., 2022; Phillips and Hine, 2021). Future studies may evaluate whether these effects persist and consider employing longitudinal datasets that contain information on other health behaviours (e.g., consumption of foods high in fat, salt, and sugar; sleep) and relevant mechanisms not captured here. Further

research can also shed light on whether particular groups of women are more vulnerable to poorer 'levels' of health behaviours. The changes in the protective effect of health behaviours on mental health can also be corroborated based on data from other countries and in other contexts. In particular, it is important to understand whether these gender differences exist for individual-level stressors (e.g., bereavement, job loss, abuse) and for other large-scale stressors (e.g., economic downturns, natural disasters).

In additional analyses, we show that the adverse changes in health behaviours of women compared to men persist when we include data until May 2023. It is possible that the 'persistence' of our findings may also be attributable to other factors, such as higher inflationary pressures that were experienced in the UK from Autumn (2022) onwards. This could be hypothesized to have a greater effect on health behaviours for women relative to men, as women who tend to earn less income and work in more precarious jobs (Office for National Statistics, 2022). On a more positive note, amongst women, we also find a partial return of the protective effect of health behaviours on mental health, once data from 2022-23 and included. A more detailed investigation of the relationship between income levels, financial insecurity, household circumstances (e.g., care responsibilities) and health behaviours between men and women would be a valuable topic for further research, to understand whether the patterns we observe continue to persist.

In terms of policy implications from a public health perspective, our data suggest that general recommendations to exercise, eat well, and drink moderately to cope with psychological distress, without addressing individual-level stressors, seem to be less effective during long periods of heightened stress. Instead, further support may be necessary for population groups expected to be more vulnerable to sustained unhealthy behaviours. Our research findings would suggest that women from lower socio-economic backgrounds with caregiving responsibilities that limit their ability to maintain levels of social engagement face more challenges in engaging in healthier behaviours. Therefore, targeted interventions such as social prescribing, accessible through referral from primary care providers and other voluntary agencies, could be made more widely available. Social prescribing connects people with organisations in their local community to meet unmet needs and support people in changing and sustaining health behaviours tailored to their own particular goals. The social prescribing model is now being embedded throughout the UK health care system and there is increasing evidence of improvement in mental health for those able to access services following referral (Kiely et al., 2022). With regards to specific health behaviours, the apparent decline in the protective effect of lower alcohol consumption points towards a need for a range of different policies that target alcohol consumption, such as combined interventions that seek to reduce consumption amongst those drinking at harmful levels, such as brief counselling interventions, alongside other support such as motivational interviewing or other types of psychological interventions (Anderson et al., 2021). Research that is able to establish the effectiveness of these suggested interventions through longitudinal study designs in non-clinical settings would be a valuable addition to the evidence base.

6. Conclusion

This paper studies gendered effects in changes in health behaviours during the COVID-19 pandemic and the changes in the relationship between health behaviours and mental health.

Our findings document larger improvements in health behaviours among men compared to women during the pandemic. Further, the pandemic considerably weakened the protective effect of health behaviours on mental health for women but not for men. Thus, we see smaller gains in health behaviours and lower psychological benefits from these behaviours for women compared to men during the pandemic. Whereas the changes in health behaviours among women compared to men persist, the reduction in the psychological benefits

derived from healthy behaviours for women attenuates over time. Further research to establish whether these trends continue into future periods would be helpful to inform policy development relating to health behaviours and mental health.

CRedit authorship contribution statement

Karen Arulsamy: Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **Paul McNamee:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Silvia Mendolia:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of competing interest

No conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2024.117565>.

Data availability

Data will be made available on request.

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