

1 **Abstract**

2 Objective: to investigate women's physical activity levels, diet and gestational weight gain,
3 and their experiences and motivations of behavior change.

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5 Design: analysis of cross-sectional data collected during a longitudinal, cohort study
6 examining physiological, psychological, sociodemographic, and self-reported behavioural
7 measures relating to bodyweight.

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9 Setting: women recruited from routine antenatal clinics at the Nottingham University
10 Hospitals NHS Trust.

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12 Participants: 193 women ≤ 27 weeks gestation and aged 18 years or over.

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14 Measurements & findings: measurements included weight and height, the Dietary Instrument
15 for Nutrition Education (Brief Version), the International Physical Activity Questionnaire
16 (Short Form), and open questions of perceptions of behaviour change. 50.3% (n=97) were
17 overweight/obese, and women gained 0.26kg/wk (IQR 0.34 kg/wk) since conception. The
18 majority consumed low levels of fat (n=121; 63.4%), high levels of unsaturated fat (n=103;
19 53.9%), and used a dietary supplement (n=166; 86.5%). However, 41% (n=76) were inactive,
20 74.8% (n=143) did not consume high levels of fibre, and 90.0% (n=171) consumed less than 5
21 portions of fruit and vegetables a day. Body mass index category was not associated with diet,
22 physical activity levels, or gestational weight gain. Themes generated from open-questions
23 relating to behaviour change were: (1) Risk management, (2) Coping with symptoms, (3) Self-
24 control, (4) Deviation from norm, (5) Nature knows best.

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26 Conclusions: early pregnancy is a period of significant and heterogeneous behaviour change,
27 influenced by perceptions of risk and women's lived experience. Behaviour was influenced
28 not only by perceptions of immediate risk to the fetus, but also by the women's lived
29 experience of being pregnant.

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31 Implications for practice: There are exciting opportunities to constructively reframe health
32 promotion advice relating to physical activity and diet in light of women's priorities. The need
33 for individualized advice is highlighted, and women across all body mass index categories
34 would benefit from improved diet and physical activity levels.

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38 **Keywords:** Pregnancy; Body Mass Index; BMI; physical activity; diet; gestational weight gain
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40 **Introduction**

41 The rising prevalence of worldwide obesity (Ng et al., 2014), is coupled with an increased
42 incidence of maternal obesity (Rasmussen and Yaktine, 2009, Modder and Fitzsimons, 2010)
43 and has focused attention on lifestyle interventions to manage gestational weight gain. The
44 antenatal period is now synonymous with the expression *teachable moment*, and is thought
45 to offer an ideal opportunity to introduce behaviour change strategies to limit excessive
46 gestational weight gain and prevent postpartum weight retention (Phelan, 2010). During this
47 period, women in developed countries have frequent contact with healthcare professionals
48 (Australian Health Ministers' Advisory Council, 2012; Institute for Clinical Systems
49 Improvement, 2012; National Institute of Health and Care Excellence, 2016), and the growth
50 and development of the unborn child has been shown to act as a stimulus for changing
51 lifestyle habits, for example smoking (Galloway, 2012), alcohol consumption (Wennberg et
52 al., 2016), poor dietary habits (Opie et al., 2016), and physical inactivity (Mottola and Artal,
53 2016).

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55 The energy requirements of pregnancy are relatively modest after allowance for the physical
56 and metabolic adaptations for pregnancy. In well-nourished women there is little need for
57 increases in intake until the third trimester (Butte and King 2005). Antenatal care guidelines
58 incorporate this understanding (Australian Health Ministers' Advisory Council 2012; Health
59 Canada, 2014) and, in the case of the UK National Institute of Health and Care Excellence
60 guidelines, it is recommended that women increase intake by approximately 200 kcal in the
61 final trimester (National Institute of Health and Care Excellence, 2010). With regards to
62 physical activity, specific guidelines vary between countries, but women are advised to
63 undertake moderate-intensity activity daily (UK, 30 minutes per day, USA 150 minutes per
64 week; National Institute of Health and Care Excellence 2010, US Department of Health and
65 Human Services, 2008). More specifically, under UK guidelines, women are encouraged to
66 take part in recreational activities such as swimming, brisk walking or strength conditioning
67 exercise, in order to stay fit, rather than to attain peak fitness (National Institute of Health
68 and Care Excellence, 2010). Previously sedentary women are directed to begin with no more
69 than 15 minutes of continuous exercise, three times a week, until the recommended daily
70 allowance is achieved. Sedentariness is discouraged and women are encouraged to sit less
71 and to incorporate walking and other forms of physical activity into daily life (National
72 Institute of Health and Care Excellence, 2010). The language used is often superficial ("no
73 need to eat for two"), vague ("stay fit"), and inexact ("moderate-intensity"), which may
74 impede understanding and the effectiveness of these guidelines (Modder and Fitzsimons,
75 2010).

76
77 A range of healthcare professionals, including obstetricians, midwives, general practitioners',
78 practice nurses, dietitians, public health nutritionists and managers, and health professionals
79 in childcare centres, are responsible for the implementation of these national guidelines
80 (National Institute of Health and Care Excellence, 2010; Australian Health Ministers' Council,

81 2012; Health Canada, 2014). The UK midwifery strategy for 2020 (Department of Health,
82 2010) however, aims for midwives to be the trusted first point of contact for women but
83 evidence showing whether this is currently the case is scarce. Unfortunately, Heslehurst et
84 al., (2014a) have described numerous barriers perceived by healthcare professionals,
85 including a need for improved communication skills, the opinion that pregnant women will
86 have an adverse reaction to weight related conversations, and insufficient weight
87 management knowledge. Both research (e.g. (Dodd et al., 2014, Poston et al., 2015, John et
88 al., 2014), and practice (e.g. (Heslehurst et al., 2014b, McGiveron et al., 2015)) are focused on
89 changing maternal behaviours to manage obstetric risk (Ahluwalia, 2015). However,
90 (Heslehurst et al., 2014a) describes the dissemination of diet and physical activity guidelines
91 as passive, while (Swift et al. 2016) described how women did not feel that their weight, diet
92 or exercise were priorities for midwives and other healthcare professionals. While more
93 proactive approaches are attractive, it is essential that midwives and those caring for women
94 in the antenatal period are mindful of women’s experience and motivations to ensure
95 constructive dialogues.

96

97 The purpose of the current study is, therefore, to investigate the relationship between current
98 behaviours, in the form of dietary indicators and estimates of physical activity, and gestational
99 weight gain, describe women’s experiences and their characterisation of dietary and physical
100 activity behaviour during early pregnancy, and describe their awareness of guidelines.

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103 **Methods**

104 *Research design*

105 This paper describes a cross-sectional analysis, of data collected at baseline from a cohort
106 study, on a number of physiological, psychological, sociodemographic, and self-reported
107 behavioural measures relating to bodyweight. Participants’ sociodemographic
108 characteristics, along with their experiences, behaviours, and expectations regarding
109 antenatal weight measurement have been previously reported (Swift et al. 2016).

110

111 *Study population and recruitment*

112 As part of the Managing Weight in Pregnancy (MAGIC) study (Swift et al. 2016), women were
113 recruited while waiting for their “dating” (10 weeks 0 days to 13 weeks 6 days) or “anomaly”
114 (18 weeks 0 days to 20 weeks 6 days) ultrasound scans (which are routine appointments for
115 all women (National Institute of Health and Care Excellence 2016)), at the Nottingham
116 University Hospitals NHS Trust. Researchers recruiting women had all undergone training and
117 held certificates in Good Clinical Practice, and had Disclosure and Barring Service clearance.
118 Inclusion criteria for the study were maternal age ≥ 18 years and proficiency in English.
119 Women of any socioeconomic background, bodyweight, and parity were eligible. The study
120 was approved by the National Health Service (NHS) Health Research Authority (NRES
121 Committee East Midlands) and Nottingham University Hospitals Trust, Research and

122 Innovation Department (12/EM/0267), and all participants provided written informed
123 consent. No incentive was provided for taking part in the study.

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126 *Anthropometrics*

127 Measurements of weight and height were taken by trained researchers on calibrated
128 equipment (Leicester height measure, Marsden, UK and bathroom scales, Salter, UK). Body
129 Mass Index (BMI) was calculated using the standard formula (weight divided by height
130 squared, $\text{kg}\cdot\text{m}^{-2}$) and classified using the World Health Organization's criteria (underweight
131 $<18 \text{ kg}\cdot\text{m}^{-2}$, recommended weight $18\text{-}24.9 \text{ kg}\cdot\text{m}^{-2}$, overweight $25\text{-}29.9 \text{ kg}\cdot\text{m}^{-2}$, obese ≥ 30
132 $\text{kg}\cdot\text{m}^{-2}$) (World Health Organization, 1995). Participants were asked to provide self-reported
133 pre-pregnancy weight in stones and pounds or in kilogrammes, from which the weight change
134 (kg/wk) from conception to recruitment was calculated; (weight taken by researchers, kg) –
135 (self-reported pre-pregnancy weight, kg) / (number of weeks gestation at which weight taken
136 by researchers, wk).

137

138 *Dietary intake*

139 Participants self-completed a paper version of the Dietary Instrument for Nutrition Education
140 – Brief Version (DINE[®] copyright holder University of Oxford) food frequency questionnaire
141 which was developed to give an indication of fat and dietary fibre intake in adults consuming
142 a typical UK diet. High, medium, and low intakes of fibre, fat and unsaturated fat were
143 determined, as per the authors' instructions (Roe et al., 1994). Participants also recorded the
144 number of pieces of fruit and vegetables they consumed on a typical day, and were asked to
145 describe any vitamin, mineral or herbal supplements use.

146

147 *Physical activity levels*

148 Physical activity levels were assessed using a paper version of the self-completed
149 International Physical Activity Questionnaire – Short Form (IPAQ), which is a tool designed for
150 population surveillance of physical activity among adults. The short form version assesses
151 three types of activities, namely walking, moderate-intensity activity and vigorous-intensity
152 activities, undertaken in four domains, namely leisure-time physical activity, domestic and
153 gardening activities, work-related physical activity and transport-related physical activity.
154 Domain specific estimates of physical activity cannot be provided, however the total score of
155 physical activity is calculated by adding the duration (min) and frequency (days) of walking,
156 moderate-intensity and vigorous-intensity activities. Both continuous (Metabolic Equivalent
157 of Task; $\text{MET}\cdot\text{min}\cdot\text{wk}^{-1}$) and categorical (low, moderate, high) estimates of physical activity
158 can be calculated from the short form version of the IPAQ. "Low" individuals do not meet the
159 criteria for "Moderate" or "High" and are considered to have low levels of physical activity.
160 "Moderate" and "High" individuals have a total physical activity score of $\geq 600 \text{ MET}\cdot\text{min}\cdot\text{wk}^{-1}$
161 and $\geq 3000 \text{ MET}\cdot\text{min}\cdot\text{wk}^{-1}$ (Craig et al., 2003). As per the authors' instructions, participants

162 were excluded if their self-reported values were unreasonably high (≥ 16 hours of activity;
163 (Craig et al., 2003)).

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165 *Perceived changes in diet and physical activity*

166 Participants were asked to record – on a self-completed, paper-based questionnaire -
167 whether the amount of exercise done, the types of food or drink consumed, the way food is
168 eaten, or the amount of food eaten had changed since becoming pregnant. Open questions
169 then asked women to describe these changes. In addition, participants were asked to describe
170 what food they wanted to eat more and less of (if appropriate).

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172 *Awareness of dietary and physical activity guidance*

173 Participants' awareness of the Department of Health's (DoH) and NHS guidance dietary and
174 physical activity guidance was also assessed using the self-completed, paper-based
175 questionnaire. Participants were asked whether they were aware of the recommendations
176 for calorie (energy) intake, vitamin and mineral supplements, and physical activity and if so,
177 how many extra calories, what supplements, and what physical activity they thought was
178 recommended.

179

180 *Data analysis*

181 Quantitative data were analysed using SPSS version 22 (IBM Corp, 2013). Data entry was
182 conducted by three members of the research team and all data entry was double-checked by
183 another member of the team. The dataset was inspected for univariate outliers and missing
184 data. Normality of continuous variables was assessed using the Kolmogorov–Smirnov test,
185 and then described using appropriate parametric and nonparametric statistics. Categorical
186 variables were described as frequencies. Chi-squared and Kruskal-Wallis were used to
187 investigate the relationship between the DINE fibre, fat and unsaturated fat indicators and
188 IPAQ categories on the one hand, and BMI classification and rate of weight change per week
189 since conception on the other.

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191 Summative content analysis was employed to analyze participants' responses regarding what
192 they believed the physical activity recommendations were by counting keywords and content
193 (Hsieh and Shannon 2005). To improve reliability, data were coded by two researchers and
194 consensus reached (JAS and KES). Finally, qualitative data from open questions relating to diet
195 and physical activity changes were subjected to an inductive, interpretive thematic (Fade and
196 Swift, 2011) by one researcher (JAS) and inspected for representativeness by the study team.
197 Verbatim quotes from participants' written responses are used to illustrate emergent themes.
198 Identification numbers are indicated alongside quotes and no attempt is made to analysis by
199 BMI category as this would clash with the relativist ontological position of this methodology
200 (Swift and Tischler, 2010).

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202

203 **Findings**

204 One hundred and ninety-three women were recruited onto the study. As reported in (Swift
205 et al. 2016), the sample recruited had 79.6% (n=121) with a National Statistics Socio-Economic
206 Classification score of 1 or 2, indicating that they or their partner were in occupations of the
207 highest social standing (Office for National Statistics, 2010), which is twice the proportion of
208 women compared with the census data for the East Midlands (<65yrs) (Office for National
209 Statistics, 2011). The average age of mothers participating (mean 32.8yrs, min 18.9yrs, max
210 47.1yrs) was which is higher than the mean (30.0 yrs) reported in the Office for National
211 Statistics data (Office for National Statistics, 2013). Participants' self-reported gestation was
212 between 10 and 27 weeks and the majority of women were recruited at 12-14 weeks'
213 gestation and 20-22 weeks' gestation (84.5%, n=163), which reflects the function of the clinics
214 recruited from (namely the 10-12 week dating scan and 18-20 week anomaly scan).

215

216 *Anthropometrics*

217 Just under half of the sample had a BMI that could be classified as within the healthy range
218 (48.7%, n=94), a third as overweight (31.6%, n=61), 18.6% as obese (n=36), and 1% (n=2) as
219 underweight. The distribution of weight change per week since conception showed a positive
220 skew with women, on average, gaining 0.26kg/wk (IQR 0.34 kg/wk, min -1.05kg/wk, max
221 9.83kg/wk) since conception. BMI classification was not significantly associated with rate of
222 weight change.

223

224 *Current dietary intakes and levels of physical activity*

225 The DINE food frequency questionnaire was completed by 191 women and indicated that the
226 majority of women reported consuming healthy levels of fat and unsaturated fat, suggesting
227 good adherence to dietary guidelines (Table 1). However, 90.0% (n=171) of women consumed
228 less than the recommended 5-a-day of fruit and vegetables and approximately three-quarters
229 of the sample did not consume high levels of fibre.

230

231 Table 1. Participants' scores on DINE; fibre, fat, and unsaturated fat indicators.

	Low intake	Medium intake	High intake
Fibre	40.8% (n=78)	34.0% (n=65)	25.1% (n=48)
Fat	63.4% (n=121)	28.3% (n=54)	8.4% (n=16)
Unsaturated fat	2.6% (n=5)	43.5% (n=83)	53.9% (n=103)

232 *N.B. Shaded areas indicate superior intakes in terms of health*

233

234 The majority of participants (86.5%, n=166) reported taking a vitamin, mineral, or herbal
235 supplement. 123 (74.1%) of these women reported using a multivitamin (n=110) or
236 multivitamin with omega-3 (n=13). Folic acid (n=15), folic acid with vitamins D and/or C
237 (n=22), and folic acid with iron (n=2) supplements were also reported. One woman reported
238 taking Chlorella and Spirulina, and one woman reported taking virgin coconut oil.

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240 Data on METs were available for 183 women with a median of 693 MET-min·wk⁻¹, (IQR 1143,
241 Q1 297, Q3 1440; range min 0 max 5340 MET-min·wk⁻¹). 41% of these women (n=76) were
242 classified as inactive, 43% (n=78) as moderately active, 6% (n=11) as highly active. 18 women
243 were excluded (8%) as their self-reported values were unreasonably high.

244

245 There were no significant associations of BMI classification with fat, unsaturated fat, and fibre
246 indicators, self-reported fruit and vegetable consumption on a typical day, or physical activity
247 levels. There was, however, a significant association between fat intake and average weight
248 change (per week) since conception ($\chi^2_{(2)}= 7.78$; $p<0.05$) with high intakes of fat associated
249 with higher rates of weight gain (median 0.46kg/wk IQR 0.77kg/wk) than medium (median
250 0.30kg/wk IQR 0.30kg/wk) and low intakes (median 0.24kg/wk IQR 0.31kg/wk).

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252 *Perceptions of dietary change and changes to physical activity levels*

253 44.0% (n=85) of women reported exercising less since becoming pregnant, 42.0% (n=81) the
254 same amount as before, and 13.5% (n=26) stated no difference (N.B. 1 missing value). The
255 majority of women reported that the amount of food they consumed had increased since
256 becoming pregnant (54.4%, n=105), 30.1% that it hadn't changed (n=58), and 15.5% (n=30)
257 that intake had decreased. 79.8% (n=154) agreed that since becoming pregnant that they had
258 changed the type of food or drinks consumed, and 82.9% (n=160) agreed that they had
259 changed the way they eat. Thematic analysis was conducted on food-related data from 185
260 participants and physical data from 105 participants and revealed five themes:

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262 **(1) Risk management**

263 Food-related behaviour change was overwhelmingly justified by considerations of **risk** to the
264 baby that were mitigated by avoidance of recommended foods. Indeed, some women
265 explicitly described the potential toxic or pathogenic risk of certain foods: *Stopped eating*
266 *foods with listeria or toxoplasmosis risk, e.g. soft cheeses, raw or cured meat (ID 10509); I*
267 *don't eat anything on the 'foods to avoid' NHS list (ID 40307). Risk management was also*
268 *overwhelmingly cited as a reason for decreasing physical activity: Worried it will hurt the baby*
269 *or cause miscarriage... (ID 50103); ...due to concern on How exercise could affect my unborn*
270 *child (ID 30104), and personal experience was emphasized: Previous miscarriages (ID 101); I*
271 *started to go swimming but started bleeding again so am quite reluctant to take up too much*
272 *exercise for fear of damaging/losing the baby (ID 40502).*

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274 Although there was an understanding that an increase in energy requirements was necessary
275 to "**grow**" the baby, very few women described how her decrease in physical activity should
276 also be accounted for: *Eating more – using more calories being pregnant (ID 40506); Assume*
277 *its (sic) the extra calories my body needs to support baby's growth (ID 50402). Also less well*
278 *described was behaviour change to **nurture** the baby - or indeed themselves - from a nutrient*
279 *point of view: I am more conscious of ensuring my food is rich in vitamins (ID 120505), or in*
280 *terms of physical fitness.*

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(2) Coping with symptoms

Women described making food-related changes to cope with **gastrointestinal** symptoms, including nausea, feeling overly full and uncomfortable, heartburn, and constipation, which were exacerbated by **perceptual** changes in terms of smell, taste and texture: *I eat more to try and combat the constant sickness, nausea (sic), horrible taste in my mouth & hunger (ID 90406)*. Women perceived an increase in **appetite** and thirst, which if were not satisfied led to low **energy** levels, feeling “wobbly” and “faint”: *Before being Pregnant I did not eat alot but now im always hungry and eating (ID 80304); I’M ALSO EATING MORE CARBS – TO AVOID DIPS IN BLOOD SUGAR LEVELS (ID 100106), ...felt nauseous and ravenously hungry! (ID 60303)*. Similarly, a decrease in physical activity was described as resulting from gastrointestinal symptoms and energy levels: *Not had the energy or felt well enough (ID 80501). I’ve not felt up to it (ID 30407)*. Furthermore, physical limitations - both pre-existing and **co-morbidities** - and respiratory issues were also described as experiences explaining changes to physical activity: *Walk less due to leg cramps (ID 50110); Back pain has prevented some exercise, as has shortness of breath (ID 50106)*.

(3) Self-control

Women implicitly described their food-related behaviour change as both **conscious and effortful**, for example prefacing their information with “I’m attempting to...” and “I am making myself...”: *Fortunately I have iron will power so have largely ignored the cravings, bar the odd weekend treat (ID 100110)*. In contrast, it was the maintenance of pre-pregnancy levels of physical activity which were described as effortful: *LAST 3 MONTHS SINCE BECOMING PREGNANT, I HAVE FELT OVER TIRED & NO ENERGY TO MOTIVATE MYSELF FOR THE GYM (ID 60102); Less energy, don’t feel really motivated to do much (ID 40102)*. Both childcare responsibilities and work/study competed for women’s available energy: *Do run around after a toddler most days though (ID 40509)*.

Interestingly, in relation to food-related behavior, a narrative of **desire** was interwoven with one of **necessity**. Readily women described changes in preferences using remarkably similar terminology, having either “gone off” certain foods and drinks and/or experiencing “cravings”: *... - finding normal foods bland and uninteresting (ID 60506); Increasing desire for fatty sugary foods (more than usual) (ID 60413)*. However, merging with this description of how women felt that what they wanted had changed, was something more forceful. Women employed terminology such as how they “needed to” engage in certain food -related behaviour, or conversely how they “couldn’t” engage in others: *Need much more or feel sick (ID 30116); I constantly feel sick so I can only stomach what I can stomach (ID 90515)*. Desire and necessity were less obvious in the data relating to physical activity although the frustration expressed by some women in regards to their reduced physical activity does not imply these changes were considered desirable: *used to run 6 miles most days, now none :((ID 80103); Felt quite tired so couldn’t run as long as I’d like (ID 50507)*.

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323 (4) Deviation from norm

324 Although some described how their current behaviour deviated from pre-pregnancy regimes,
325 such as for weight loss and athletic training, most women implied that they did not consider
326 their current dietary behaviour (during this pregnancy period) as **normal**: *Never used to eat*
327 *breakfast or snack, now I do both! (ID 90510); I have always had weight issues since being a*
328 *teenager and being pregnant means I can eat other foods such as carbs which I might normally*
329 *avoid (ID 40108). Similarly, a cessation of normal physical activity behaviour was described by*
330 *women, often abruptly on confirmation of pregnancy: after my baby who is 9 months old I*
331 *tried looseing (sic) weight by doing Zumba but when I found out preg again stoped (sic) (ID*
332 *10411); I was training for a marathon but had to stop when I found out I was pregnant (ID*
333 *90502).*

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335 Increasing the **frequency and regularity** of eating events, particularly snacks was strategy
336 employed by most women: *I find I need to eat little & often (ID 30113); Try to eat regular (ID*
337 *40104). While some women specified that these changes did or did not increase the overall*
338 *amount of food consumed, others were less sure: Feel the need to snack more (but eating less*
339 *at evening meal so hopefully not much more!) (ID 100103); Eat more often as helps with*
340 *sickness so probably eating more overall (ID 30410). Women identified specific foods or drinks*
341 *that they either wanted to or felt a need to consume more or less of, but also categorised*
342 *foods in terms of constituents (e.g. caffeine, "carbs") or characteristics (fatty, spicy) and*
343 *discussed how these interacted with experienced symptoms: I want 'comfort' foods and*
344 *savory (sic) foods eg carbs, white bread, potatoe (sic) (ID 40509); More fatty food, more*
345 *starchy food to avoid nausea and comfort eating (ID 100504). Categorization didn't extend to*
346 *the labels healthy (or unhealthy) which were rarely employed in relation to food: Just haven't*
347 *fancied eating many things especially anything healthy! (ID 12040), and never in terms of*
348 *physical activity.*

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350 (5) Nature knows best

351 Throughout the women's responses to changes in food-related behaviour there was a sense
352 of **wonder** at their body's changes: *I have no idea why!! (ID 100109); I don't know.....*
353 *pregnant! (ID 40303). Women also spontaneously sought explanation for these changes:*
354 *Pasta salad – not sure why (ID 90411); Ice / icelollys / ice cream - think it's the 'fresh' taste...*
355 *(ID 60106), often referring to how their changes in preferences and behaviour must be in*
356 *response to some change in their body's or their baby's requirements: I am eating more*
357 *cheese & dairy products, I think that this is due to calcium deficits maybe? (ID 10413); ...I think*
358 *I crave what my body is lacking (50504); Carbs – baby wants carbs! (ID 110405). This sense of*
359 *wonder was not evident in women's narratives regarding their physical activity changes.*
360 *Although women were still 'listening' to, and responding to, their bodies changing signals*
361 *(particularly in terms of nausea and tiredness) this did not evoke the same curiosity that was*
362 *evident in the food-related data.*

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Awareness of guidance

The majority of participants reported that they were not aware of the DoH and NHS guidance on energy (calorie) intake or physical activity during pregnancy (Table 2). Among those participants who provided an estimation of the extra energy (calories) recommended in pregnancy, the median was 200 (IQR 100, min 100, max 500). Overall, 20 women (10.4%) were aware that energy intake recommendations were dependent on trimester.

Table 2. Participants’ self-reported awareness of dietary and physical activity guidance.

	Not aware of guidance	Aware of guidance but no description reported	Aware of guidance and description reported
Energy (calorie) intake	54.9% (n=106)	7.8% (n=15)	37.3% (n=72)
Supplements	25.4% (n=49)	6.7% (n=13)	67.9% (n=131)
Physical activity	57.5% (n=111)	4.7% (n=9)	37.8% (n=73)

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In contrast, the majority of participants reported that they were aware of guidance on supplements during pregnancy. The vast majority of the 131 participants who provided a description of supplement guidance specified that folic acid (n=93) or a folic-containing multivitamin was recommended (n=36). Vitamin D (n=52), vitamin C (n=4), calcium (n=3), iron (n=9) and omega-3 (n=3) were also mentioned.

Over half of the participants were unable to provide a description of physical activity guidance (Table 2) and those who did emphasised intensity and mode, over frequency and duration (Table 3).

Table 3. Content analysis of participants’ responses regarding what they believed the physical activity recommendations were.

Theme	Number	Percentage
Frequency	18	25
3-5 times per week	5	7
Everyday	5	7
Regularly	8	11
Duration	16	23
30 minutes	12	17
20 minutes	4	6
Intensity[†]	30	41
“Gentle”	16	22
“Moderate”	7	10
“Enough to increase heart rate”	1	1
“Light”	6	8

“Not strenuous”	5	7
“Not out of breath”	2	3
Mode	37	51
Swimming	13	18
Yoga/Pilates	9	13
Walking	13	18
Cycling	1	1
Pelvic floor and tummy exercises	1	1
Avoid	32	46
Balance sports/risk of falling	5	7
Risky sports	2	3
New activities	6	8
Activities that are too physical/heavy lifting	4	6
High impact sports	4	6
Combat/contact sports	9	13
Sports that increase body temperature	2	3
No change from before pregnancy	13	18
Keep active	7	10

386 † All direct quotes from the participants

387 NB: Themes are not mutually exclusive

388 Discussion

389 This study clearly demonstrates that, for participants in this study, early pregnancy is a period
390 of significant and heterogeneous behaviour change, which women described in detail and
391 with considerable nuance. Midwives and those caring for women in the antenatal period need
392 to be cognizant of women’s lived experience when providing lifestyle advice, particularly in
393 the context of weight management.

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395 The qualitative data presented demonstrates that the changes women make to their diet and
396 physical activity behaviour do not develop gradually during early pregnancy, but instead
397 appear to be triggered by the confirmation of conception. Women described making
398 conscious decisions relating to behaviour change, particularly referencing the management
399 of risk to the fetus. Considering the current emphasis on obstetric risk management
400 (Ahluwalia, 2015) this is perhaps unsurprising. In addition, women described behaviour
401 change either as a result of, or to cope with, their lived experience of pregnancy, most notably
402 nausea, appetite, and perceived energy levels, and with varying degrees of self-control. These
403 are immediate but short-term responses to perceived symptoms, and there was little sense
404 that these behaviours might have negative long-term consequences. Instead, women
405 implicitly constructed their pregnancies as ‘natural’ and trusted that this natural state, the
406 result of eons of natural selection, was perfectly adapted; the ‘wisdom of nature’ heuristic
407 (Bostrom and Sandberg, 2008).

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409 This has important implications for the dietary and physical activity advice provided by
410 healthcare professionals to women in developed countries. Clearly the messaging around risk
411 and its' management has been co-opted by our UK participants, demonstrated by the high
412 levels of knowledge and use of nutritional supplements, and the dominant risk management
413 qualitative theme. Similarly, in Australia, (Lucas et al., 2016) reported that risk aversion was
414 an important factor influencing dietary choice in pregnant women. One, therefore, might
415 expect there to be little resistance to providing advice to mitigate risk in these, so-called, *risk*
416 *averse* societies (Lucas et al., 2016). What might resonate less well are messages such as
417 "there is no need to eat for two" (National Health Service, 2016) and "Just a little more food"
418 (US Department Of Health And Human Services, 2010), along with advice framed as "If you
419 feel peckish..." (National Health Service, 2016) as women report experiencing much stronger
420 physical cues, which they feel compelled to comply with. As well as privileging wisdom of
421 nature, women also subscribe to the inherent logic that the growth of the fetus requires
422 energy, which must be accounted for as an additional requirement. Furthermore, advice to
423 improve nutrient intake by consuming more fruit and vegetables or iron-rich foods (National
424 Health Service, 2016) might also fail to be accepted. When women are selecting foods they
425 are choosing those that display (or do not display) characteristics that are related in some
426 way to the physical cues experienced. Appeals to the positive aspects of health, such the
427 benefit of physical activity on limiting gestational weight gain (Elliott-Sale et al., 2015), are
428 therefore likely to be disregarded. It is interesting to speculate whether the high prevalence
429 of multivitamin supplementation observed in the current sample, which notably is over and
430 above UK recommendations (National Health Service, 2016), also serves to undermine
431 appeals to change dietary behaviour. Future work might usefully explore whether
432 supplementation is being used as insurance, reducing the necessity of consuming nutrient-
433 rich food and liberating the diet for symptom control.

434

435 Although health is the primary impetus for midwives and other professionals caring for
436 women during the antenatal period, this doesn't necessarily speak to women beyond a
437 concern about immediate threats to the fetus. However, a recommendation to provide
438 women with more 'education' regarding a wider range of health risks doesn't necessarily
439 follow. Despite its intuitive appeal and long history, the efficacy of threatening
440 communication in health education practice has not been substantiated (Ruiter et al., 2014).
441 Instead, midwives might do well to consider constructing their dialogue around food and
442 physical activity in terms of how it can also be used to manage the lived experience of
443 pregnancy; for example, how food choices can offer satiety, biological and emotional
444 nourishment, convenience (Swift and Tischler, 2010), and how fatigue can be reduced and
445 energy improved with exercise (Ward-Ritacco et al. 2016). This person-centred approach
446 would embrace the subjective nature of pregnancy symptoms which – as demonstrated by
447 this analysis – can vary widely, rather than what *should* be experienced. For example, rather
448 than working from a position that a woman might feel "peckish", the midwife would accept

449 that for participant 60303 feeling “ravenous” was her reality. Furthermore, midwives might
450 also see a benefit in not simply countering “eating for two” by describing it as a *myth* (National
451 Health Service, 2016) or by stating that this doesn’t mean “eating twice as much” (US
452 Department Of Health and Human Services, 2010), but rather recognising that this might feel
453 counterintuitive and provide an explanation for where this energy comes from. The energy
454 requirements of pregnancy are not distributed equally throughout the antenatal period, with
455 requirements to support fetal growth and an increase in basal metabolic rate heavily
456 weighted towards the third trimester (Butte and King, 2005). Changes in fat metabolism
457 during the first and second trimester work to increase maternal fat deposition. Understanding
458 that there is minimal increase in energy requirement during this period, particularly in
459 societies where women may reduce physical activity, and that excess energy intake
460 contributes to increased maternal fat deposition rather than fetal development may be more
461 compelling than simply describing it as a *myth*.

462
463 When making recommendations about advice giving, one might like to consider developing
464 more comprehensive resources detailing foods, recipes and physical activity opportunities.
465 However, the current study demonstrates just how expansive changes to lifestyle behaviour
466 can be, which raises questions as to how comprehensive resources can practically be. A
467 solution-focused approach (Ferraz and Wellman, 2008) could enable midwives to privilege a
468 woman’s personal food culture, her exercise preferences, and, as in the case of a tobacco
469 reduction programme (Browne et al., 1999), her sense of self-efficacy.

470
471 Much is made of pregnancy as a “window of opportunity” for motivating healthy behaviours
472 (Olander et al., 2015). However, another important finding of this study is that women do not
473 construct their behaviour during this period of their life as normal. It may follow that any
474 behaviour changes made in this abnormal period - even if they are beneficial to health - are
475 unlikely to be sustained long-term when the focus changes. Future work might, therefore,
476 usefully investigate whether/when normality is achieved post-pregnancy, or whether the very
477 concept of normality is renegotiated (Montgomery et al., 2011). Instead, what might be a
478 useful legacy from the antenatal period is the way in which women connect to the functional
479 aspects of their bodies (Hodgkinson et al., 2014) attending to and trusting its’ signals.
480 Cognitive dietary restraint has been identified as a predictor of excess gestational weight
481 control (Kapadia et al., 2015) but the antenatal period might offer a “window of opportunity’
482 to develop attentive and intuitive eating styles which are emerging areas of research with the
483 potential to improve individuals’ relationships with food and disordered eating patterns
484 (Robinson et al., 2013, Van Dyke and Drinkwater, 2014).

485
486 In this study, BMI category was not found to be associated with diet, physical activity, or
487 gestational weight gain. These findings, therefore, serve to underline the importance of
488 delivering individualised advice about weight-related behaviours without prejudice (Swift et

489 al. 2016), and tackling weight bias among midwives (Mulherin et al., 2013) and other
490 healthcare professionals.

491

492 As discussed in Swift et al. (2016), there are limitations with the size and representativeness
493 of the sample in the current study. Further from these issues, it is important to recognize the
494 strengths and limitations associated with the measures of diet and physical activity. The
495 original purpose of DINE was to provide a brief and inexpensive tool for dietary assessment
496 in primary care health promotion programmes (Roe et al., 1994), but it has been used in
497 research, notably with pregnant women as part of the Healthy Eating and Lifestyle in
498 Pregnancy study (John et al., 2014). Similarly, the IPAQ was designed to evaluate population-
499 level surveillance across developed and developing countries and not intended to replace
500 precise, objective measures of individual changes in activity levels in intervention or research
501 studies (van der Ploeg et al., 2010). However, participants found the completion of both DINE
502 and IPAQ quick and straightforward which speaks to their potential clinical utility as a means
503 of initiating a solution-focused approach. For example, considering the strong narrative
504 around appetite and satiety, indications around fibre intake might prove particularly useful in
505 practice.

506

507 Although the use of self-reported pre-pregnancy weight is used in widely used in research
508 and clinical practice, questions remain as to how reliable and valid pre-pregnancy BMI is
509 compared to measure pre-pregnancy BMI (Natamba et al. 2016). It is, therefore, important
510 to recognize that comparisons between pre-pregnancy BMI and BMI in early pregnancy may
511 be influenced by misreporting as well as gestational weight gain.

512

513 **Conclusion**

514 Early pregnancy is clearly a period of significant and heterogeneous behaviour change in
515 relation to diet and physical activity. Behaviour was influenced not only by perceptions of
516 immediate risk to the fetus, but also by the women's lived experience of being pregnant.
517 Midwives need to be cognizant of this, and should seek to reframe health promotion advice
518 relating to physical activity and diet in light of women's priorities. The need for individualized
519 advice is underscored not only by the significant variations in experience but also by the
520 finding that women across the BMI categories would benefit from improved diet and physical
521 activity levels.

522

523 **Funding**

524 This work was supported by: the School of Biosciences, University of Nottingham and the
525 Revere Charitable Trust.

526 **References**

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