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Positive lifestyle changes around the time of pregnancy: effectiveness of public health and clinical practice efforts: a cross sectional study

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ABSTRACT

Objectives: To examine the effectiveness of current public health and clinical practice efforts in affecting positive lifestyle changes after pregnancy recognition.

Design: Cross sectional study.

Setting: Population based study in Ireland.

Participants: 718 women of predominantly Caucasian origin from the Pregnancy Risk Monitoring System Ireland (PRAMS).

Primary and secondary outcome measures: Positive lifestyle behaviours before and during pregnancy in Ireland in line with UK and Irish national clinical guidelines around alcohol consumption, smoking, folate use and nutrition.

Results: Of the 718 women surveyed, 24% were adherent to all three recommendations on alcohol consumption, smoking and folate before pregnancy. This increased to 39% for the same three behaviours during pregnancy, with greater increases in adherence observed among women with the lowest adherence before pregnancy. Age, education and ethnicity gaps in adherence before pregnancy appeared to narrow during pregnancy. Adherence to all seven food pyramid guidelines was less than 1% overall, and less than a 1% of participants met all four micronutrient guidelines on vitamin D, folate, calcium and iron intake around the time of pregnancy.

Conclusions: Low levels of change in the uptake of protective lifestyle behaviours during pregnancy demonstrate an urgent need for increased public health efforts to target deleterious health behaviours during pregnancy. Given that these behavioural targets are also key contributors to later adult chronic disease, further research, interventions and policy which also focus on potential for subsequent later life chronic disease risk reduction among mothers as a complete and integrated life course health approach is required.

ARTICLE SUMMARY

Strengths and limitations of the study

- Our study is the first of its kind to examine adherence to clinical and nutrition guidelines together around the time of pregnancy in Ireland.
- We provide data on adherence to national clinical guidelines at two time points and for multiple health behaviours providing insight into the effectiveness of current public health and clinical practice efforts in influencing positive behaviour change during pregnancy.
- However, our data could be influenced by recall biases given its retrospective nature and our dietary data, derived from Food Frequency Questionnaires does not take account of variation in dietary patterns around the time of pregnancy.
- Despite this, the compatibility of our estimates with other data in the UK and Ireland illustrate the validity of the findings raising important public health concerns regarding the current adequacy of efforts to encourage positive behaviour change during pregnancy.

INTRODUCTION

Deleterious health behaviours such as smoking and alcohol consumption still remain prevalent among women during the peri-conceptual window in the UK and Ireland [1, 2]. These behaviours persist despite substantial longitudinal evidence of the health effects of specific health behaviours around the time of conception and during pregnancy on offspring health [3, 4], clinical trials of interventions to affect behaviour change during pregnancy [5-7] and widespread policy and practice guidelines for health professionals to target adverse lifestyle exposures [8, 9]. Moreover, given that up to 70% of later adult chronic disease shares risk factors [10, 11] with those also targeted in interventions and policy during pregnancy, other critical public health opportunities, including the concomitant reduction of risk factors implicated in later chronic disease burden,[12] could be crucially missed when the impact of public health efforts on behaviour change within the transition to pregnancy are unmonitored or ineffective.

As over 80% of women in high income countries bear at least one child during their reproductive life time,[13] pregnancy presents a single common, widespread opportunity in women's lives to target adverse offspring health outcomes and reduce women's later chronic disease risk concomitantly by capitalising on increased and sustained contact with health professionals to affect long term behaviour change [12]. However, to what extent public health and clinical efforts are resulting in meaningful improvements in maternal lifestyle behaviours before and during pregnancy is not well documented.

In a cross sectional study in Ireland, PRAMS Ireland, examined adherence to key health behaviours before and during pregnancy with a view to examining the extent to which current public health, policy and practice efforts targeting health behaviours around the time of pregnancy including those outlined in clinical practice guidelines in the UK and Ireland result in meaningful changes in women’s lifestyles.

METHODS

Sampling strategy

The details of PRAMS Ireland have been described previously [2, 14]. Using hospital discharge records, a sample of women with recent live births was selected from delivery records at Cork University Maternity Hospital, a large urban, obstetric hospital in the South of Ireland where almost 9,000 live births per year occur (12% of all Irish births and 66% of all births in the health services region) [15]. A constant sampling fraction of one in two records alternately sampled 1,212 from a sampling frame of approximately 2,424 mother-infant pairs discharged between May 14th 2012 and August 18th 2012. Name, address and other demographic and clinical characteristics were recorded. We administered a letter inviting women to participate in the study, three postal surveys, a reminder letter and a telephone follow-up, which included a reminder text. The surveys asked women about their health behaviours and experiences before pregnancy and during pregnancy. A semi-quantitative Food Frequency Questionnaire (FFQ) was also administered with the survey asking women to report their usual weekly diet in the 12 months preceding receipt of the questionnaire. Participants were on average 4.6 months post-

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3 delivery when they completed the questionnaire (minimum two months and maximum nine
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5 months).
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8 **Statistical analysis and variable definitions**

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11 We examined adherence to major lifestyle guidelines for pregnancy by age, education,
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13 ethnicity, body mass index (BMI) and pregnancy intention in Stata V.12. Variables were defined
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15 in line with National Clinical Guidelines on nutrition and lifestyle during pregnancy as set out by
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17 the Institute of Obstetricians and Gynaecologists in Ireland, Royal College of Physicians of
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19 Ireland and the Health Service Executive [9]. These included intake of a daily supplement of
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21 folic acid at least four weeks prior to conception and during the first 12 weeks of pregnancy,
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23 not smoking before or during pregnancy, not consuming more than 11 units of alcohol per
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25 week before pregnancy, not consuming any alcohol during pregnancy and exclusive
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27 breastfeeding until six months postpartum.
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35 The ages of infants of respondents ranged from two to nine months from when the first
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37 and last woman responded. Thus, we calculated exclusive breastfeeding up to two months
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39 postpartum only given the range of infant ages at which women had responded to the survey.
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41 We examined adherence to food pyramid guidelines including intake of six or more servings of
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43 carbohydrates a day, five or more servings a day of fruit and vegetables, three servings a day of
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45 dairy, two servings a day of cooked meat or protein, two portions of fats and oils and not more
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47 than one serving of foods high in salt, sugar and fat [16]. We examined micronutrient intake
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49 from food for key vitamins and minerals necessary for a healthy pregnancy. This included folic
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acid intake of 400 micrograms (μg) or more per day, vitamin D intake of 10 μg or more per day, calcium of 1000 milligrams (mg) or more per day, and iron intake of 14mg or more per day.

Participant's age was derived from discharge data by subtracting date of birth from maternal date of birth and categorized into three age groups: 15-29, 30-39 and 40-51 years. Education was dichotomised to allow those with some third level education (>14 years) to be compared to those with first and second level education only (≤ 14 years). Women's ethnic or cultural background was grouped into either "White Irish" or "Other Background" (Other White Background, African, Any Other Black Background, Chinese or Any Other Asian Background). BMI was calculated based on self-reported weight in kilograms (kg) and height in meters (m) and categorised as underweight ($<20\text{kg/m}^2$), normal ($20\text{--}25\text{kg/m}^2$), overweight or obese ($>25\text{kg/m}^2$). Unintended pregnancy was defined as a pregnancy that a woman wanted later (mistimed) or did not want at any time (unwanted).

RESULTS

Of the 718 women participating in the study, 23% were aged 15-29, 71% were aged 30-39, and 5.6% aged 40-51. Most women had a third level education (82.4%), and most women were White Irish (80.7%). Approximately 3.8% of respondents were underweight, 67% were normal weight and 29% were overweight or obese while one fifth of women did not intend on being pregnant at that time.

Table 1 describes adherence to health behaviours before and during pregnancy by age, education, ethnicity, BMI and pregnancy intention. Over one quarter of women (26.2%) adhered to all three recommendations on smoking, alcohol and folate before pregnancy. Lower

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3 adherence was evident among younger women (8.7%), women with second level education
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5 only (9.6%), non-Irish women (11.3%) and women who did not wish to be pregnant at that time
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7 (6.3%).
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11 During pregnancy, adherence to guidelines on the same health behaviours increased
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13 across all socio-demographic groups to 39% overall. However, socio-demographic differences in
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15 adherence reduced due to larger gains in adherence among women with the lowest adherence
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17 rates before pregnancy. During pregnancy, 34% of younger women, 35% of women with a
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19 second level education, 45% of non-Irish women and 25% of women who did not wish to be
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21 pregnant became adherent to all three smoking, alcohol and folate guidelines. However,
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23 although overall adherence to all guidelines increased, gaps in adherence to smoking guidelines
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25 during pregnancy remained. For example, a 28% gap in adherence to smoking guidelines
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27 remained between the youngest (15-29) and oldest women (40-51) despite a narrowing gap
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29 between these groups for folate and alcohol use during pregnancy.
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36 Overall 30% of women breastfed exclusively up to two months postpartum. Lower
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38 adherence to this guideline was evident among younger women aged 15-29 (21.7%) vs. 32.7%
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40 among women aged 30-39 and 30% among women aged 40-51. Lower adherence was also
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42 evident among less educated women (20.8%) compared to higher educated women (32.1%).
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44 Irish women (26.3%) also had lower adherence levels compared to non-Irish women.
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46 Overweight and obese women had lower adherence rates (23%) compared to underweight and
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48 normal weight participants, 32% and 33% respectively. However, breastfeeding rates among
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50 women who did not intend to be pregnant were similar to those of women who planned their
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52 pregnancy (~30%).
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Table 1 Adherence to health behaviours before and during pregnancy by age, education, ethnicity, BMI and pregnancy intention

		Age				Education		Ethnicity		BMI			Pregnancy intention	
		Total	15-29	30-39	40-51	2 nd level	3 rd level	Irish	Other	<20	20-25	>25	No	Yes
		718 (100)	167 (23.3)	510 (71.1)	40 (5.6)	126 (17.6)	590 (82.4)	571 (80.7)	137 (19.4)	26 (3.8)	464 (67.1)	202 (29.2)	138(79.3)	579 (80.8)
Before*														
	Smoking	542 (76.1)	100 (60.6)	406 (80.2)	36 (90.0)	76 (60.8)	463 (79.4)	428 (75.6)	109 (79.6)	19 (73.1)	348 (75.5)	155 (77.1)	90 (65.2)	452 (78.8)
	Alcohol	263 (66.8)	44 (63.8)	201 (66.1)	18 (85.7)	27 (58.7)	235 (67.7)	217 (64.8)	45 (78.9)	7 (77.8)	186 (67.9)	61 (61.6)	52 (67.5)	211 (66.6)
	<11 units per week)													
	Folate	414 (58.1)	62 (37.1)	327 (64.8)	24 (60.0)	47 (37.9)	365 (62.4)	341 (60.0)	67 (49.3)	14 (53.9)	280 (60.9)	107 (53.0)	24 (17.5)	390 (67.7)
Adherence**		121 (26.2)	10 (8.7)	102 (32.0)	9 (32.1)	9 (9.6)	112 (30.7)	109 (30.2)	11 (11.3)	2 (10.5)	87 (30.2)	31 (21.8)	5 (6.3)	116 (30.3)
During***														
	Smoking	542 (79.1)	100 (62.1)	406 (84.1)	36 (90.0)	76 (63.2)	463 (82.8)	428 (76.7)	109 (82.6)	19 (73.1)	348 (78.6)	155 (80.7)	90 (65.7)	452 (82.5)
	Alcohol	383 (54.1)	106 (64.2)	255 (50.7)	22 (56.4)	72 (60.5)	307 (52.6)	293 (51.9)	86 (64.7)	16 (64.0)	237 (51.9)	111 (55.2)	67 (49.3)	316 (55.3)
	Folate	601 (83.9)	139 (83.3)	430 (84.7)	31 (77.5)	98 (74.8)	500 (85.2)	483 (84.7)	109 (79.6)	22 (84.6)	400 (86.2)	159 (79.1)	104(75.9)	497 (85.8)
Adherence****		263 (39.0)	54 (34.0)	193 (40.6)	16 (41.0)	40 (35.1)	221 (39.8)	202 (37.6)	58 (45.3)	12 (48.0)	168 (38.5)	72 (37.9)	33 (24.6)	230 (42.6)
Since birth														
	Breastfeeding	209 (30.1)	35 (21.7)	161 (32.7)	12 (30.0)	25 (20.8)	183 (32.1)	147 (26.3)	61 (47.7)	8 (32.0)	148 (33.0)	46 (23.1)	41 (29.9)	168 (30.1)
	(2months)													

*Three months before pregnancy ** Adherence to all three health behaviours before pregnancy *** During three trimesters of pregnancy ****Adherence to three health behaviours during pregnancy

Table 2 shows adherence to dietary guidelines in the 12 months preceding response to the survey. Less than 1% of women were adherent to all seven food pyramid guidelines during an average week in the 12 months preceding completion of the questionnaire. Only 7.7% of women reached the recommended guideline of consumption of less than one serving per day of foods high in salt, fat and sugar. However, 81% of women reported meeting fruit and vegetable consumption guidelines of five or more servings per day. For carbohydrate, dairy protein and oils intake, 24-32% of women met the guidelines. Similarly, adherence to physical activity guidelines of moderate intensity activity on five or more days of the week was low overall at 12.3%. In general, adherence to dietary and physical activity guidelines was low across all age groups and did not appear to substantially differ by age, education, ethnicity, BMI and pregnancy intention.

Micronutrient analysis revealed that of some of the key nutrients necessary for a healthy pregnancy, only 26% of women reached folate recommendations, 0.9% reached vitamin D recommendations, 36% met calcium recommendations and 17.6% met iron recommendations, from food. Major differences in age and education were not observed. However, non-Irish women appeared to have higher adherence to all micronutrient intakes compared to Irish women.

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Table 2 Adherence to nutritional and physical activity guidelines around the time of pregnancy age, education, ethnicity, BMI and pregnancy intention

11		Age				Education		Ethnicity		BMI			Pregnancy intention	
12		Total	15-29	30-39	40-51	2 nd level	3 rd level	Irish	Other	<20	20-25	>25	No	Yes
13		718 (100)	167 (23.3)	510 (71.1)	40 (5.6)	126 (17.6)	590 (82.4)	571 (80.7)	137 (19.4)	26 (3.8)	464 (67.1)	202 (29.2)	138(79.3)	579 (80.8)
14	Diet*													
15	Carbohydrates	179 (25.5)	26 (16.3)	139 (27.8)	15 (35.0)	30 (25.2)	147 (25.5)	136 (24.2)	40 (30.8)	10 (41.7)	118 (26.1)	43 (21.6)	29 (21.6)	149 (26.3)
16	Fruit & Veg	567 (80.9)	119 (74.4)	419 (83.8)	28 (70.0)	83 (69.8)	479 (83.0)	438 (78.1)	120 (92.3)	21 (87.5)	361 (79.7)	162 (81.4)	102(76.1)	464 (82.0)
17	Dairy	192 (27.8)	48 (30.6)	136 (27.5)	8 (20.0)	30 (25.9)	161 (28.2)	156 (28.3)	36 (27.7)	5 (21.7)	112 (25.0)	63 (32.1)	40 (30.1)	152 (27.2)
18	Protein	224 (32.0)	43 (26.9)	168 (33.6)	12 (30.0)	30 (25.2)	192 (33.3)	187 (33.3)	33 (25.4)	5 (20.8)	153 (33.8)	55 (27.6)	41 (30.6)	183 (32.3)
19	Fats and oils	168 (24.0)	42 (26.3)	119 (23.8)	7 (17.5)	25 (21.0)	142 (24.6)	125 (22.3)	38 (29.2)	6 (25.0)	108 (23.8)	47 (23.6)	23 (17.2)	145 (25.6)
20	Top shelf	54 (7.7)	18 (11.3)	33 (6.6)	3 (7.5)	8 (6.7)	46 (7.8)	42 (7.5)	11 (8.5)	1 (4.2)	33 (7.3)	15 (7.5)	9 (6.7)	45 (8.0)
21	Total**	1 (0.1)	0	1 (0.2)	0	0	1 (0.2)	1 (0.2)	0	0	0	1 (0.5)	0	1 (0.2)
22	Folate	183 (26.1)	40 (25.0)	135 (27.0)	8 (20.0)	31 (26.1)	151 (26.2)	131 (23.4)	51 (39.2)	8 (33.3)	120 (26.5)	48 (24.1)	35 (26.1)	147 (26.0)
23	Vitamin D	6 (0.9)	2 (1.3)	4 (0.8)	0 (0)	1 (0.8)	4 (0.7)	2 (0.4)	3 (2.3)	0	5 (1.1)	0	1 (0.8)	4 (0.7)
24	Fiber	252 (36.0)	54 (33.8)	186 (37.2)	12 (30.0)	45 (37.8)	204 (35.4)	184 (32.8)	66 (50.8)	11 (45.8)	169 (37.3)	64 (32.2)	44 (32.8)	207 (36.6)
25	Calcium	123 (17.6)	31 (19.4)	86 (17.2)	6 (15.0)	25 (21.0)	96 (16.6)	79 (14.1)	42 (32.3)	3 (12.5)	83 (18.3)	33 (16.6)	26 (19.4)	96 (17.0)
26	Exercise***	88 (12.3)	22 (13.2)	61 (12.0)	4 (10.0)	14 (11.3)	74 (12.6)	73 (12.8)	14 (10.4)	3 (11.5)	68 (14.7)	13 (6.4)	13 (9.5)	75 (13.0)

*Carbohydrate consumption of six or more servings per day, fruit and vegetable consumption of five or more servings per day, dairy consumption of two portions per day, protein consumption of three portions per day, fats and oils consumption of two portions per day and less than one serving per day of top shelf items (foods high in sugar, salt and fat) ** Adherence to all seven food group guidelines *** Physical activity guidelines of moderate intensity exercise five or more days per

DISCUSSION

In this cross sectional study of 718 women in the South of Ireland we found a change from 26% three months before pregnancy to 39% in early pregnancy for adherence to key protective health behaviours dually significant for both neonatal health outcomes, offspring health and women's chronic disease risk in later life. Furthermore, we found that under 1% of women were meeting nutritional or micronutrient guidelines around the time of pregnancy. Critically, we found that low adherence was prevalent across all social groups but was even more pronounced among high-risk younger and less educated women. These findings have a number of important public health and policy implications.

IMPLICATIONS

First, our findings on low adherence to lifestyle behaviours around the time of pregnancy have implications for both policy, practice and public health within the obstetric and reproductive health community illustrating a distinct and urgent need for widespread initiatives targeting women's health behaviour profiles around the time of pregnancy for improved neonatal health outcomes but also life-course offspring health, irrespective of whether lifestyle changes are sustained beyond the peri-conceptual window.

Second, our findings have important implications for the wider community involved in chronic disease prevention. Up to 70% of most chronic diseases including cardiovascular disease and type 2 diabetes may be preventable through early intervention and lifestyle modification including cessation of smoking, engaging in regular physical activity and

consuming a healthy and varied diet,[11, 17] behaviours which underwent low levels of change during pregnancy. Given that over 80% of women bear at least one child in their reproductive lifetime and with an average age of first time mothers in the United Kingdom is thirty years,[18] pregnancy may present an effective, widespread and critical early life juncture for reducing women’s later chronic disease risk by targeting top global priorities for chronic disease prevention in order to affect sustained behaviour change beyond pregnancy. Moreover, since women are naturally engaged with health services and experiencing changing health motivations during this period of transition, interventions which look beyond peri-conceptual behaviour change alone may be more cost effective than at other times in the life-course. Furthermore, given women’s strong influence on diet and lifestyle within the family unit as a whole, interventions that target female behaviour change may have strong positive influences on diet and lifestyle within the family unit as a whole.

Strengths and limitations

There are a number of strengths to this study including collection of data on a wide variety of important health behaviours and experiences and detailed nutritional data around the time of pregnancy. Our study is one of the first to look at adherence to clinical and nutrition guidelines before and after pregnancy recognition as a proxy for the effectiveness of public health and clinical practice efforts in exerting behaviour change. Moreover, our study extends beyond the framing of behaviour change in pregnancy as merely an issue of relevance for professionals within the obstetric and reproductive arena but rather one of concern for the wider public health and clinical community involved in chronic disease prevention efforts. Although our data

could be influenced by recall biases that reduce validity, the high level of comparability of our data with data from other similar populations within the UK and Ireland [19, 20] provides reassurance that our findings are valid and generalizable. Furthermore, although FFQs are a validated form of collection of nutritional data generally,[21] they do not take account of variation in dietary patterns which may occur around the time of pregnancy . Nonetheless, given the compatibility of our data with dietary data from the female general population in Ireland,[22, 23] it is reasonable to assume our data to be somewhat reliable for dietary patterns of women in the postpartum period if not in pregnancy, and the relatively poor diets reported by women during this time of higher nutritional demand is a public health concern.

CONCLUSION

Low levels of change in the uptake of protective lifestyle behaviours during pregnancy demonstrate an urgent need for increased public health and clinical efforts to target deleterious health behaviours during pregnancy. Given that these behavioural targets are also key contributors to later adult chronic disease, further research, interventions and policy which also focus on potential for subsequent later life chronic disease risk reduction among mothers as a complete and integrated life course health approach is required.

Author Contributions

LMO’K had the original idea for the study, wrote the first draft of the article, applied critical revisions to the article based on other co-author recommendations, and approved the final version for publication. PMK, PC and RG conceptualised the design of the study, assisted in interpretation of the data, reviewed and revised the manuscript and approved the final version for publication. MM contributed to the critical revisions of the article and approved the final version for publication. DLD and JMH assisted in the interpretation of the data, reviewed and revised the manuscript and approved the final version for publication.

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Ethics approval

This research protocol and all study materials received ethical approval from the Clinical Research Ethics Committee of the Cork Teaching Hospitals.

Competing interests

None declared.

Data Sharing Statement

No additional data are available.

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Positive lifestyle changes around the time of pregnancy: a cross-sectional study

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Positive lifestyle changes around the time of pregnancy: a cross sectional study

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ABSTRACT

Objectives: To examine the prevalence of positive lifestyle behaviours before and during pregnancy in Ireland.

Design: Cross sectional study.

Setting: Population based study in Ireland.

Participants: 718 women of predominantly Caucasian origin from the Pregnancy Risk Monitoring System (PRAMS) Ireland.

Primary and secondary outcome measures: Positive lifestyle behaviour changes before and during pregnancy in Ireland on alcohol consumption, smoking, folate use and nutrition.

Results: Of 1212 surveyed, 718 women (59%) responded. Twenty six per cent were adherent to all three recommendations on alcohol consumption, smoking and folate before pregnancy. This increased to 39% for the same three behaviours during pregnancy, with greater increases in adherence observed among women with the lowest adherence before pregnancy. Age, education and ethnicity gaps in adherence before pregnancy appeared to narrow during pregnancy. Adherence to all seven food pyramid guidelines was less than 1% overall, and less than 1% of participants met all four micronutrient guidelines on vitamin D, folate, calcium and iron intake around the time of pregnancy.

Conclusions: Low levels of healthy lifestyle behaviours before pregnancy and low levels of adoption of positive lifestyle behaviours during pregnancy demonstrate an urgent need for increased clinical and public health efforts to target deleterious health behaviours both before, during and after pregnancy.

ARTICLE SUMMARY

Strengths and limitations of the study

- We provide data on lifestyle behaviours around the time of pregnancy at two time points and for multiple health behaviours.
- However, our data could be influenced by recall biases given its retrospective nature and our dietary data, derived from Food Frequency Questionnaires does not take account of variation in dietary patterns around the time of pregnancy.
- Despite this, the compatibility of our estimates with other data in the UK and Ireland support the reliability of the findings.
- Our results highlight important public health concerns regarding the current adequacy of efforts to encourage positive behaviour change before and during pregnancy, and reflect the wider public health issues in the general female population in Ireland.

INTRODUCTION

Deleterious health behaviours such as smoking and alcohol consumption are prevalent among women during the peri-conceptual window in the UK and Ireland (1-3). These behaviours persist despite substantial longitudinal evidence of their deleterious offspring health effects (4, 5), clinical trials of interventions to affect behaviour change during pregnancy (6-8) and widespread policy and practice guidelines for health professionals to target adverse lifestyle exposures (9).

Up to 70% of later adult chronic disease shares its risk factors with those targeted in interventions and policy for behavioural change during pregnancy (10, 11). Consequently, as over 80% of women in high income countries bear at least one child during their reproductive life time (12), pregnancy provides a single common, widespread opportunity in women's lives to capitalise on increased and sustained contact with health professionals to affect behaviour change which benefits pregnancy outcomes and long term chronic disease risk (5, 13). Therefore, antenatal care could be used to target adverse offspring health outcomes and reduce women's later chronic disease risk. However, the extent to which positive lifestyle change are realised during pregnancy is not well documented in Ireland.

In a cross sectional study of 718 women in the South of Ireland, PRAMS Ireland (14, 15), we examined positive lifestyle patterns before and during pregnancy in relation to cessation of potentially deleterious health behaviours of smoking and alcohol consumption and uptake of protective behaviours of dietary changes and folate.

METHODS

Sampling strategy

The details of PRAMS Ireland have been described previously (14, 15). Using hospital discharge records, a sample of women with recent live births was selected from delivery records at Cork University Maternity Hospital, a large urban, obstetric hospital in the South of Ireland where almost 9,000 live births per year occur (12% of all Irish births and 66% of all births in the health services region) (16). A constant sampling fraction of one in two records alternately sampled 1,212 from a sampling frame of approximately 2,424 mother-infant pairs discharged between May 14th 2012 and August 18th 2012. Name, address and other demographic and clinical characteristics were recorded. We administered a letter inviting women to participate in the study, three postal surveys, a reminder letter and a telephone follow-up, which included a reminder text. The surveys asked women about their health behaviours and experiences before pregnancy and during pregnancy. A semi-quantitative Food Frequency Questionnaire (FFQ) was also administered with the survey asking women to report their usual weekly diet in the 12 months preceding receipt of the questionnaire. Participants were on average 4.6 months post-delivery when they completed the questionnaire (minimum two months and maximum nine months). Of the 1212 women sampled, 718 women (59%) responded (15). Characteristics of non-responders and comparison of responder characteristics to the national maternity profile in 2011 have been described in previous publications (14, 15). In brief, our sample produced a largely representative sample with broadly similar characteristics to the national birth profile which had mean age of 32, 40 % primiparous women, 33 % single women, 5.8 % preterm birth

prevalence, 5.2 % low birth weight prevalence and 28 % caesarean section rate in 2011 (17). However, responders of PRAMS were older, married and had a higher prevalence of health insurance compared to non-responders and this should be taken into account in the interpretation of results.

Statistical analysis and variable definitions

We examined adherence to major lifestyle guidelines for pregnancy by age, education, ethnicity, body mass index (BMI) and pregnancy intention in Stata V.12 using frequencies and descriptive statistics. For each individual behaviour, all data available irrespective of whether there was missing data for other variables was included resulting in slight variation of sample sizes across different estimates. In particular we chose this over a complete case analysis to preserve sample size and retain generalisability where possible, since a complete case analysis would bias our estimates toward women who completed every item of interest to this analysis. However, rates of missing data were generally low and varied from 1.4% for reporting on alcohol use during pregnancy to 4.6% for smoking during pregnancy and 0.7% for demographic variables such as age and education.

Nutritional and dietary variables were defined in line with National Clinical Guidelines on nutrition on lifestyle during pregnancy as set out by the Institute of Obstetricians and Gynaecologists in Ireland, Royal College of Physicians of Ireland and the Health Service Executive (18). These included intake of a daily supplement of folic acid at least four weeks prior to conception and during the first 12 weeks of pregnancy; not smoking before or during pregnancy, not consuming more than 11 units of alcohol per week before pregnancy, not

consuming any alcohol during pregnancy [both in line with Irish government guidelines] (19, 20), exclusive breastfeeding until six months postpartum and engaging in physical activity. Although these guidelines were established after the PRAMS study was conducted, we sought to estimate uptake of positive lifestyle changes prior to the guidelines in order to establish baseline levels of positive behaviour change.

The ages of infants of respondents ranged from two to nine months. Thus, we calculated exclusive breastfeeding up to two months postpartum only given the range of infant ages at which women had responded to the survey. We examined adherence to food pyramid guidelines including intake of six or more servings of carbohydrates a day, five or more servings a day of fruit and vegetables, three servings a day of dairy, two servings a day of cooked meat or protein, two portions of fats and oils and not more than one serving of foods high in salt, sugar and fat (21). We examined micronutrient intake from food for key vitamins and minerals necessary for a healthy pregnancy. This included folic acid intake of 400 micrograms (μg) or more per day, vitamin D intake of $10\mu\text{g}$ or more per day, calcium of 1000 milligrams (mg) or more per day, and iron intake of 14mg or more per day.

Participant's age was derived from discharge data by subtracting date of birth from maternal date of birth and categorized into three age groups: 15-29, 30-39 and 40-51 years. Education was dichotomised to allow those with some third level education (>14 years) to be compared to those with first and second level education only (≤ 14 years). Women's ethnic or cultural background was grouped into either "White Irish" or "Other Background" (Other White Background, African, Any Other Black Background, Chinese or Any Other Asian Background). BMI was calculated based on self-reported weight in kilograms (kg) and height in meters (m) at

the beginning of pregnancy and categorised as underweight ($<20\text{kg/m}^2$), normal ($20\text{--}25\text{kg/m}^2$), overweight or obese ($>25\text{kg/m}^2$). Unintended pregnancy was defined as a pregnancy that a woman wanted later (mistimed) or did not want at any time (unwanted).

RESULTS

Of the 718 women participating in the study (59% of 1212 women sampled), 23% were aged 15-29, 71% were aged 30-39, and 5.6% aged 40-51. Most women had a third level education (82.4%), and most women were White Irish (80.7%). Approximately 3.8% of respondents were underweight, 67% were normal weight and 29% were overweight or obese. One fifth of women did not intend on being pregnant.

Table 1 describes adherence to health behaviours before and during pregnancy by age, education, ethnicity, BMI and pregnancy intention. Over one quarter of women (26.2%) adhered to all three recommendations on smoking, alcohol and folate before pregnancy. Lower adherence was evident among younger women (8.7%), women with second level education only (9.6%), non-Irish women (11.3%) and women who did not wish to be pregnant at that time (6.3%).

During pregnancy, adherence to guidelines on the same health behaviours increased across all socio-demographic groups to 39% overall. However, socio-demographic differences in adherence reduced due to larger gains in adherence among women with the lowest adherence rates before pregnancy. During pregnancy, 34% of younger women, 35% of women with a second level education, 45% of non-Irish women and 25% of women who did not wish to be pregnant became adherent to all three smoking, alcohol and folate guidelines. However,

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2
3 although overall adherence to all guidelines increased, gaps in adherence to smoking guidelines
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5 during pregnancy remained. For example, a 28% gap in adherence to smoking guidelines
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7 remained between the youngest (15-29) and oldest women (40-51) despite a narrowing gap
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9 between these groups for folate and alcohol use during pregnancy.
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13 Overall 30% of women breastfed exclusively up to two months postpartum. Lower
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15 adherence to this guideline was evident among younger women aged 15-29 (21.7%) vs. 32.7%
16
17 among women aged 30-39 and 30% among women aged 40-51. Lower adherence was also
18
19 evident among less educated women (20.8%) compared to higher educated women (32.1%).
20
21 Irish women (26.3%) also had lower adherence levels compared to non-Irish women.
22
23 Overweight and obese women had lower adherence rates (23%) compared to underweight and
24
25 normal weight participants, 32% and 33% respectively. However, breastfeeding rates among
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27 women who did not intend to be pregnant were similar to those of women who planned their
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29 pregnancy (~30%).
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Table 1 Adherence to health behaviours before and during pregnancy by age, education, ethnicity, BMI and pregnancy intention

	Age				Education		Ethnicity		BMI			Pregnancy intention	
	Total	15-29	30-39	40-51	2 nd level	3 rd level	Irish	Other	<20	20-25	>25	No	Yes
	718 (100)	167 (23.3)	510 (71.1)	40 (5.6)	126 (17.6)	590 (82.4)	571 (80.7)	137 (19.4)	26 (3.8)	464 (67.1)	202 (29.2)	138(79.3)	579 (80.8)
Before*													
Smoking	542 (76.1)	100 (60.6)	406 (80.2)	36 (90.0)	76 (60.8)	463 (79.4)	428 (75.6)	109 (79.6)	19 (73.1)	348 (75.5)	155 (77.1)	90 (65.2)	452 (78.8)
Alcohol (<11 units per week)	263 (66.8)	44 (63.8)	201 (66.1)	18 (85.7)	27 (58.7)	235 (67.7)	217 (64.8)	45 (78.9)	7 (77.8)	186 (67.9)	61 (61.6)	52 (67.5)	211 (66.6)
Folate	414 (58.1)	62 (37.1)	327 (64.8)	24 (60.0)	47 (37.9)	365 (62.4)	341 (60.0)	67 (49.3)	14 (53.9)	280 (60.9)	107 (53.0)	24 (17.5)	390 (67.7)
Adherence**	121 (26.2)	10 (8.7)	102 (32.0)	9 (32.1)	9 (9.6)	112 (30.7)	109 (30.2)	11 (11.3)	2 (10.5)	87 (30.2)	31 (21.8)	5 (6.3)	116 (30.3)
During***													
Smoking	542 (79.1)	100 (62.1)	406 (84.1)	36 (90.0)	76 (63.2)	463 (82.8)	428 (76.7)	109 (82.6)	19 (73.1)	348 (78.6)	155 (80.7)	90 (65.7)	452 (82.5)
Alcohol	383 (54.1)	106 (64.2)	255 (50.7)	22 (56.4)	72 (60.5)	307 (52.6)	293 (51.9)	86 (64.7)	16 (64.0)	237 (51.9)	111 (55.2)	67 (49.3)	316 (55.3)
Folate	601 (83.9)	139 (83.3)	430 (84.7)	31 (77.5)	98 (74.8)	500 (85.2)	483 (84.7)	109 (79.6)	22 (84.6)	400 (86.2)	159 (79.1)	104(75.9)	497 (85.8)
Adherence****	263 (39.0)	54 (34.0)	193 (40.6)	16 (41.0)	40 (35.1)	221 (39.8)	202 (37.6)	58 (45.3)	12 (48.0)	168 (38.5)	72 (37.9)	33 (24.6)	230 (42.6)
Since birth													
Breastfeeding (2months)	209 (30.1)	35 (21.7)	161 (32.7)	12 (30.0)	25 (20.8)	183 (32.1)	147 (26.3)	61 (47.7)	8 (32.0)	148 (33.0)	46 (23.1)	41 (29.9)	168 (30.1)

*Three months before pregnancy ** Adherence to all three health behaviours before pregnancy *** During three trimesters of pregnancy ****Adherence to three health behaviours during pregnancy

Table 2 shows adherence to dietary guidelines in the 12 months preceding response to the survey. Less than 1% of women were adherent to all seven food pyramid guidelines during an average week in the 12 months preceding completion of the questionnaire. Only 7.7% of women reached the recommended guideline of consumption of less than one serving per day of foods high in salt, fat and sugar. However, 81% of women reported meeting fruit and vegetable consumption guidelines of five or more servings per day. For carbohydrate, dairy protein and oils intake, 24-32% of women met the guidelines. Similarly, adherence to physical activity guidelines of moderate intensity activity on five or more days of the week was low overall at 12.3%. In general, adherence to dietary and physical activity guidelines was low across all age groups and did not appear to substantially differ by age, education, ethnicity, BMI and pregnancy intention.

Micronutrient analysis revealed that of some of the key nutrients necessary for a healthy pregnancy, only 26% of women reached folate recommendations, 0.9% reached vitamin D recommendations, 36% met calcium recommendations and 17.6% met iron recommendations, from food. Major differences in age and education were not observed. However, non-Irish women appeared to have higher adherence to all micronutrient intakes compared to Irish women.

Table 2 Adherence to nutritional and physical activity guidelines around the time of pregnancy age, education, ethnicity, BMI and pregnancy intention

	Age				Education		Ethnicity		BMI			Pregnancy intention	
	Total	15-29	30-39	40-51	2 nd level	3 rd level	Irish	Other	<20	20-25	>25	No	Yes
	718 (100)	167 (23.3)	510 (71.1)	40 (5.6)	126 (17.6)	590 (82.4)	571 (80.7)	137 (19.4)	26 (3.8)	464 (67.1)	202 (29.2)	138(79.3)	579 (80.8)
Diet*													
Carbohydrates	179 (25.5)	26 (16.3)	139 (27.8)	15 (35.0)	30 (25.2)	147 (25.5)	136 (24.2)	40 (30.8)	10 (41.7)	118 (26.1)	43 (21.6)	29 (21.6)	149 (26.3)
Fruit & Veg	567 (80.9)	119 (74.4)	419 (83.8)	28 (70.0)	83 (69.8)	479 (83.0)	438 (78.1)	120 (92.3)	21 (87.5)	361 (79.7)	162 (81.4)	102(76.1)	464 (82.0)
Dairy	192 (27.8)	48 (30.6)	136 (27.5)	8 (20.0)	30 (25.9)	161 (28.2)	156 (28.3)	36 (27.7)	5 (21.7)	112 (25.0)	63 (32.1)	40 (30.1)	152 (27.2)
Protein	224 (32.0)	43 (26.9)	168 (33.6)	12 (30.0)	30 (25.2)	192 (33.3)	187 (33.3)	33 (25.4)	5 (20.8)	153 (33.8)	55 (27.6)	41 (30.6)	183 (32.3)
Fats and oils	168 (24.0)	42 (26.3)	119 (23.8)	7 (17.5)	25 (21.0)	142 (24.6)	125 (22.3)	38 (29.2)	6 (25.0)	108 (23.8)	47 (23.6)	23 (17.2)	145 (25.6)
Top shelf	54 (7.7)	18 (11.3)	33 (6.6)	3 (7.5)	8 (6.7)	46 (7.8)	42 (7.5)	11 (8.5)	1 (4.2)	33 (7.3)	15 (7.5)	9 (6.7)	45 (8.0)
Total**	1 (0.1)	0	1 (0.2)	0	0	1 (0.2)	1 (0.2)	0	0	0	1 (0.5)	0	1 (0.2)
olate	183 (26.1)	40 (25.0)	135 (27.0)	8 (20.0)	31 (26.1)	151 (26.2)	131 (23.4)	51 (39.2)	8 (33.3)	120 (26.5)	48 (24.1)	35 (26.1)	147 (26.0)
itamin D	6 (0.9)	2 (1.3)	4 (0.8)	0 (0)	1 (0.8)	4 (0.7)	2 (0.4)	3 (2.3)	0	5 (1.1)	0	1 (0.8)	4 (0.7)
ron	252 (36.0)	54 (33.8)	186 (37.2)	12 (30.0)	45 (37.8)	204 (35.4)	184 (32.8)	66 (50.8)	11 (45.8)	169 (37.3)	64 (32.2)	44 (32.8)	207 (36.6)
alcium	123 (17.6)	31 (19.4)	86 (17.2)	6 (15.0)	25 (21.0)	96 (16.6)	79 (14.1)	42 (32.3)	3 (12.5)	83 (18.3)	33 (16.6)	26 (19.4)	96 (17.0)
Exercise***	88 (12.3)	22 (13.2)	61 (12.0)	4 (10.0)	14 (11.3)	74 (12.6)	73 (12.8)	14 (10.4)	3 (11.5)	68 (14.7)	13 (6.4)	13 (9.5)	75 (13.0)

*Carbohydrate consumption of six or more servings per day, fruit and vegetable consumption of five or more servings per day, dairy consumption of two portions per day, protein consumption of three portions per day, fats and oils consumption of two portions per day and less than one serving per day of top shelf items (foods high in sugar, salt and fat) ** Adherence to all seven food group guidelines *** Physical activity guidelines of moderate intensity exercise five or more days per

DISCUSSION

In this cross sectional study of 718 women in the South of Ireland we found a low prevalence of positive lifestyle behaviours before pregnancy (26%) which changed to 39% in early pregnancy. Furthermore, we found less than 1% of women were meeting nutritional or micronutrient guidelines around the time of pregnancy. Critically, we found that low adherence was prevalent across all social groups but was even more pronounced among younger and less educated women.

IMPLICATIONS

Up to 70% of most chronic diseases may be prevented through early intervention and lifestyle modification including smoking cessation, engaging in regular physical activity and consuming a healthy and varied diet with moderate alcohol consumption (11, 22). These behaviours have been the focus of many of Ireland’s long term policy and public health initiatives (23, 24) and more recently, “Health Ireland”, Ireland’s newest framework focusing on behaviour change and wellbeing in the population (25). Consequently, our finding that only 26% of women are adherent to all lifestyle behaviours in advance of pregnancy have important implications for public health initiatives at large as these lifestyle patterns reflect the wider lifestyle patterns of women in the Irish population. For example, although a workplace smoking ban has existed in Ireland since 2004 (26), and smoking rates in the general population have declined by about 8% (27), the relatively high rates of smoking prior to and during pregnancy in PRAMS suggest that

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2
3 further efforts to support smoking cessation in women in the general population and before
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5 they become pregnant are required. In relation to breastfeeding, although the Maternity
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7 Protection (Amendment) act was introduced in 2004 (28) to allow women in employment to
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9 take time off work each day to breastfeed, employers are currently not obliged to provide work
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11 place facilities to do so and therefore, an examination of more comprehensive work place
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13 initiatives and legislation to encourage breastfeeding may be beneficial. In addition, considering
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15 the role of primary care and women's contact with health providers or health promotion before
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17 pregnancy in order to establish a continuum of behavioural counselling and health education
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19 that focuses on improving women's lifestyle behaviours generally, would have benefits for
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21 health behaviours prior to and during pregnancy and for behaviour change efforts from first
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23 booking visit through antenatal care. In relation to maternity care specifically, maternity care is
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25 predominantly hospital based and consultant led in Ireland (0.2% of births occurring at home)
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27 (29)while postnatal follow-up is carried out by the public health nursing service with at least
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29 one home visit usually 2 days after birth and a follow-up check-up provided at 6 weeks by the
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31 general practitioner(30). Therefore, examining how current primary care, antenatal and
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33 postnatal care services could develop a more integrated approach to supporting behaviour
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35 change in women is required. However, given the low level of positive lifestyle behaviours in
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37 PRAMS participants prior to pregnancy, our findings reflect a wider public health problem
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39 which requires an upscaling of current public health efforts in the general population.
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41 Moreover, a system for monitoring change over time in lifestyle patterns including those of
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43 pregnancy at the national and regional level may be required so that the effects of new public
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45 health efforts on health behaviour change can be monitored.
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While wider public health initiatives are required in the general population which would have benefits for women’s health behaviours and health status in advance of and during pregnancy, the findings also have some implications for initiatives and care within and after pregnancy. For example, in the 2005 government strategic action plan on breastfeeding(31), two specific 5 year targets included development of a comprehensive, accurate and timely infant feeding data collection system within 5 years of the plan and 100% baby friendly hospital status; however, currently only 9 of 20 Irish maternity hospitals have been assessed as achieving baby friendly hospital status, the WHO/UNICEF quality initiative for encouraging breastfeeding which includes steps such as staff training, policy and support groups (32). Moreover, a comprehensive infant feeding data collection system has not been established more than 10 years after the action plan was written. Regarding antenatal counselling, standard care currently during pregnancy includes assessment for alcohol, smoking and substance abuse with subsequent referral to the national smoking cessation programme and discussion with a consultant on alcohol or substance abuse, when necessary. However, in relation to dietary and exercise guidelines, only high risk groups receive dietary advice and our data showing that less than 1% of women were adhering to all nutrition guidelines during pregnancy suggest that this should be established for all women. In addition, providing greater depth and scope to the 2013 “Nutrition in Pregnancy”(18) guidelines for care providers may be beneficial, including extensive coverage on alcohol use during pregnancy which is currently lacking. More specific and detailed training, key performance indicators for care providers, and incentives for all health care providers to counsel women on their behaviours may be beneficial. Innovation in

health education approaches may also be useful including the use of social media and other non –conventional routes to influence lifestyle change.

Strengths and limitations

There are a number of strengths to this study i) including collection of data on a wide variety of important health behaviours and experiences, ii) detailed nutritional data around the time of pregnancy and ii) data on behaviours for two time; before and during pregnancy. However, recall bias is a substantial threat to validity of our results, particularly for self-reported height and weight and socially unacceptable lifestyle behaviours such as alcohol consumption and smoking. Secondly, FFQ's do not take account of variation in dietary patterns which may occur between the pre-pregnancy, antenatal and postnatal period. However, the high level of comparability of our data with data from other similar populations within the UK and Ireland (33, 34) provides re-assurance that our findings are valid and generalizable.

CONCLUSION

We observed low levels of protective lifestyle behaviours before pregnancy and limited increases in positive behaviours during pregnancy demonstrating a need for increased public health and clinical efforts to target deleterious health behaviours both in the general population and during pregnancy. Given that these behavioural targets are also key contributors to later adult chronic disease, further research, interventions and policy which focus on developing supportive environments for behaviour change in the Irish population are required.

Author Contributions

LMO’K had the original idea for the study, wrote the first draft of the article, applied critical revisions to the article based on other co-author recommendations, and approved the final version for publication. PMK, PC and RG conceptualised the design of the study, assisted in interpretation of the data, reviewed and revised the manuscript and approved the final version for publication. MM contributed to the critical revisions of the article and approved the final version for publication. DLD and JMH assisted in the interpretation of the data, reviewed and revised the manuscript and approved the final version for publication.

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Ethics approval

This research protocol and all study materials received ethical approval from the Clinical Research Ethics Committee of the Cork Teaching Hospitals.

Competing interests

None declared.

Data sharing

No additional data are available.

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STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*
Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any pre-specified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	5,6
		(b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed Case-control study—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7,8
Bias	9	Describe any efforts to address potential sources of bias	5,6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6,7,8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6,7
		(b) Describe any methods used to examine subgroups and interactions	6,7,8
		(c) Explain how missing data were addressed	6
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed Case-control study—If applicable, explain how matching of cases and controls was addressed	5,6

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	5,6
		(c) Consider use of a flow diagram	19 (Ref 15)
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	6
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	10, 12
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10, 12
		(b) Report category boundaries when continuous variables were categorized	10, 12
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	13,14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13,14,15
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.