Lifestyle behaviours and health measures of women at increased risk of breast cancer taking chemoprevention.

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--Manuscript Draft--

Abstract:	**Objectives** Women at increased breast cancer risk are eligible for chemoprevention. Healthy lifestyles are potentially important for these women to improve efficacy and minimise side effects of chemoprevention and reduce risk of breast cancer and other lifestyle related conditions. We investigated whether women taking chemoprevention adhere to healthy lifestyle recommendations, how their lifestyle risk factors and health measures compare to women in the general population, and whether these change whilst taking chemoprevention. **Methods** Lifestyle risk factors and health measures in 136 premenopausal women taking tamoxifen for prevention of breast cancer (Tam-Prev study) were compared to both national recommendations and an age-matched female population from the Health Survey for England 2012. **Results** The Tam-Prev population had high rates of overweight and obesity (59.2%) and low adherence to physical activity recommendations (30.6%) which were comparable to the general population (respectively 55.2% and 35.1%). Fewer Tam-Prev participants were current smokers (10.5% vs. 18.2%, p=0.032), but more exceeded alcohol

recommendations (45.0% vs. 18.7%, p<0.001). Tam-Prev participants had suboptimal diets; proportions not meeting fibre, saturated fat and non-milk extrinsic sugar recommendations were 87.8%, 64.9% and 21.4% respectively. Many Tam-Prev participants had markers of cardiovascular disease risk and the metabolic syndrome. Health behaviours did not change during the first year on tamoxifen.

Conclusions
Women taking chemoprevention had a high prevalence of unhealthy lifestyle behaviours and health measures, similar to an age-matched English cohort. Improving these measures in women at increased breast cancer risk could significantly decrease rates of breast cancer and other non-communicable diseases.

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Professor Jaak Janssens
Editor-in-Chief
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1st August 2018

Dear Professor Janssens,

Please find enclosed our revised submission to the European Journal of Cancer Prevention:

Lifestyle behaviours and health measures of women at increased risk of breast cancer taking chemoprevention
Mary Pegington, D. Gareth Evans, Anthony Howell, Louise S. Donnelly, Julia Wiseman, Jack M. Cuzick and Michelle N. Harvie

We are very grateful to your two reviewers for their helpful comments. I enclose a revised manuscript and below is a point-by-point response.

Reviewer #1:
1. We have reduced the length of the discussion as recommended.
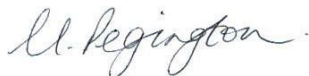
Reviewer #2:
1. The comparator group was chosen as the aim of the paper was to investigate whether women at increased risk of breast cancer eligible for chemoprevention are already leading a healthier lifestyle compared to women in the general population. Our statistician advised that the comparing two groups of different sizes was acceptable.
2. The variables that were measured differently in the two cohorts were waist, alcohol and physical activity.
   o We have removed reference to waist. Because we also have weight and BMI, we agree that the addition of waist by a different measurement was not adding to the aim of the paper.
   o Alcohol and physical activity remain in the paper as they are key determinants of a healthy lifestyle and the manuscript clearly exercises caution over these comparisons.
3. We have reduced the length of the discussion as recommended.
4. We have not included a discussion on the relevance of tamoxifen adherence and changes after treatment which we acknowledge is a very interesting area. We include three participants who were known to have stopped taking tamoxifen before one year but we do not have data on tamoxifen adherence for the other 106 women who completed the Tam-Prev study. The suggested Maurice *et al* (2006) paper from our research group looked at predictors of compliance and found that not smoking

was associated with IBIS I study completion. Our manuscript describes no difference in smoking status between completers and those that dropped out of Tam-Prev. We have not gone into further detail with this as it would have added to the length of the discussion and was not the main focus of study. Likewise for the Land *et al* (2011) paper which showed mixed results for lifestyle and compliance in the NSABP BCPT, the effect of lifestyle on drug compliance was not the main focus of our study and could not be as we lack data on compliance in Tam-Prev.

5. Many thanks for highlighting the discrepancy in whether lifestyle advice was given. We have clarified this by adding that no 'individualised' advice was given (Procedures, line 2; Discussion, paragraph 7).

6. We have not stated that CVD risk is increased by tamoxifen and we agree with the reviewer that evidence suggests that tamoxifen does not increase risk. We have stated that tamoxifen does not lower CVD rates, despite it reducing total and LDL cholesterol levels. We make this point to highlight that many women taking tamoxifen need to act on their raised CVD risk. We have added to this paragraph to clarify our argument (Discussion, paragraph 8).

Please contact me if you require any further clarification or information.

We look forward to hearing from you.

Mrs Mary Pegington

On behalf of Louise S. Donnelly, Julia Wiseman, Jack M. Cuzick, D. Gareth Evans, Anthony Howell and Michelle N. Harvie

TITLE PAGE

Lifestyle behaviours and health measures of women at increased risk of breast cancer taking chemoprevention

Running head: Lifestyle of women at increased breast cancer risk

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ABSTRACT

Lifestyle behaviours and health measures of women at increased risk of breast cancer taking chemoprevention

Objectives

Women at increased breast cancer risk are eligible for chemoprevention. Healthy lifestyles are potentially important for these women to improve efficacy and minimise side effects of chemoprevention and reduce risk of breast cancer and other lifestyle related conditions. We investigated whether women taking chemoprevention adhere to healthy lifestyle recommendations, how their lifestyle risk factors and health measures compare to women in the general population, and whether these change whilst taking chemoprevention.

Methods

Lifestyle risk factors and health measures in 136 premenopausal women taking tamoxifen for prevention of breast cancer (Tam-Prev study) were compared to both national recommendations and an age-matched female population from the Health Survey for England 2012.

Results

The Tam-Prev population had high rates of overweight and obesity (59.2%) and low adherence to physical activity recommendations (30.6%) which were comparable to the general population (respectively 55.2% and 35.1%). Fewer Tam-Prev participants were current smokers (10.5% vs. 18.2%, p=0.032), but more exceeded alcohol recommendations (45.0% vs. 18.7%, p<0.001). Tam-Prev participants had suboptimal diets; proportions not meeting fibre,

saturated fat and non-milk extrinsic sugar recommendations were 87.8%, 64.9% and 21.4% respectively. Many Tam-Prev participants had markers of cardiovascular disease risk and the metabolic syndrome. Health behaviours did not change during the first year on tamoxifen.

Conclusions

Women taking chemoprevention had a high prevalence of unhealthy lifestyle behaviours and health measures, similar to an age-matched English cohort. Improving these measures in women at increased breast cancer risk could significantly decrease rates of breast cancer and other non-communicable diseases.

Keywords:

Chemoprevention, lifestyle, diet, physical activity, weight, tamoxifen, breast cancer

TEXT

Lifestyle behaviours and health measures of women at increased risk of breast cancer taking chemoprevention

Introduction

Breast cancer (BC) is the most common cancer in the UK with 55,122 diagnoses in 2015 (Cancer Research UK, online). Expert reports estimate maintaining a healthy weight, limiting alcohol, and being physically active could prevent 19-38% of BC in the UK (World Cancer Research Fund International / American Institute for Cancer Research, online; Parkin, 2011). Further reductions would be achieved through not smoking (Macacu *et al.*, 2015; Kispert and McHowat, 2017).

Tamoxifen is one of three drugs licenced for chemoprevention of BC in women at increased risk of BC in the UK. Tamoxifen reduces BC risk by 40% but carries an increased risk of venous thromboembolism and postmenopausal endometrial cancer, as well as vasomotor side effects.

Although evidence is mixed, there are suggestions from the adjuvant (Goodwin, 2015) and prevention (Cecchini *et al.*, 2012) settings that chemopreventative medications are less effective in overweight women, and carry more side effects (Cohen *et al.*, 2001; Al-Azemi, Labib and Omu, 2002; Dignam *et al.*, 2003). Furthermore since the majority of women taking chemoprevention will not develop BC (Antoniou *et al.*, 2003), they need to attend to their risk of other lifestyle-related diseases, for example cardiovascular disease (CVD).

There are few published data on the lifestyle behaviours of women at increased risk of BC, and none concerning those behaviours in women taking BC chemoprevention. This paper describes

the lifestyle behaviours and health measures of women at increased risk of BC opting to take tamoxifen compared to the general UK population, and changes during a year of chemoprevention.

Methods

Participants

The Tamoxifen Prevention Study (Tam-Prev, ISRCTN 53844391) was approved by Greater Manchester West Research Ethics Committee (11/H1014/4) and performed in accordance with the Declaration of Helsinki (Donnelly *et al.*, 2014). It recruited 136 premenopausal women at increased risk of BC in 2011-12 to establish uptake of tamoxifen for BC prevention, and to determine who is most likely to benefit.

The Tam-Prev study has been described previously (Donnelly *et al.*, 2014). Women were eligible if they were at moderately high or high risk of BC (≥17% lifetime risk) (Tyrer, Duffy and Cuzick, 2004), attending a regional Family History Clinic (FHC), aged 33-46 years, premenopausal and not on hormonal contraception. From 1279 eligible women invited, 136 were recruited (10.6% uptake), none of whom were known BRCA gene mutation carriers. All participants provided written informed consent.

Procedures

Women were asked to take tamoxifen (20mg/d) and were reviewed at eight weeks and one year. No individualised lifestyle advice was given. All participants had previously been given a leaflet on the lifestyle prevention of BC upon joining the FHC which included advice to control weight, limit alcohol and increase physical activity (PA). The median duration from joining the FHC to starting the Tam-Prev study was four years (range 0-19).

Assessments at baseline (before commencing tamoxifen) and one year included weight and body fat determined by multi-frequency bioelectrical impedance (MC-180MA; Tanita Europe, Amsterdam, The Netherlands), fasting lipids, insulin and glucose taken using standardised methods described previously (Harvie *et al.*, 2013). Self-reported dietary intake was assessed at baseline and one year from seven day food diaries checked for completeness with the respondent and analysed using WISP v3.3 (Tinuviel Software, Anglesey, UK) for mean daily saturated fatty acids, fibre (Association of Official Analytical Chemists [AOAC] method), non-milk extrinsic sugars (NMES: total of sugars added during manufacturing or before consumption, sugars in honey, syrups and unsweetened fruit juices, and 50% of sugars from dried, stewed or canned fruit) and alcohol. Self-reported PA in the past seven days was assessed using the International Physical Activity Questionnaire (IPAQ) short version at the same time points (Craig *et al.*, 2003) and was used to calculate Metabolic Equivalent of Task (MET). Walking at 3.0 miles per hour is a 3.3 MET activity, and an hour of brisk walking equates to 3.3 x 60 = 198 MET-minutes.

Insulin was measured by chemiluminescent microparticle immunoassay (ARCHITECT i2000, Abbott, Illinois, USA). Glucose was measured by hexokinase/glucose-6-phosphate inter-assay dehydrogenase method and colorimetric enzyme reactions were used to measure total cholesterol, triglycerides and HDL cholesterol (all ARCHITECT c1600, Abbott, Illinois, USA). Levels were measured spectrophotometrically by an automated Olympus AU600 analyser (Olympus, Rungis, France). LDL cholesterol was calculated using the formula of Friedewald *et al* (Friedewald, Levy and Fredrickson, 1972). Fasting insulin and glucose were combined to calculate the insulin resistance index using the homeostasis model assessment (HOMA) (Matthews *et al.*, 1985).

Statistics

We compared the Tam-Prev population (age, deprivation level, BMI, total and HDL cholesterol, smoking, alcohol and PA habits) to a population of 1072 women aged 33-46 years in the Health Survey for England (HSE) (Craig and Mindell, 2013). The 2012 HSE was used to ensure a comparable time frame. Indices of Deprivation 2007 Layer Super Output Area Scores were identified from participant postcodes via Geoconvert (UK Data Service Census Support, online). There were some methodological differences between the two data sets; PA data were collected in Tam-Prev by the IPAQ short version covering the previous seven days, and in HSE by a longer set of questions covering the previous four weeks (Craig and Mindell, 2013), Tam-Prev used a seven day food diary to collect dietary data whereas HSE used a verbal food frequency questionnaire. We assessed changes in weight, BMI, body composition and dietary intakes at one year in the Tam-Prev cohort. Changes in lipids, glucose or HOMA were not assessed as these can be altered by tamoxifen (Johansson *et al.*, 2008; Filippatos *et al.*, 2009).

Data were analysed using SPSS v23 (IBM, Armonk, New York, USA). Normally distributed data are presented as mean and SD (age, body fat percentage, total, LDL and HDL cholesterol, glucose, fibre and saturated fat), otherwise median and range are presented. Categorical data are presented as number and percentage (deprivation, smoking, proportion not meeting recommendations for BMI, body fat percentage, lipids, glucose, PA and dietary variables). Independent samples t-tests, Mann-Whitney U tests and Pearson's chi squared tests were used to compare the Tam-Prev and HSE populations at baseline. Changes over one year were calculated for weight, BMI, body fat, PA and the dietary variables using both per protocol and baseline observation carried forward (BOCF) values. Normally distributed change variables

(weight, BMI, body fat, PA and saturated fat) were compared using paired samples t-tests, otherwise related samples Wilcoxon signed-rank tests were used.

Results

Baseline characteristics

The baseline characteristics of Tam-Prev participants are reported in Table 1. The median BMIs of the populations were comparable (median [range] Tam-Prev 25.9 [18.4-50.8] kg/m^2 and HSE 25.8 [15.71-58.44] kg/m^2, p=803). Women in Tam-Prev were slightly taller (mean [SD] 1.65 [0.06] vs 1.63 [0.06] m, p<0.001), but were also non-significantly heavier than the HSE population (median [range] 70 [45.5-130.2] vs 68.5 [37.5-140.4] kg, p=0.106). The majority of women in both populations were either overweight or obese (59.2 and 55.3% in Tam-Prev and HSE). This aligns with the observation that half of women in Tam-Prev had a body fat percentage above the normal range (Gallagher *et al.*, 2000). The Tam-Prev population was marginally older than the HSE population but had an equivalent spread of deprivation. Mean total cholesterol level was lower in the Tam-Prev population compared to the general population (4.9 [0.8] vs 5.2 [1.0] mmol/L, p<0.001), however the HDL fraction was also lower (1.5 [0.3] vs 1.6 [0.4] mmol/L, p<0.001) and 26.7% of Tam-Prev women had a low HDL level (<1.29 mmol/L) compared to 17.6% of the HSE population (p=0.019), which is one of the markers of the metabolic syndrome (International Diabetes Federation, 2006). Other markers of the metabolic syndrome were present in Tam-Prev women; 13.9% had triglycerides ≥1.7 mmol/L and 4.4% had fasting plasma glucose ≥5.6 mmol/L (International Diabetes Federation, 2006). HOMA, a measure of insulin resistance which increases risk of metabolic syndrome, was increased (>2.5) in 14.1% of Tam-Prev women (Kuk and Ardern, 2009).

Table 2 compares health behaviours in the two populations. Smoking was less prevalent amongst the Tam-Prev women (10.5 vs 18.2%, p=0.032). A third of women in both populations did not meet PA guidelines. Self-reported median daily alcohol intake was markedly higher in Tam-Prev women (13.6 [0-107.8] vs 3.6 [0-680.0] g per day, p<0.001) and 45% of Tam-Prev participants exceeded the recommended UK maximum of 14 units per week (equivalent to 1.4 bottles of wine or six pints of lager) compared to 18.7% of the HSE population (p<0.001). Proportions of Tam-Prev women not meeting UK guidelines for fibre, saturated fat and NMES were 88%, 65% and 21% respectively, though there were no comparable figures for the HSE population.

Of 115 women in Tam-Prev with full information, over half (51%) had at least two out of four key lifestyle risk factors as defined by the World Cancer Research Fund and the American Institute for Cancer Research (WCRF/AICR: overweight or obesity, low PA, smoking, exceeding seven alcoholic drinks per week: 9-13 units / week), 18% had at least three, and one participant had all four. Only 8.7% had a low-risk lifestyle with none of these risk factors (World Cancer Research Fund International / American Institute for Cancer Research, 2007).

Withdrawal from the Tam-Prev Study

Twenty-seven women (19.9%) withdrew before one year: 21 (15.4%) due to tamoxifen side effects, three (2.2%) lost contact, one (0.7%) became pregnant and two (1.5%) left for other reasons. There were no differences in baseline BMI or smoking status between completers and those that dropped out (median BMI [range] 26.3 [18.4-45.7] vs 25.2 [19.5-50.8] kg/m^2, p=0.943; 10.1 vs 13.3% smokers, p=0.701), however completers had a higher alcohol intake (15.6 [0.0-107.8] vs 4.0 [0.0-58.6] g/day, p=0.001). Three participants took tamoxifen for less than one year but their results are included here as they completed the one year assessments.

Change after one year of chemoprevention

Per-protocol analyses are reported in Table 3. BOCF analyses gave similar results (data not shown). There were modest reductions in weight, BMI and body fat mass over the year. Using ±3% to define natural daily weight variation (Stevens *et al.*, 2006), 23% of women lost weight, 68% maintained, and 9% gained. The proportions losing and gaining a clinically significant 5% of baseline weight were 15.7% and 4.6% respectively (Jensen *et al.*, 2014). There were small reductions in saturated fat (26.1g to 24.0g per day, p=0.011) and NMES (37.2g to 33.7g per day, p=0.030) during the year, but no change in other dietary parameters or PA. Despite these reductions, significant proportions of the women remained overweight and were not adhering to recommendations for PA, alcohol or diet at one year.

Discussion

Here we report lifestyle behaviours and health measures in women in an FHC taking tamoxifen for prevention of BC, and the change in these during a year of chemoprevention. At baseline, Tam-Prev participants had a high prevalence of unhealthy lifestyle behaviours, for example overweight, low PA and adverse health measures, which were comparable to an English, age-matched female population from the HSE. They reported higher alcohol intake but lower smoking rates. Significant proportions were found to have markers of poor metabolic health and indicators of poor diet.

Previous studies of lifestyle behaviours in women at increased risk of BC in the UK have also highlighted the prevalence of overweight and obesity and low adherence to PA recommendations (Begum *et al.*, 2009; Anderson *et al.*, 2017). Begum *et al* reported the majority of women (76%) in an English FHC were overweight or obese and 24% did no PA

(Begum *et al.*, 2009), while Anderson *et al* found 52% of respondents in a Scottish genetics service were overweight or obese and 55% did not adhere to PA recommendations (Anderson *et al.*, 2017). Both studies, in addition to Tam-Prev and HSE, used self-reported methods for PA which are acknowledged to overestimate (Boon *et al.*, 2010) so it is likely that actual PA levels were even lower than reported.

The lower rate of smoking in Tam-Prev (10.5%) compared to the general population (18.2%) is an interesting observation which has also been noted in women with a family history of breast and/or ovarian cancer undergoing genetic testing (Rouleau *et al.*, 2004). Two UK surveys found many women with a family history of BC incorrectly believe that smoking is the most important risk factors (Begum *et al.*, 2009; Anderson *et al.*, 2017). The low rate of smoking seen here and in the surveys could be due to these beliefs.

Forty-five percent of the Tam-Prev population exceeded alcohol recommendations. The two UK surveys above have found similar (56%) and much lower (1%) proportions exceeding recommendations, despite all studies using self-reported data (Begum *et al.*, 2009; Anderson *et al.*, 2017). The apparent greater alcohol intake in the Tam-Prev population compared to HSE data could be the result of a difference in methods; though both were self-reported, HSE used a verbal food frequency questionnaire and Tam-Prev used a seven day food diary which may provide a more honest and accurate reflection of behaviours.

Unhealthy behaviours amongst women with a family history of BC are not confined to the UK. A study of Californian women with a family history of BC found poor adherence to WCRF/AICR healthy living recommendations (World Cancer Research Fund International / American Institute for Cancer Research, 2007; Bostean, Crespi and McCarthy, 2013) as did a study of

female BRCA mutation carriers in The Netherlands using data collected between 1996 and 2012 (World Cancer Research Fund International / American Institute for Cancer Research, 2007; van Erkelens *et al.*, 2017).

Studies have found minimal or no change in lifestyle after BRCA counselling (O'Neill *et al.*, 2008; Quach *et al.*, 2009; Spector *et al.*, 2009). This is supported by a recent meta-analysis which found that disease risk information, even when personalised, does not have a strong effect on behaviour (French *et al.*, 2017). Belief in the efficacy of certain health behaviours to prevent or delay cancer has been associated with practice of these behaviours (Quach *et al.*, 2009). Therefore efforts to encourage behaviour change in FHCs should include education to address current poor understanding and improve credibility of lifestyle risk factors, and their response efficacy. The National Institute for Health and Care Excellence (NICE) recommend that women with a family history of BC in the UK receive written information on lifestyle, including diet, PA and alcohol (NICE, 2013). Despite previously receiving written information the Tam-Prev population had a high prevalence of unhealthy lifestyle behaviours. This is consistent with previous data highlighting the limited efficacy of standard written advice (Mazzuca, 1982). An effective lifestyle intervention would include education around lifestyle risk factors, combined with an programme proven to aid behaviour change such as a self-monitoring website with additional telephone calls (Cadmus-Bertram *et al.*, 2013; Hartman *et al.*, 2015).

Tam-Prev participants completed food diaries at baseline and one year in the study which are known to promote behaviour change (Burke, Wang and Sevick, 2011) and could have contributed to the small improvements in weight and diet seen here. Sixteen percent of women achieved a clinically significant 5% weight loss. Our results agree with previous

research showing that tamoxifen does not cause weight gain in the prevention setting (Sestak *et al.*, 2012).

Women about to commence tamoxifen had lower levels of total and HDL cholesterol than women in the general population. Two studies by Boyd *et al* reported generally more favourable lipid profiles in women with a family history of BC, but findings were variable and the reasons for these potential differences are not understood (Boyd *et al.*, 1989, 1995). Women with a family history of BC are reported to underestimate their CVD risk and overestimate their BC risk (Erblich *et al.*, 2000) and our results suggest that a significant proportion of Tam-Prev women had an increased risk of CVD at baseline of which they may have been unaware. Despite tamoxifen provoking beneficial reductions in total and LDL-cholesterol levels, it does not consistently lead to lower CVD rates, perhaps due to detrimental effects on triglyceride levels (Filippatos *et al.*, 2009) insulin sensitivity (Johansson *et al.*, 2008), and thromboembolism, thus other methods of reducing CVD risk in these women, such as lifestyle change, should be encouraged.

This is the first prospective study on lifestyle behaviours and health measures in women undertaking BC chemoprevention. It benefits from an almost complete data set for women who entered Tam-Prev. Most of the Tam-Prev and HSE data were gathered using similar methods though a weakness is that PA and alcohol methods were different. Another weakness is that we do not have data on change over a year in higher risk women not taking tamoxifen, therefore cannot assess whether the changes observed here would normally be expected over time. Dietary and PA data were self-reported and people tend to underestimate amounts eaten and overestimate PA (Mertz *et al.*, 1991; Lichtman *et al.*, 1992; Boon *et al.*, 2010). It is recognised that this could affect both data sets.

This population of higher risk women taking chemoprevention had a high prevalence of suboptimal lifestyle behaviours. We have not compared the Tam-Prev population to higher risk women in general who are not taking tamoxifen. Women who opt to take chemoprevention could have different behaviours to other high risk women. However our data is consistent with rates of suboptimal behaviours from previous surveys in the general high risk population. This study highlights the need to initiate lifestyle change programmes in FHCs. Future research should focus on engaging higher risk women with lifestyle improvement. This should reduce the burden of BC and other lifestyle-related diseases, leading to potential improvements in quality of life, and cost savings for the NHS.

Acknowledgements

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Table 1: Baseline characteristics of women in the Tam-Prev study compared to an age matched women in the general population in England

	Tam-Prev population	English population [1]	P value
Age (years) [2]	41.2 (3.5)	39.7 (4.0)	**<0.001**
	(n=136)	(n=1072)	
Indices of Deprivation [3]			
1 (least deprived)	33 (24.3%)	234 (21.8%)	0.439
2	34 (25.0%)	209 (19.5%)	
3	24 (17.6%)	217 (20.2%)	
4	25 (18.4%)	210 (19.6%)	
5 (most deprived)	20 (14.7%)	202 (18.8%)	
	(n=136)	(n=1072)	
Height (m) [2]	1.65 (0.06)	1.63 (0.06)	**<0.001**
	(n=130)	(n=955)	
Weight (kg) [4]	70 (45.5 – 130.2)	68.5 (37.5 – 140.4)	0.106
	(n=130)	(n=898)	
BMI (kg/m^2) [4]	25.9 (18.4 – 50.8)	25.8 (15.71 – 58.44)	0.803
	(n=130)	(n=894)	
BMI category [3,5]			0.709
Underweight (<18.5 kg/m^2)	1 (0.8%)	14 (1.6%)	
Normal (18.5 – 24.9 kg/m^2)	52 (40.0%)	386 (43.2%)	
Overweight (25 – 29.9 kg/m^2)	46 (35.4%)	279 (31.2%)	

Obese (≥30.0 kg/m^2)	31 (23.8%)	215 (24.0%)	
	(n=130)	(n=894)	
Body fat percentage (%) [6]	34.2 (7.3)	No data	-
	(n=130)		
Body fat percentage over the ideal for their age [7]	50%	No data	-
Total cholesterol (mmol/L) [2]	4.9 (0.8)	5.2 (1.0)	**<0.001**
	(n=135)	(n=488)	
LDL cholesterol (mmol/L) [6]	3.0 (0.7)	No data	-
	(n=135)		
HDL cholesterol (mmol/L) [2]	1.5 (0.3)	1.6 (0.4)	**<0.001**
	(n=135)	(n=488)	
HDL cholesterol <1.29 mmol/L [3, 8]	26.7%	17.6%	**0.019**
Triglycerides (mmol/L) [10]	0.8 (0.3 – 3.1)	No data	-
	(n=136)		
Triglyceride level ≥1.7 mmol/L [8]	13.9%		
Glucose (mmol/L) [6]	4.7 (0.4)	No data	-
	(n=136)		
Glucose ≥5.6 mmol/L [8]	4.4%		
HOMA insulin resistance [9]	1.5 (0.4 – 6.1)	No data	-
	(n=135)		
HOMA insulin resistance ≥2.5 [10]	14.1%		

[1] (Craig and Mindell, 2013)**,** [2] Mean (SD) and independent samples t-test, [3] Percentage and Pearson's chi squared, [4] Median (range) and Mann Whitney U test, [5] (WHO, 1995), [6] Mean (SD), [7] (Gallagher *et al.*, 2000), [8] (International Diabetes Federation, 2006), [9] Median (range), [10] (Kuk and Ardern, 2009)

Table 2: Baseline health behaviours of women in the Tam-Prev study compared to an age matched women in the general population in England

	Tam-Prev population	English population [1]	P value
Smoker [2]	10.5% (n=124)	18.2% (n=1071)	**0.032**
Do not meet physical activity guidelines [2, 3] (minimum 150 min/week moderate intensity or 75 min/week vigorous intensity physical activity or a combination)	30.6% (n=134)	35.1% (n=1059)	0.229
Alcohol intake (g per day) [4]	13.6 (0 – 107.8)	3.6 (0 – 680.0)	**<0.001**
Exceed UK guidelines of ≤14 units per week [2] (8g = 1 unit of alcohol)	45.0% (n=131)	18.7% (n=1049)	**<0.001**
Fibre (g per day) [5]	17.5 (5.3)	No data	-
Do not meet UK daily recommendation of >24g/ day [6]	87.8%		
Saturated fat (g per day) [5]	26.1 (10.3)	No data	-

Percentage of daily energy from saturated fat [5]	12.4 (3.1) %		
Exceed UK recommendation of <11% of energy [6]	64.9%		
Non-milk extrinsic sugar (g per day) [7]	37.2 (0.1 – 145.1)	No data	-
Percentage of daily energy from non-milk extrinsic sugars [5]	8.1 (4.6) %		
Exceed UK recommendation of <11% of energy [6]	21.4%		

[1] (Craig and Mindell, 2013)**,** [2] Percentage and Pearson's chi squared, [3] Physical activity data for Tam-Prev collected using IPAQ short version covering the previous seven days, HSE used a longer set of questions covering the previous four weeks, [4] Median (range) and Mann Whitney U test, [5] Mean (SD), [6] (Department of Health, 1991), [7] Median (range)

Table 3: Per-protocol analysis of change at one year

	Baseline (completers only, n=109)	One year	p value for change	% not meeting UK recommendations at baseline	% not meeting UK recommendations at one year
Weight (kg) [1] (n=108)	74.8 (17.6)	73.8 (17.1)	**0.001**	-	-
BMI (kg/m²) [1] (n=108)	27.2 (6.0)	26.9 (5.9)	**0.001**		
BMI category [2]					
Underweight (<18.5 kg/m²)				0.9%	0.9%
Normal (18.5 – 24.9 kg/m²)				39.8%	43.5%
Overweight (25 – 29.9 kg/m²)				35.2%	31.5%
Obese (≥30.0 kg/m²)				24.1%	24.1%
Body fat (kg) [1] (n=108)	26.6 (11.7)	26.0 (11.6)	**0.010**	-	-
Physical activity	3249 (2750)	3054 (2473)	0.719	30.3%	27.6%

(Metabolic Equivalent of Tasks [MET]-minutes / week) [1] (n=109)					
Alcohol (g per day) [3] (n=101)	15.6 (0.0 – 107.8)	15.8 (0 – 91.3)	0.496	49.5%	50.5%
Fibre (g per day) [3] (n=101)	17.9 (7.0 – 34.8)	16.8 (0.9 – 41.2)	0.085	84.2%	92.3%
Saturated fat (g per day) [1] (n=101)	26.1 (10.2)	24.0 (8.4)	**0.011**	61.4%	65.3%
Non-milk extrinsic sugar (g per day) [3] (n=101)	37.2 (0.1 – 145.1)	33.7 (1.9 – 195.7)	**0.030**	20.8%	18.8%

[1] Mean (SD) for values at baseline and one year, paired samples t-test for change, [2] (WHO, 1995), [3] (International Diabetes Federation, 2006; NICE, 2014), [3] Median (range) for values at baseline and one year, related samples Wilcoxon signed rank test for change