

## RESEARCH ARTICLE

## Epidemiology

# The physical-mental health interface in the preconception period: analysis of 131 182 women planning pregnancy in the UK

Conor Tosh<sup>1</sup> | Kimberley Kavanagh<sup>1</sup> | Angela C Flynn<sup>2</sup> | Judith Stephenson<sup>3</sup> | Sara L White<sup>2</sup>  | Raquel Catalao<sup>4</sup>  | Claire A Wilson<sup>4,5</sup> 

<sup>1</sup>Department of Mathematics and Statistics, University of Strathclyde, Glasgow, UK

<sup>2</sup>Department of Women and Children's Health, King's College London, London, UK

<sup>3</sup>Institute for Women's Health, University College London, London, UK

<sup>4</sup>Section of Women's Mental Health, King's College London, London, UK

<sup>5</sup>South London and Maudsley NHS Foundation Trust, London, UK

**Correspondence**

C. A. Wilson, Section of Women's Mental Health, King's College London, PO31, London SE5 8AF, UK.

Email: [claire.i.wilson@kcl.ac.uk](mailto:claire.i.wilson@kcl.ac.uk)

**Funding information**

National Institute for Health Research; Public Health England; Royal College of Obstetricians and Gynaecologists; Tommy's Baby Charity

**Abstract**

**Objective:** The physical and mental health of women prior to conception can have a significant impact on pregnancy and child outcomes. Given the rising burden of non-communicable diseases, the aim was to explore the relation between mental health, physical health and health behaviour in women planning a pregnancy.

**Methods:** Cross-sectional analysis of responses from 131 182 women to a preconception health digital education tool, providing data on physical and mental health and health behaviour. Logistic regression was used to explore associations between mental health and physical health variables.

**Results:** Physical health conditions were reported by 13.1% and mental health conditions by 17.8%. There was evidence for an association between self-reported physical and mental health conditions (odds ratio [OR] 2.22, 95% CI 2.14–2.3). Those with a mental health condition were less likely to engage with healthy behaviour at preconception such as folate supplementation (OR 0.89, 95% CI 0.86–0.92) and consumption of the recommended amount of fruit and vegetables (OR 0.77, 95% CI 0.74–0.79). They were more likely to be physically inactive (OR 1.14, 95% CI 1.11–1.18), smoke tobacco (OR 1.72, 95% CI 1.66–1.78) and use illicit substances (OR 2.4, 95% CI 2.25–2.55).

**Conclusions:** Greater recognition of mental and physical comorbidities is needed and closer integration of physical and mental healthcare in the preconception period, which could support people to optimise their health during this time and improve long-term outcomes.

**KEYWORDS**

epidemiology, mental health, preconception

## 1 | INTRODUCTION

Around one in five women present with the common mental disorders (CMDs) of anxiety and depression in the UK, with younger aged women particularly at risk.<sup>1</sup> There is evidence that individuals with mental disorders have high rates of physical comorbidities such as obesity and Type 2 diabetes, which contribute to premature mortality and health inequalities throughout life.<sup>2</sup> Associations between mental and physical health have been found to be more common in women.<sup>3–5</sup> However, most studies do not disaggregate findings by

gender or age, therefore the physical-mental health interface in women of reproductive age remains poorly understood.

It is increasingly recognised that women's health around the time of conception is a key determinant of pregnancy outcome and impacts the health of the next generation. Indeed the preconception period represents an opportunity to intervene to optimise the health of women and their children,<sup>6</sup> although the impact of physical and mental multimorbidity prior to pregnancy on maternal and child outcomes is not well documented.<sup>7</sup> Relatively few studies report obstetric and neonatal outcomes for women with mental disorders

R. Catalao and C. A. Wilson are considered joint senior authors.

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2023 The Authors. *BJOG: An International Journal of Obstetrics and Gynaecology* published by John Wiley & Sons Ltd.

adjusted for preconception physical health comorbidities and risk factors.<sup>8,9</sup> There is also evidence that in women with chronic physical and mental health conditions, there are significant gaps in knowledge of the benefits of preconception recommendations such as folic acid supplementation.<sup>10</sup>

As the global burden of non-communicable diseases (NCDs) rises, there is an urgent need to understand better the relation between physical and mental health in women of childbearing age, to inform the development of interventions that optimise health in women who wish to conceive.<sup>10</sup> The aim of this analysis was to explore the association between mental health, physical health and health behaviour in women planning a pregnancy.

## 2 | METHODS

### 2.1 | Study sample

Tommy's charity in partnership with the UK's Royal College of General Practitioners, Royal College of Obstetricians and Gynaecologists and Public Health England, launched a preconception health digital education tool in 2018 to collect anonymised self-reported information on a range of demographics, health indicators, health behaviour and diagnoses. The tool was advertised on social media platforms such as Facebook and was targeted at females aged 16–45. The tool is accessible from Tommy's website (<https://www.tommys.org/pregnancy-information/planning-pregnancy/planning-for-pregnancy-tool>). At the time of data collection, it asked up to 26 questions relating to health and lifestyle behaviour in those planning a pregnancy. Responses used were from 22 June 2018 to 31 July 2019. Duplicate responses, as determined by identical IP address and submission time, were removed, leaving 131 182 responses originating from within the UK as determined by IP address (Figure 1).

At the time of data collection, it asked up to 26 questions relating to health and lifestyle behaviour in those planning a pregnancy. Responses used were from 22 June 2018 to 31 July 2019. Duplicate responses, as determined by identical IP address and submission time, were removed, leaving 131 182 responses originating from within the UK as determined by IP address (Figure 1).

### 2.2 | Mental health variables

The following binary (yes or no) questions pertaining to mental health were asked:

'Do you/did you have a mental health condition or did you have a mental health condition in a previous pregnancy?'

'Do you have bipolar disorder or schizophrenia or do you/did you have a mental health condition that needed medication or a referral to a psychiatrist?'

If women answered gave a positive answer to either of these two questions, they were also asked the following binary (yes or no) question:

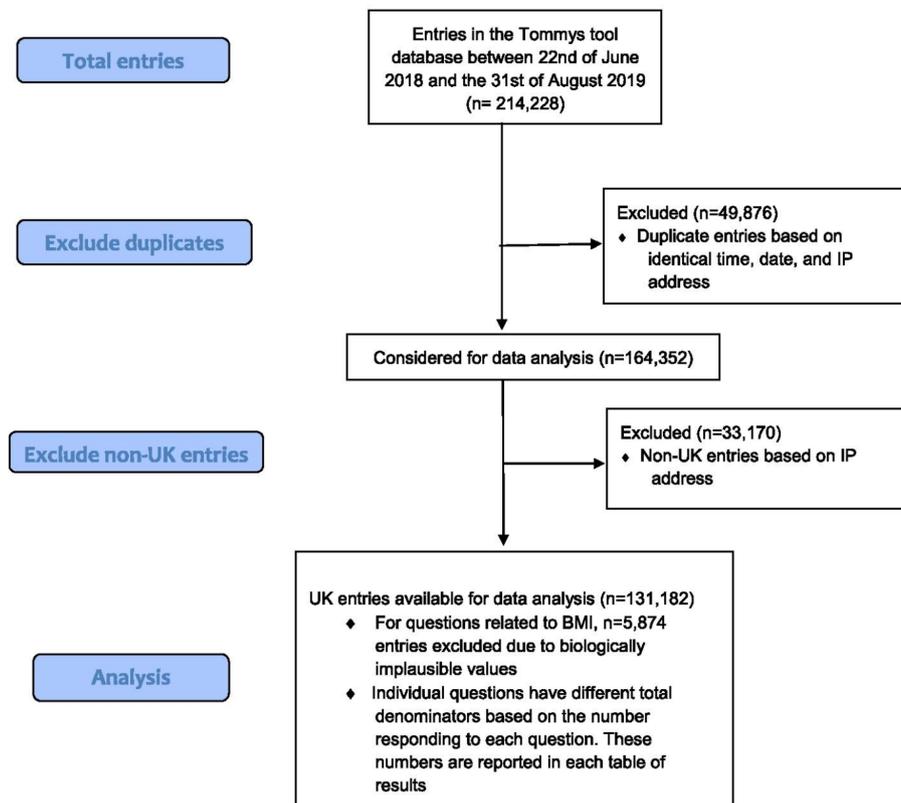


FIGURE 1 How the sample was obtained.

‘Have you spoken to a doctor or specialist about your pregnancy plans?’

In addition, women were asked about current symptoms of depression using the validated Whooley questions. These questions ask about core symptoms of depression: low mood and loss of interest:

‘During the past month have you been bothered by feeling down, depressed or hopeless?’

‘During the past month have you been bothered by little interest or pleasure in doing things?’

The Whooley questions are used within maternity services in the UK as part of routine enquiry about mental ill health as recommended by the UK National Institute for Health and Care Excellence (NICE).<sup>11</sup> Responding ‘yes’ to at least one of the Whooley questions was coded for the purposes of the analysis as experiencing depressive symptoms.

## 2.3 | Physical health and health behaviour variables

The following binary (yes or no) question pertaining to chronic physical health conditions was asked:

‘Do you have an existing physical health condition that requires medication or did you have a complication in a previous pregnancy?’

As with women who reported a mental health condition, if women gave a positive answer to the above question about physical health conditions, they were also asked the following binary (yes or no) question:

‘Have you spoken to a doctor or specialist about your pregnancy plans?’

In addition, the following binary (yes or no) questions relating to lifestyle were asked:

‘Do you smoke?’

‘Do you take illicit or recreational drugs?’

‘Do you drink alcohol?’

‘Do you eat five portions of fruit or veg on four or more days of the week?’

‘Are you currently taking 400 (microg) of folic acid a day?’

There was also a question pertaining to physical activity: ‘how would you describe your level of activity?’, which was an ordinal variable (see Table 1).

Body mass index (BMI) was calculated based on the weight and height provided by respondents in the questionnaire. BMI was then categorised according to the following groups: <18.5 (underweight), 18.5–24.9 (normal range), 25–29 (overweight) and 30+ (obese).

## 2.4 | Other demographic variables

Other data obtained included age of the respondent. Some information on race was provided by the question:

‘Do you or the baby's biological father have ancestors from Africa, the Caribbean, the Mediterranean, India, Pakistan, South and South-East Asia or the Middle East?’

This question was included in the tool to explore risk for sickle cell disease and/or thalassaemia.

## 2.5 | Statistical analysis

Data were analysed using R version 3.6.1. In the survey, not every question had to be answered. As a result, there are missing data in the responses. Additionally, several questions were only asked to participants who gave a particular response to another question. Hence, there are also data missing by design (structural) in the responses.

Multiple Imputation using Chained Equations (MICE) using the mice package in R was used to replace the non-structural missing data in the dataset. Predictors of missingness were checked to verify which variables satisfied the missing at random assumption. All analysis variables were included in the imputation and every variable was included as a predictor for every other variable. Linear regression was used for predicting numerical variables, logistic regression for binary categorical, and polytomous regression for non-binary categorical. Questions whose response determined whether another question was asked to the participant were not used as predictors for those variables. Twenty imputations of the missing data were performed. The imputation was checked by assessing the stability of the mean and standard deviation of the numerical variables over the iterations for each of the multiple imputed datasets. In addition, tables showing the distribution of responses to the categorical variables for each of the multiple imputed datasets were produced. Any variables deemed to be non-representative or unstable were not included in the imputed results. Once multiple imputation had been performed, the logistic regression models detailed below were performed on each of the completed datasets and the estimates for the coefficients

**TABLE 1** Participant characteristics.

Variable	Level	Total n = 131 182 (100%)	P-yes M-yes n = 5585 (4.2%)	P-yes M-no n = 11 523 (8.8%)	P-no M-yes n = 17 586 (13.4%)	P-no M-no n = 80 458 (61.3%)
Age	18–24	47 977 (36.6%)	2125 (38.1%)	3248 (28.2%)	8083 (45.9%)	28 624 (35.8%)
	25–34	64 684 (49.3%)	2657 (47.6%)	6167 (53.5%)	7969 (45.3%)	42 338 (52.6%)
	35–40	12 905 (9.8%)	688 (12.3%)	1820 (15.8%)	1279 (7.3%)	8038 (9.9%)
	41+	1536 (1.2%)	83 (1.5%)	217 (1.9%)	133 (0.8%)	1005 (1.2%)
	Missing	4080 (3.1%)	32 (0.5%)	71 (0.6%)	122 (0.7%)	453 (0.5%)
Ancestors from Africa, Caribbean, Mediterranean, India, Pakistan, South and South-East Asia or the Middle East	Do not know	3726 (2.8%)	275 (4.9%)	362 (3.1%)	717 (4.1%)	2350 (2.9%)
	No	95 753 (72.9%)	4516 (80.9%)	9358 (81.2%)	14 783 (84.1%)	66 639 (82.8%)
	Yes	13 501 (10.3%)	529 (9.5%)	1480 (12.8%)	1688 (9.6%)	9733 (12.1%)
	Missing	18 202 (14.0%)	265 (4.7%)	323 (2.8%)	398 (2.3%)	1736 (2.2%)
Depressive symptoms	No	68 787 (52.4%)	1358 (24.3%)	7246 (62.9%)	5250 (29.8%)	54 410 (67.6%)
	Yes	38 163 (29.1%)	1833 (32.8%)	4239 (36.8%)	6115 (34.8%)	25 758 (32.0%)
	Missing	24 232 (18.5%)	2394 (42.9%)	38 (0.3%)	6221 (35.4%)	290 (0.4%)
Bipolar disorder, schizophrenia or a mental health condition that needed medication or a referral to a psychiatrist	No	14 625 (11.1%)	3161 (56.6%)	0 (0%)	11 349 (64.5%)	0 (0%)
	Yes	8670 (6.6%)	2415 (43.2%)	0 (0%)	6203 (35.3%)	0 (0%)
	Missing	107 887 (82.2%)	9 (0.2%)	11 523 (100%)	34 (0.2%)	80 458 (100%)
Has mental health condition and discussed pregnancy plans with doctor/specialist	No	6170 (4.7%)	1483 (26.6%)	0 (0%)	4656 (26.5%)	0 (0%)
	Yes	2522 (1.9%)	944 (16.9%)	0 (0%)	1569 (8.9%)	0 (0%)
	Missing	122 490 (93.4%)	3158 (56.5%)	11 523 (100%)	11 361 (64.6%)	80 458 (100%)
Has physical health condition and discussed pregnancy plans with doctor/specialist	No	10 151 (7.7%)	3360 (60.2%)	6753 (58.6%)	0 (0%)	0 (0%)
	Yes	6942 (5.3%)	2202 (39.4%)	4724 (41.0%)	0 (0%)	0 (0%)
	Missing	114 089 (87.0%)	23 (0.4%)	46 (0.4%)	17 586 (100%)	80 458 (100%)
Alcohol	No	57 772 (44.0%)	2940 (52.6%)	5831 (50.6%)	7777 (44.2%)	34 880 (43.3%)
	Yes	69 195 (52.8%)	2623 (47.0%)	5659 (49.1%)	9752 (55.5%)	45 278 (56.3%)
	NA	4215 (3.2%)	22 (0.4%)	33 (0.3%)	57 (0.3%)	300 (0.4%)
Smoking	No	101 611 (77.5%)	3871 (69.3%)	9332 (81.0%)	12 973 (73.8%)	65 954 (82.0%)
	Yes	25 445 (19.4%)	1692 (30.3%)	2136 (18.5%)	4517 (25.7%)	14 070 (17.5%)
	Missing	4126 (3.1%)	22 (0.4%)	55 (0.5%)	96 (0.6%)	434 (0.5%)
Illicit or recreational drugs	No	122 288 (93.2%)	5154 (92.3%)	11 145 (96.7%)	16 417 (93.4%)	77 876 (96.8%)
	Yes	4698 (3.6%)	408 (7.3%)	338 (2.9%)	1095 (6.2%)	2232 (2.8%)
	Missing	4196 (3.2%)	23 (0.4%)	40 (0.4%)	74 (0.4%)	350 (0.4%)

(Continues)

TABLE 1 (Continued)

Variable	Level	Total <i>n</i> = 131 182 (100%)	P-yes M-yes <i>n</i> = 5585 (4.2%)	P-yes M-no <i>n</i> = 11 523 (8.8%)	P-no M-yes <i>n</i> = 17 586 (13.4%)	P-no M-no <i>n</i> = 80 458 (61.3%)
Five portions of fruit or veg on four or more days of the week	No	36 590 (27.9%)	1924 (34.4%)	3667 (31.8%)	6147 (34.9%)	24 277 (30.2%)
	Yes	61 741 (47.1%)	2712 (48.6%)	6112 (53.0%)	8351 (47.5%)	43 699 (54.3%)
	Do not know	17 463 (13.3%)	898 (16.1%)	1640 (14.2%)	2921 (16.6%)	11 677 (14.5%)
	Missing	15 388 (11.7%)	51 (0.9%)	104 (0.9%)	167 (1.0%)	805 (1.0%)
Weekly level of physical activity	<150 mins	49 072 (37.4%)	2680 (48.0%)	5054 (43.9%)	7711 (43.8%)	32 781 (40.7%)
	At least 150 mins moderate activity	50 813 (38.7%)	2165 (38.8%)	4971 (43.1%)	7544 (43.0%)	35 365 (44.0%)
	>150 mins vigorous activity	16 948 (12.9%)	728 (13.0%)	1473 (12.8%)	2290 (13.0%)	12 140 (15.1%)
400 microg folic acid per day	Missing	14 349 (10.9%)	12 (0.2%)	25 (0.2%)	41 (0.2%)	172 (0.2%)
	No	68 033 (51.9%)	2850 (51.0%)	5678 (49.3%)	10 741 (61.1%)	48 428 (60.2%)
	Yes	31 329 (23.9%)	1539 (27.6%)	3821 (33.2%)	4118 (23.4%)	21 701 (27.0%)
Missing	31 820 (24.2%)	1196 (21.4%)	2024 (17.6%)	2727 (15.5%)	10 329 (12.8%)	

Note: The number of participants who responded to each question in the dataset, and as a percentage of total responses to the question. This is done for the whole dataset in the total column, as well as for participants who responded to different combinations of 'yes' and 'no' to mental health condition and physical condition in each column. P-yes/no indicates the response to having a physical condition, and M-yes/no indicates the response to having a mental health condition. The number (*n*) in each column shows the number of participants who gave the corresponding responses to physical condition and mental health condition.

were pooled using Rubin's rules to obtain estimates and confidence intervals (CIs) for the odds ratios (ORs).

Logistic regression models on the imputed data were used to model the univariable association between the three mental health outcomes (a mental health condition, depressive symptoms and bipolar disorder or schizophrenia and/or a mental health condition requiring medication or psychiatric referral) and the predictors (having a physical health condition and the six health behaviour variables). The *p*-values associated with each of the odds ratios were recorded and significant *p*-values identified with a significance level of 0.05 were highlighted.

A subgroup analysis of the above analysis was performed of those participants who reported having ancestors from Africa, the Caribbean, the Mediterranean, India, Pakistan, South and South-East Asia or the Middle East, in order to investigate the impact of ethnicity on the results.

## 2.6 | Patient and public involvement

Tommy's preconception health digital education tool was developed in consultation with multidisciplinary experts and the general public, including women planning a pregnancy. We have chosen to use the word 'woman' to distinguish our sample from male partners' pregnancy planning behaviour. However, we wish to highlight that by 'woman' we include all birthing people.

## 3 | RESULTS

### 3.1 | Participant characteristics

Among all responders, 17.8% (*n* = 23 400) reported having a current or previous mental health condition and 13.1% (*n* = 17 166) reported a physical health condition. Table 1 shows the distribution of participant characteristics across the whole sample, stratified by whether or not a physical and/or mental health condition was reported. In all, 34.2% (*n* = 7992) of women who reported having a mental health condition also responded yes to one or both of the Whooley questions, indicating possible current depressive symptoms. In all, 37.1% (*n* = 8670) of those who responded yes to the more general question about a mental health condition (Do you/did you have a mental health condition or did you have a mental health condition in a previous pregnancy?) additionally reported having bipolar disorder, schizophrenia and/or a mental health condition requiring medication or referral to a psychiatrist.

Of the women with a mental health condition, 8.9% (*n* = 1569) reported seeing a doctor or specialist to discuss plans for pregnancy, compared with 41% (*n* = 4724) of women with a physical health condition. It should be noted that there was a high level of missing data for this question in women who reported a mental health condition, whereas near complete data was available for those with a

physical health condition. For women who reported both mental and physical health conditions (4.2%,  $n = 5585$ ), a higher proportion saw a doctor to discuss physical health in pregnancy compared with those who saw a doctor to discuss mental health: 39.4% ( $n = 2202$ ) versus 16.9% ( $n = 944$ ), respectively.

### 3.2 | Associations between mental health and physical health

There was evidence for an association between all three mental health variables and having a physical health condition, particularly for women reporting bipolar disorder, schizophrenia or a mental health condition that needed medication or referral to a psychiatrist (OR 2.43, 95% CI 2.31–2.56) (Table 2).

### 3.3 | Associations between mental health and health behaviour

Women who reported a mental health condition (including bipolar disorder, schizophrenia or a mental health condition that needed medication or referral to a psychiatrist) and/or depressive symptoms were more likely to report tobacco smoking and recreational drug use (Table 2). There was some, albeit limited, evidence for reduced alcohol consumption in women with a mental health condition. There was also evidence of an association between reporting of a mental health condition and/or current depressive symptoms and reduced consumption of fruit and vegetables, lack of folic acid supplementation and physical inactivity.

The unimputed results are provided in the Supporting Information; results mirrored those of the imputed results. For body mass index (BMI), a comparison of the observed and imputed values suggested an ill fit of the imputation model, so the decision was made to exclude BMI from the imputed model. Unimputed analyses provide evidence of an association between all three mental health variables and BMI both above (overweight and obese) and below the normal range (underweight) (Table S1).

### 3.4 | Subgroup analysis by race

A total of 13 501 women (10.3% of total sample) reported having ancestors from Africa, Caribbean, Mediterranean, India, Pakistan, South or South East Asia or the Middle East. Women with ancestors were less likely to report a general mental health condition (OR 0.77, 95% CI 0.73–0.80) or a diagnosis of bipolar disorder, schizophrenia and/or mental health condition requiring medication or referral to a psychiatrist (OR 0.86, 95% CI 0.80, 0.92). However, they were more likely to report current depressive symptoms (OR 1.34, 95% CI 1.29–1.39) (Table 3).

The direction of associations were similar to that of the primary analysis in those who reported having ancestors from Africa, the Caribbean, the Mediterranean, India, Pakistan, South and South-East Asia or the Middle East. The strength of associations was slightly smaller, particularly in those who reported bipolar disorder, schizophrenia and/or a mental health condition requiring medication or referral to a psychiatrist than the association with having a physical health condition (OR 1.25, 95% CI 1.02–1.52) and recreational drug use (OR 2.08, 95% CI 1.54–1.79). There was no evidence of association in this group with decreased folic acid supplementation and intake of fruits and vegetables. There was evidence that women with ancestors and depressive symptoms and women with ancestors and bipolar, schizophrenia or who reported taking psychiatric medication were more likely to drink alcohol than were those without ancestors (Table S2).

## 4 | DISCUSSION

### 4.1 | Main findings

In this cross-sectional study using the largest sample to date of women planning a pregnancy in the UK, depressive symptoms were common and mental health conditions (17.8% of the sample) more prevalent than physical health conditions (13.1%). This is somewhat lower than expected from previous studies of the UK reproductive age population<sup>1,12</sup> and may indicate a slightly healthier sample using our pregnancy planning tool. To our knowledge this is one of few studies investigating the prevalence of mental and physical health conditions in women planning pregnancy, as much literature to date has focused on the impact of health conditions and behaviour during pregnancy<sup>13</sup> and has neglected to investigate the burden of multi-morbidity. In our study, only a small percentage (8.9%) of women with mental health conditions sought medical advice while planning a pregnancy, compared with women with physical health conditions, who were more likely to speak to their doctor or specialist (41%). Women who reported a mental health condition were more likely to report a comorbid physical health condition and have a BMI outside (both above and below) the normal range, highlighting that pathways to multi-morbidity start early in women's lives; 36.6% of the sample were 18–24 years old. They were also less likely to engage with healthy lifestyle behaviour at preconception such as folic acid supplementation, physical activity, consumption of the recommended amount of fruit and vegetables and abstinence from smoking and illicit or recreational drug use.

Our results show that women from ethnic minority groups are less likely to report a diagnosis of a mental health condition. On the other hand, they were more likely to report current depressive symptoms, raising the question of whether there are different cultural constructs of mental health diagnoses in this population or there is under-recognition and diagnosis of mental health conditions in women of ethnic minority groups by clinicians.

**TABLE 2** Logistic regression of physical and mental health variables using imputed data ( $n = 131\ 182$ ).

Variable	Level	Mental health condition			Depressive symptoms			Bipolar disorder, schizophrenia or a mental health condition that needed medication or a referral to a psychiatrist		
		%	OR (95% CI)	<i>p</i> -value	%	OR (95% CI)	<i>p</i> -value	%	OR (95% CI)	<i>p</i> -value
Physical health condition	No (baseline)	75.8	1		82.4	1		71.9	1	
	Yes	24.2	2.22 (2.14–2.30)	<0.001	17.6	1.40 (1.35–1.45)	<0.001	28.1	2.43 (2.31–2.56)	<0.001
Alcohol	No (baseline)	47.1	1		45.7	1		46.9	1	
	Yes	52.9	0.93 (0.90–0.96)	<0.001	54.3	0.99 (0.97–1.02)	0.568	53.1	0.94 (0.90–0.98)	0.006
Smoking	No (baseline)	72.4	1		73.1	1		67.9	1	
	Yes	27.6	1.72 (1.66–1.78)	<0.001	26.9	1.94 (1.88–2.01)	<0.001	32.1	2.006 (1.91–2.11)	<0.001
Illicit or recreational drugs	No (baseline)	93.3	1		93.9	1		90.8	1	
	Yes	6.7	2.39 (2.25–2.55)	<0.001	6.1	2.76 (2.59–2.94)	<0.001	9.2	3.02 (2.79–3.27)	<0.001
Five portions of fruit or veg on four or more days of the week	No (baseline)	35.3	1		37.3	1		38.4	1	
	Yes	47.9	0.77 (0.74–0.79)	<0.001	44.9	0.57 (0.57–0.60)	<0.001	44.6	0.67 (0.64–0.71)	<0.001
	Do not know	16.8	0.99 (0.95–1.04)	0.859	17.8	0.99 (0.95–1.03)	0.629	17.0	0.92 (0.87–0.98)	0.014
Weekly level of physical activity	<150 minutes	45.0	1.14 (1.11–1.18)	<0.001	45.6	1.32 (1.29–1.36)	<0.001	46.5	1.19 (1.13–1.25)	<0.001
	At least 150 minutes moderate activity (baseline)	41.8	1		39.5	1		41.1	1	
400 microg folic acid per day	>150 minutes vigorous activity	13.2	0.93 (0.89–0.97)	0.001	14.9	1.21 (1.16–1.26)	<0.001	12.4	0.90 (0.83–0.96)	0.003
	No (baseline)	70.4	1		74.6	1		71.8	1	
Yes	29.6	0.89 (0.86–0.92)	<0.001	25.4	0.62 (0.61–0.64)	<0.001	28.2	0.84 (0.79–0.89)	<0.001	

*Note:* Pooled logistic regression models on the datasets obtained after missing values were imputed. The columns mental health condition, depressive symptoms, and bipolar disorder, schizophrenia or medication correspond to the outcome variable and the row corresponds to the predictor variable. The odds ratio of each level over the baseline level are shown, as well as confidence intervals and corresponding *p*-values. The level used as the baseline for the odds ratio in each variable is indicated by '(baseline)' in the level name. Significant *p*-values (<0.05) are highlighted in bold. The average percentage of participants who gave each response to a question from the 20 imputed datasets is also shown for the participants who responded 'yes' to the corresponding column.

**TABLE 3** Logistic regression and participant characteristics by ancestor variable ( $n = 109\,254$ ).

		No ancestors ( $n = 95\,753$ )	Ancestors ( $n = 13\,501$ )	Logistic regression	
				Odds ratio (95% CI)	$p$ -value
Mental health condition	No (baseline)	76 143 (79.52%)	11 242 (83.27%)	1	
	Yes	19 338 (20.20%)	2 220 (16.44%)	0.77 (0.73–0.80)	<b>&lt;0.001</b>
	Missing	272 (0.28%)	39 (0.29%)		
Depressive symptoms	No (baseline)	58 218 (60.80%)	7 315 (54.18%)	1	
	Yes	29 980 (31.31%)	5 227 (38.72%)	1.34 (1.29–1.39)	<b>&lt;0.001</b>
	Missing	7 555 (7.89%)	959 (7.10%)		
Bipolar disorder, schizophrenia or a mental health condition that needed medication or a referral to a psychiatrist	No (baseline)	88 422 (92.34%)	12 581 (93.19%)	1	
	Yes	7 024 (7.34%)	879 (6.51%)	0.861 (0.80–0.92)	<b>&lt;0.001</b>
	Missing	307 (0.32%)	41 (0.30%)		
Mental health condition + Depressive symptoms	No (baseline)	81 900 (85.53%)	11 790 (87.33%)	1	
	Yes	6 555 (6.85%)	801 (5.93%)	0.83 (0.77–0.89)	<b>&lt;0.001</b>
	Missing	7 298 (7.62%)	910 (6.74%)		
Bipolar disorder, schizophrenia or a mental health condition that needed medication or a referral to a psychiatrist + Depressive symptoms	No (baseline)	88 447 (92.37%)	12 586 (93.22%)	1	
	Yes	41 (0.04%)	8 (0.06%)	1.32 (0.62–2.82)	0.464
	Missing	7 265 (7.59%)	907 (6.72%)		
Physical health condition	No (baseline)	81 637 (85.26%)	11 446 (84.78%)	1	
	Yes	13 914 (14.53%)	2 018 (14.95%)	1.026 (0.98–1.08)	0.314
	Missing	202 (0.21%)	37 (0.27%)		
Physical health condition + Mental health condition	No (baseline)	87 801 (91.67%)	12 322 (91.27%)	1	
	Yes	7 775 (8.12%)	1 139 (8.44%)	1.02 (0.95–1.09)	0.583
	Missing	177 (0.18%)	40 (0.30%)		

Note: Results of logistic regression models with having ancestors from Africa, the Caribbean, the Mediterranean, India, Pakistan, South and South East Asia or the Middle East as the outcome variable, and various mental and physical health condition questions as predictor variables, indicated by row. The level used as the baseline for the odds ratio in each variable is indicated by '(baseline)' in the level name. Significant  $p$ -values ( $<0.05$ ) are highlighted in bold. Also shown are the number of participants who gave each response in each related question, and as a percentage of total responses to the question, in participants that responded 'no' and 'yes' to the ancestors question.

## 4.2 | Strengths and limitations

Strengths of the study include its large sample size and wide geographical distribution of respondents, making it a unique source of information about the health behaviour of women planning a pregnancy in the UK.<sup>14</sup> Nonetheless, there are a number of limitations. Outcomes were measured using self-report data, which may miss undiagnosed conditions and result in a degree of under-reporting of high-risk health behaviour due to social desirability bias. However, women responded to the tool anonymously online, which may have minimised such under-reporting. Indeed, there was a high prevalence of behaviour such as smoking and alcohol use, suggesting that this digital tool was acceptable to participants and was able to reach a wide sample of women planning to conceive.<sup>14</sup> Despite this, the limited demographic information, such as socioeconomic status, limits our ability to ascertain the representativeness of this sample. Detailed information on race or ethnicity of respondents was lacking and investigation of potential differences in preconception health behaviour between ethnic groups is an important area for future research considering the growing evidence of inequalities in

health outcomes for women from ethnic minority groups during the perinatal period.<sup>15</sup> Approximately half of pregnancies in the UK are planned,<sup>16</sup> therefore our study provides valuable health information on women planning a pregnancy but may not be representative of all women who conceive in the UK. More specific data on health service use in this population may also facilitate the identification of potential missed opportunities for intervention. Moreover, participants were not asked for further details about their mental and physical health diagnoses, limiting exploration of any distinct associations between different disorders.

## 4.3 | Interpretation

Despite growing consensus on the importance of preconception health for subsequent maternal and child health,<sup>6</sup> findings from this preconception health digital tool<sup>14</sup> echo previous studies showing suboptimal adherence to health recommendations such as folic acid supplementation, smoking and illicit/recreational drug use, physical activity and intake of fruit and vegetables in those planning pregnancy.<sup>13,17</sup>

A survey of 750 women in the UK by Tommy's charity found that 67% of women plan for three or more months for a holiday, in contrast to 20% planning for three or more months for a pregnancy.<sup>18</sup>

Previous confidential enquiries into maternal mortality in the UK have emphasised that lack of preconception care is a contributory factor to maternal deaths as well as highlighting a need for better management of women with multiple health conditions.<sup>15,19</sup> Suicide remains one of the leading causes of direct maternal mortality and successive reports have stressed the need for better mental healthcare and coordination between primary care, maternal and mental health services. Mental disorders are increasingly common in young women<sup>1</sup> and mental disorders before pregnancy are associated with increased risk of disorders during the perinatal period as well as having an impact on maternal–infant bonding.<sup>20,21</sup> Perinatal mental health services in the UK offer preconception counselling, which can help women optimise their mental and physical health before pregnancy.<sup>22</sup> However, our study shows that women seemed to be more likely to seek medical advice to help manage physical than mental health conditions. In addition, our study echoes previous reports that women from ethnic minority groups are less likely to have mental health conditions recognised in primary care.<sup>23</sup> Studies have highlighted complex multi-level barriers to women accessing mental healthcare in the perinatal period, including at individual (e.g. stigma and poor awareness), organisational (e.g. resource inadequacies and service fragmentation), sociocultural (e.g. language and cultural barriers) and structural (e.g. unclear policy) levels,<sup>24</sup> as well as additional barriers faced by women of ethnic minority groups.<sup>25</sup> Future research is required to explore how these barriers can be overcome in order to sustainably improve access to care.

## 5 | CONCLUSION

Our study shows that women planning pregnancy with mental health conditions report a higher prevalence of physical health conditions compared with those without a mental health condition. Modifiable health behaviour identified in this study could be addressed by greater integration between physical and mental health services and embedding 'healthy conversations' about healthy lifestyles within routine appointments.<sup>22</sup> Current approaches to preconception care in health services have largely focused on contraception, often neglecting the needs of women with mental and physical health comorbidity who wish to conceive. Specialist perinatal mental health services offer preconception advice for women with severe mental illness but the provision of services for women with CMDs (anxiety and depression), particularly those with multi-morbidity, is scarce.<sup>26</sup>

Previous studies have highlighted that women who received preconception education and counselling were more likely to have improved knowledge, self-efficacy and health locus of control, and reduced risk behaviour such as

alcohol consumption.<sup>27</sup> However, there is limited evidence for preconception interventions that improve outcomes for mothers and babies on a larger scale.<sup>27,28</sup> Future research on effective strategies to empower women to optimise their health during this period are required; there needs to be a move beyond the realm of health promotion to targeted education of health professionals and greater synergy between different parts of the health system, in order better to meet the needs of each person planning a pregnancy.

## AUTHOR CONTRIBUTIONS

JS was involved in the design of the study tool. ACF and SLW worked with those overseeing the digital tool to obtain data for the purposes of research. CAW conceived the research question and designed the study analysis plan. KK, ACF, SLW and RC approved the data analysis plan. CT and KK analysed the data. CAW, CT, KK and RC wrote the first draft of the paper. ACF, JS and SLW critically revised it. All authors approved the final version of the paper. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

## ACKNOWLEDGEMENTS

The Tommy's Planning for Pregnancy tool and accompanying social media campaign was funded by Public Health England, Tommy's charity and the Royal College of Obstetricians and Gynaecologists but none had a role in data analysis or interpretation, writing of the paper or the decision to submit it for publication. Tommy's also provide salary support for ACF and SLW. CAW and RC receive salary support from the National Institute for Health Research (NIHR).

We gratefully acknowledge the contribution of all women planning pregnancy who completed the questionnaire.

## FUNDING INFORMATION

Public Health England, Tommy's charity and Royal College of Obstetricians and Gynaecologists.

## CONFLICT OF INTEREST STATEMENT

None declared. Completed disclosure of interest forms are available to view online as supporting information.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## ETHICS APPROVAL

Participants who use the online tool from which data are drawn are asked to provide their consent to the sharing of anonymised data relating to specific health conditions or lifestyle issues with non-profit health research organisations with the aim of improving public health, for the possible use in research publications.

(<https://www.tommys.org/about-us/tommys-policies/tommys-data-protection-and-privacy-policy#where>).

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## ORCID

S. L. White  <https://orcid.org/0000-0001-7979-0508>R. Catalao  <https://orcid.org/0000-0003-3672-6359>C. A. Wilson  <https://orcid.org/0000-0003-2169-5115>

## REFERENCES

- Adult Psychiatric Morbidity Survey: Survey of Mental Health and Wellbeing, England. NHS Digital. 2014 Available from: <https://digit.al.nhs.uk/data-and-information/publications/statistical/adult-psychiatric-morbidity-survey/adult-psychiatric-morbidity-survey-survey-of-mental-health-and-wellbeing-england-2014>. Accessed Dec, 2021.
- Thornicroft G. Premature death among people with mental illness. *BMJ*. 2013;346:f2969.
- Husky MM, Mazure CM, Ruffault A, Flahault C, Kovess-Masfety V. Differential associations between excess body weight and psychiatric disorders in men and women. *J Women's Heal*. 2018;27(2):183–90.
- Lloyd CE, Nouwen A, Sartorius N, Ahmed HU, Alvarez A, Bahendeka S, et al. Prevalence and correlates of depressive disorders in people with type 2 diabetes: results from the international prevalence and treatment of diabetes and depression (INTERPRET-DD) study, a collaborative study carried out in 14 countries. *Diabet Med*. 2018;35(6):760–9.
- Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. The prevalence of comorbid depression in adults with diabetes: a meta-analysis. *Diabet Care*. 2001;24(6):1069–78.
- The Lancet T. Campaigning for preconception health. *Lancet*. 2018;391(10132):1749.
- Beeson JG, Homer CSE, Morgan C, Menendez C. Multiple morbidities in pregnancy: time for research, innovation, and action. *PLoS Med*. 2018;15(9):e1002665.
- Sūdžiūtė K, Murauskienė G, Jarienė K, Jaras A, Minkauskienė M, Adomaitienė V, et al. Pre-existing mental health disorders affect pregnancy and neonatal outcomes: a retrospective cohort study. *BMC Pregnancy Childbirth*. 2020;20(1):419.
- Judd F, Komiti A, Sheehan P, Newman L, Castle D, Everall I. Adverse obstetric and neonatal outcomes in women with severe mental illness: to what extent can they be prevented? *Schizophr Res*. 2014;157(1–3):305–9.
- Firoz T, McCaw-Binns A, Filippi V, Magee LA, Costa ML, Cecatti JG, et al. A framework for healthcare interventions to address maternal morbidity. *Int J Gynaecol Obstet*. 2018;141(1):61–8.
- NICE. Antenatal and postnatal mental health: clinical management and service guidance. England: NICE; 2014 Available from: <https://www.nice.org.uk/guidance/cg192>
- Stephenson J, Schoenaker DAJM, Hinton W, Poston L, Barker M, Alwan NA, et al. A wake-up call for preconception health: a clinical review. *Br J Gen Pract*. 2021;71:233–6.
- Stephenson J, Patel D, Barrett G, Howden B, Copas A, Ojukwu O, et al. How do women prepare for pregnancy? Preconception experiences of women attending antenatal services and views of health professionals. *PLoS One*. 2014;9(7):e103085.
- McDougall B, Kavanagh K, Stephenson J, Poston L, Flynn AC, White SL. Health behaviours in 131,182 UK women planning pregnancy. *BMC Pregnancy Childbirth*. 2021;21(1):530.
- Knight M, Bunch K, Tuffnell D, Jayakody H, Shakespeare J, Kotnis R, et al. Saving Lives, Improving Mothers' Care Maternal, Newborn and Infant Clinical Outcome Review Programme. 2018.
- Wellings K, Jones KG, Mercer CH, Tanton C, Clifton S, Datta J, et al. The prevalence of unplanned pregnancy and associated factors in Britain: findings from the third National Survey of sexual attitudes and lifestyles (Natsal-3). *Lancet*. 2013;382(9907):1807–16.
- Lang AY, Harrison CL, Barrett G, Hall JA, Moran LJ, Boyle JA. Opportunities for enhancing pregnancy planning and preconception health behaviours of Australian women. *Women Birth*. 2021;34(2):e153–61.
- Tommy's. New Planning for Pregnancy tool launched to support safe and healthy pregnancies. 2018 Available from: <https://www.tommys.org/pregnancy-information/im-pregnant/pregnancy-news-and-blogs/new-planning-pregnancy-tool-launched-support-safe-and-healthy-pregnancies>. Accessed Dec, 2021
- Knight M, Bunch K, Tuffnell D, Shakespeare J, Kotnis R, Kenyon S, et al. Saving Lives, Improving Mothers' Care Maternal, Newborn and Infant Clinical Outcome Review Programme. 2020 Available from: [https://www.npeu.ox.ac.uk/assets/downloads/mbrrace-uk/reports/maternal-report-2020/MBRRACE-UK\\_Maternal\\_Report\\_Dec\\_2020\\_v10\\_ONLINE\\_VERSION\\_1404.pdf](https://www.npeu.ox.ac.uk/assets/downloads/mbrrace-uk/reports/maternal-report-2020/MBRRACE-UK_Maternal_Report_Dec_2020_v10_ONLINE_VERSION_1404.pdf). Accessed Dec, 2021
- Borschmann R, Molyneux E, Spry E, Moran P, Howard LM, Macdonald JA, et al. Pre-conception self-harm, maternal mental health and mother–infant bonding problems: a 20-year prospective cohort study. *Psychol Med*. 2018;49(16):2727–35.
- Olsson CA, Spry EA, Alway Y, Moreno-Betancur M, Youssef G, Greenwood C, et al. Preconception depression and anxiety symptoms and maternal-infant bonding: a 20-year intergenerational cohort study. *Arch Womens Ment Health*. 2020;24:513–23.
- Howard L, Easter A, Atmore K. Delivering preconception care to women of childbearing age with serious mental illness. 2020 Available from: [https://www.tommys.org/sites/default/files/2021-02/Pre-conception%20care%20and%20serious%20mental%20illness%20FINAL\\_updated\\_0.pdf](https://www.tommys.org/sites/default/files/2021-02/Pre-conception%20care%20and%20serious%20mental%20illness%20FINAL_updated_0.pdf)
- Catalao R, Dorrington S, Pritchard M, Jewell A, Broadbent M, Ashworth M, et al. Ethnic inequalities in mental and physical multimorbidity in women of reproductive age: a data linkage cohort study. *BMJ Open*. 2022;12(7):e059257.
- Smith MS, Lawrence V, Sadler E, Easter A. Barriers to accessing mental health services for women with perinatal mental illness: systematic review and meta-synthesis of qualitative studies in the UK. *BMJ Open*. 2019;9:24803.
- Jankovic J, Parsons J, Jovanović N, Berrisford G, Copello A, Fazil Q, et al. Differences in access and utilisation of mental health services in the perinatal period for women from ethnic minorities—a population-based study. *BMC Med*. 2020;18(1):245.
- Howard LM, Khalifeh H. Perinatal mental health: a review of progress and challenges. *World Psychiatry*. 2020;19(3):313–27.
- Hussein N, Kai J, Qureshi N. The effects of preconception interventions on improving reproductive health and pregnancy outcomes in primary care: a systematic review. *Eur J Gen Pract*. 2016;22(1):42–52.
- Barker M, Dombrowski SU, Colbourn T, Fall CHD, Kriznik NM, Lawrence WT, et al. Intervention strategies to improve nutrition and health behaviours before conception. *The Lancet*. 2018;391(10132):1853–64.

## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

**How to cite this article:** Tosh C, Kavanagh K, Flynn AC, Stephenson J, White SL, Catalao R, et al. The physical-mental health interface in the preconception period: analysis of 131 182 women planning pregnancy in the UK. *BJOG*. 2023;130(9):1028–1037. <https://doi.org/10.1111/1471-0528.17447>