Relationship of obesity with B vitamin status: analysis of NDNS data from UK women of reproductive age

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Introduction

- Maternal obesity (BMI>30 kg/m^2 at first antenatal consultation) is associated with an increased risk of a range of obstetric complications [(1)]
- There is also consistent evidence over the last 20 years that maternal obesity is associated with a 2-fold increased risk of Neural Tube Defects (NTD) in the offspring [(2-3)]
- It is unclear whether the link between obesity and NTD is explained by a folate related mechanism or by unrelated factors. However several studies support the hypothesis that folate metabolism may be compromised in obese women [(4-5)]
- Normal metabolism of folate requires an adequate status of not only folate but also the related B vitamins [vitamins B12, B6 and riboflavin] [(6)]
- The Royal College of Obstetrics and Gynaecologists advise prescription of high dose (5mg/day) folic acid supplements to obese women planning a pregnancy in order to prevent NTD. However the evidence base for this recommendation is limited [(7)]

Aim

To investigate the relationship of obesity with biomarker status of folate and related B vitamins (vitamin B12, vitamin B6 and riboflavin) in a representative cohort of non-pregnant UK women of reproductive age

Methods

- Data for years 5-8 (2012-2016) of the National Diet and Nutrition Survey (NDNS) [(8-9)] were extracted for women aged 16-45 years, with a valid BMI >18.5Kg/m^2
- Following exclusion of those who reported B vitamin supplement use (*n* 602) data were examined in relation to:
  - Obesity (defined as BMI >30Kg/m^2 and/or waist circumference[WC] >88cm)
  - Folate (Serum and red blood cell [RBC] folate concentration)
  - Vitamin B12 (total serum B12 and serum Holotranscobalamin [HoloTC] concentration)
  - Serum Vitamin B6 (Plasma Pyridoxal-5'-Phosphate [PLP] concentration)
  - Riboflavin (Erythrocyte Glutathione Reductase Activation co-efficient [EGRac]; functional assay whereby higher values indicate lower status)

Results

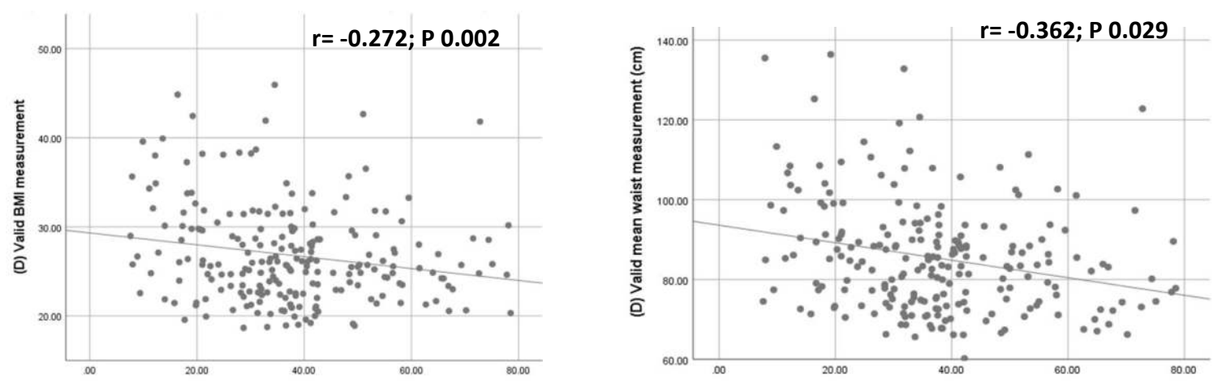
- 22%-34% of the cohort were identified as being obese (based on BMI >30Kg/m^2 and WC >88cm, respectively) (**Table 1; Table 2**)
- No significant correlations were observed between either BMI or WC and biomarker status of folate (RBC and serum folate), vitamin B12 (total serum B12 and serum HoloTC) or riboflavin (EGRac). However vitamin B6 status (PLP concentration) was negatively correlated with both BMI and WC (r -0.272, P 0.002 and r-0.362; P 0.029, respectively **Figure 1**)
- No significant differences were observed between lean and obese women in biomarker status of folate (RBC* and serum folate*), vitamin B12 (total serum B12 and serum HoloTC*) or riboflavin (EGRac) (**Table 2**)
- Vitamin B6 status was significantly lower among the obese women compared with the lean women (*P* 0.017; **Table 2**)

*Analysis is preliminary as biomarker data are incomplete

Table 1: General and B vitamin dietary characteristics of UK women (16-45y) according to weight status

General characteristics[a]	All (n 602)	Normal weight n 285 (47%)	Overweight n 182 (30%)	Obese n 135 (22%)	P
Age (y)	**29.1(9.6)**	27.1 (9.5)[a]	30.3 (9.5)[b]	31.5 (9.3)[b]	**0.001**
Current smoker[1](%)	**29%**	23%	33%	34%	0.215[b]
Weight (Kg)	**71.1 (16.4)**	59.0 (6.8)[a]	73.1 (6.8)[b]	94.1 (13.9)[c]	**<0.001**
BMI (wt/ht^2)	**26.5 (5.8)**	22.0 (1.8)[a]	27.2 (1.4)[b]	35.2 (4.8)[c]	**<0.001**
Waist Circumference (cm)	**84.4 (13.9)**	74.9 (6.7)[a]	87.0 (8.3)[b]	103.6 (12.1)[c]	**<0.001**
Dietary intakes[c]					
Energy (MJ/day)	**6.539 (6.372-6.706)**	7.122 (6.888-7.356)[a]	6.222 (5.931-6.513)[b]	6.270 (5.930-6.609)[b]	**<0.001**
Total folate (µg/day)	**189 (183-194)**	189 (180-197)	193(183-203)	183 (171-195)	0.448
Vitamin B12 (µg/day)	**3.9 (3.8-4.1)**	3.8 (3.5-4.0)	4.2 (3.8-4.4)	3.8 (3.5-4.1)	0.098
Vitamin B6 (mg/day)	**1.6 (1.5-1.6)**	1.5 (1.4-1.6)	1.6 (1.5-1.8)	1.6 (1.4-1.7)	0.499
Riboflavin (mg/day)	**1.3 (1.2-1.3)**	1.2(1.2-1.3)	1.3(1.3-1.4)	1.3(1.2-1.3)	0.210
Fortified food consumer[2] (%)	**53%**	56%	53%	47%	0.494[b]

[a] Values shown are mean (standard deviation) and compared using one-way ANOVA (P<0.05, significant) [b] Percentage data compared by Chi-square tests [c] Dietary intake values are estimated marginal means (95% CI). Energy intakes are adjusted for age. B vitamin intake data are adjusted for age and energy intake (ANCOVA; P,0.05 significant). [1]Defined as those who answered yes to being a smoker 'nowadays' [2] Defined as consumption of breakfast cereal at least once within the 4-day recording period.



[a] Partial correlation (Logged data) controlling for age and smoking.

Figure 1: Association of vitamin B6 (plasma pyridoxal-5-phosphate [PLP]) with weight status (BMI and WC) among UK women (16-45y)[a]

Table 2: B vitamin biomarker status according to waist circumference among UK women aged 16-45y

	All[1]	Lean Waist <88cm	Obese Waist >88cm	P[2]
Waist circumference (cm)	*n 419* **84.4 (83.1-85.7)**	*n 277* (66%) 76.4 (75.6-77.2)	*n 142* (34%) 99.9 (98.1-101.8)	<0.001
Red cell folate (nmol/L)[a]	*n 97* **415 (387-443)**	*n 65* 382 (336-429)	*n 32* 397 (331-463)	0.861
Serum folate (nmol/L)[a]	*n 98* **12.9 (11.6-14.0)**	*n 68* 12.7 (10.7- 14.7)	*n 30* 10.6 (7.6-13.5)	0.482
Serum B12 (pmol/L)[b]	*n 228* **234 (226-242)**	*n 153* 229 (216-243)	*n 75* 228 (211-246)	0.996
Serum Holotranscobalamin (pmol/L)[a]	*n 97* **53.4 (49.7-57.1)**	*n 68* 53.9 (47.40 60.3)	*n 29* 55.0 (45.8-64.3)	0.785
Vitamin B6 (PLP[3], nmol/l)[b]	*n 219* **37.6 (35.5-39.7)**	*n 138* 37.9 (34.6-41.2)	*n 81* 30.6 (26.4-34.8)	**0.017**
Riboflavin (EGRac[4])[b]	*n 245* **1.43 (1.40-1.46)**	*n 160* 1.43 (1.39-1.47)	*n 85* 1.41 (1.35-1.46)	0.780

[1]Values shown are estimated marginal means (95% CI). B vitamin biomarker data represent available biomarker data at the time of current analysis as shown and are adjusted for age and smoking ([2]ANCOVA; P<0.05 significant). [3]Pyridoxal-5-phosphate for vitamin B6 analysis [4]Erythrocyte glutathione activation coefficient for riboflavin analysis. [a] Representative of NDNS years 7-8; [b] Representative of NDNS years 5-6 and years 7-8.

Conclusions

- This is the first population- based investigation of the impact of obesity on folate and *all* metabolically related B vitamin biomarkers (vitamins B12, B6 and riboflavin) among women of reproductive age
- Obese women aged 16-45y may be at an increased risk of lower biomarker status of vitamin B6, not explained by lower dietary intake
- Based on these preliminary findings, the current research cannot confirm the relationship of folate or vitamin B12 with obesity, as the analysis is incomplete at this time

References

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