**Abstract**

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

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

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

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

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

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

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

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

## Introduction

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

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

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

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

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

## Methods

*Research design*

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

*Study population and recruitment*

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

Authority (NRES Committee East Midlands) and Nottingham University Hospitals Trust, Research and Innovation Department (12/EM/0267), and all participants provided written informed consent. No incentive was provided for taking part in the study.

*Anthropometrics*

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

*Dietary intake*

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

*Physical activity levels*

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

the authors' instructions, participants were excluded if their self-reported values were unreasonably high (≥ 16 hours of activity; (Craig et al., 2003)).

*Perceived changes in diet and physical activity*

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

*Awareness of dietary and physical activity guidance*

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

*Data analysis*

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

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

**Findings**

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

*Anthropometrics*

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

*Current dietary intakes and levels of physical activity*

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

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) |

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

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

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

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

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

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

**(1) Risk management**

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

Although there was an understanding that an increase in energy requirements was necessary to "**grow**" the baby, very few women described how her decrease in physical activity should also be accounted for: *Eating more – using more calories being pregnant (ID 40506); Assume its (sic) the extra calories my body needs to support baby's growth (ID 50402).* Also less well described was behaviour change to **nurture** the baby - or indeed

themselves - from a nutrient point of view: *I am more conscious of ensuring my food is rich in vitamins (ID 120505)*, or in terms of physical fitness.

**(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, nausia (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-morbidites** - 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).*

**(4) Deviation from norm**

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

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

**(5) Nature knows best**

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

signals (particularly in terms of nausea and tiredness) this did not evoke the same curiosity that was evident in the food-related data.

*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) |

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*** |

† All direct quotes from the participants

NB: Themes are not mutually exclusive

## Discussion

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

The qualitative data presented demonstrates that the changes women make to their diet and physical activity behaviour do not develop gradually during early pregnancy, but instead appear to be triggered by the confirmation of conception. Women described making conscious decisions relating to behaviour change, particularly referencing the management of risk to the fetus. Considering the current emphasis on obstetric risk management (Ahluwalia, 2015) this is perhaps unsurprising. In addition, women described behaviour change either as a result of, or to cope with, their lived experience of pregnancy, most notably nausea, appetite, and perceived energy levels, and with varying degrees of self-control. These are immediate but short-term responses to perceived symptoms, and there was little sense that these behaviours might have negative long-term consequences. Instead, women implicitly constructed their pregnancies as 'natural' and trusted that this

natural state, the result of eons of natural selection, was perfectly adapted; the 'wisdom of nature' heuristic (Bostrom and Sandberg, 2008).

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

Although health is the primary impetus for midwives and other professionals caring for women during the antenatal period, this doesn't necessarily speak to women beyond a concern about immediate threats to the fetus. However, a recommendation to provide women with more 'education' regarding a wider range of health risks doesn't necessarily follow. Despite its intuitive appeal and long history, the efficacy of threatening communication in health education practice has not been substantiated (Ruiter et al., 2014). Instead, midwives might do well to consider constructing their dialogue around food and physical activity in terms of how it can also be used to manage the lived experience of pregnancy; for example, how food choices can offer satiety, biological and emotional nourishment, convenience (Swift and Tischler, 2010), and how fatigue can be reduced and energy improved with exercise (Ward-Ritacco et al. 2016). This person-centred approach would embrace the subjective nature of pregnancy symptoms which – as demonstrated by

this analysis – can vary widely, rather than what *should* be experienced. For example, rather than working from a position that a woman might feel "peckish", the midwife would accept that for participant 60303 feeling "ravenous" was her reality. Furthermore, midwives might also see a benefit in not simply countering "eating for two" by describing it as a *myth* (National Health Service, 2016) or by stating that this doesn't mean "eating twice as much" (US Department Of Health and Human Services, 2010), but rather recognising that this might feel counterintuitive and provide an explanation for where this energy comes from. The energy requirements of pregnancy are not distributed equally throughout the antenatal period, with requirements to support fetal growth and an increase in basal metabolic rate heavily weighted towards the third trimester (Butte and King, 2005). Changes in fat metabolism during the first and second trimester work to increase maternal fat deposition. Understanding that there is minimal increase in energy requirement during this period, particularly in societies where women may reduce physical activity, and that excess energy intake contributes to increased maternal fat deposition rather than fetal development may be more compelling than simply describing it as a *myth*.

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

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

In this study, BMI category was not found to be associated with diet, physical activity, or gestational weight gain. These findings, therefore, serve to underline the importance of

492 delivering individualised advice about weight-related behaviours without prejudice (Swift et
493 al. 2016), and tackling weight bias among midwives (Mulherin et al., 2013) and other
494 healthcare professionals.
495
496 As discussed in Swift et al. (2016), there are limitations with the size and representativeness
497 of the sample in the current study. Further from these issues, it is important to recognize
498 the strengths and limitations associated with the measures of diet and physical activity. The
499 original purpose of DINE was to provide a brief and inexpensive tool for dietary assessment
500 in primary care health promotion programmes (Roe et al., 1994), but it has been used in
501 research, notably with pregnant women as part of the Healthy Eating and Lifestyle in
502 Pregnancy study (John et al., 2014). Similarly, the IPAQ was designed to evaluate
503 population-level surveillance across developed and developing countries and not intended
504 to replace precise, objective measures of individual changes in activity levels in intervention
505 or research studies (van der Ploeg et al., 2010). However, participants found the completion
506 of both DINE and IPAQ quick and straightforward which speaks to their potential clinical
507 utility as a means of initiating a solution-focused approach. For example, considering the
508 strong narrative around appetite and satiety, indications around fibre intake might prove
509 particularly useful in practice.
510
511 Although the use of self-reported pre-pregnancy weight is used in widely used in research
512 and clinical practice, questions remain as to how reliable and valid pre-pregnancy BMI is
513 compared to measure pre-pregnancy BMI (Natamba et al. 2016). It is, therefore, important
514 to recognize that comparisons between pre-pregnancy BMI and BMI in early pregnancy may
515 be influenced by misreporting as well as gestational weight gain.
516
517 **Conclusion**
518 Early pregnancy is clearly a period of significant and heterogeneous behaviour change in
519 relation to diet and physical activity. Behaviour was influenced not only by perceptions of
520 immediate risk to the fetus, but also by the women's lived experience of being pregnant.
521 Midwives need to be cognizant of this, and should seek to reframe health promotion advice
522 relating to physical activity and diet in light of women's priorities. The need for
523 individualized advice is underscored not only by the significant variations in experience but
524 also by the finding that women across the BMI categories would benefit from improved diet
525 and physical activity levels.
526
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