final report

Project Code: D.MHN.0709

Prepared by: Zumin Shi[1], Shao J Zhou[2,3,4], and Maria Makrides[2]
[1]Discipline of Medicine, University of Adelaide
[2]Women's & Children's Health Research Institute
[3]School of Paediatrics & Reproductive Health, University of Adelaide
[4]School of Agriculture, Food & Wine, University of Adelaide

Date published: January 2013

PUBLISHED BY
Meat and Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

Dietary patterns, nutrient intake and obesity in preschool children in Adelaide

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

EXECUTIVE SUMMARY

Background: Dietary patterns have been shown to be associated with nutrient intakes and lifestyle disease including diabetes and obesity in adults. However, little is known about the association in young children.

Aim: To determine the association between dietary patterns, intakes of macronutrients and key micronutrients and micronutrient status as well as risk of overweight and obesity in a representative population of preschool children in Adelaide.

Methods: Dietary intake of 288 preschool children who participated in a cross sectional survey of Food Intake and Nutritional Status – the FINS study were assessed using a 3-d weighed food diary. Dietary patterns were identified by factor analysis. Iron and zinc status were assessed by accredited laboratories. Weight, length/height were measured using standard methods and z-scores were calculated using WHO growth reference. Children were classified as Overweight was defined as BMI z-score between 85^{th} – 95^{th} percentiles and obese was defined as BMI z-score above the 95^{th} percentile.

Results: Three dietary patterns were identified. The Home-made dietary pattern was characterised by grains, fruit, vegetable, and red meat. The Processed dietary pattern was characterised by snack foods, preserves, beverages, biscuits and cakes. The Alternative dietary pattern was characterised by eggs, fish, composite foods where vegetable is a key ingredient, polyunsaturated margarines and low fat dairy products. The tertile Home-made dietary pattern score was associated with increase intakes of iron and zinc while the Processed dietary pattern score was associated with decrease intakes of iron and zinc, but dietary patterns scores were not associated with biomarkers of iron or zinc status. Age and energy intake were positively associated with tertiles of all three dietary patterns scores. The Home-made dietary pattern was positively associated with risk of overweight and obesity. No significant association was observed between the other two dietary patterns and weight status.

Conclusion: Interpretation of the association between dietary patterns and risk of overweight and obesity is limited due to the cross sectional nature of the study. Longitudinal follow up will help to elucidate the relationship between dietary patterns in childhood and risk of overweight and obesity.

Introduction

Appropriate nutrition in early childhood plays an important role in normal growth and development as well as influencing long term health of individuals. Research on dietary intake and nutritional adequacy in young children has been focused on intake of single nutrients. However, diet comprises a variety of foods and nutrients that can interact with each other and the effect of overall diet on health is more complex than a simple additive of the effects of individual nutrients. There is increasing recognition that dietary pattern, a combination of foods commonly eaten together, better reflects the overall quality of the diet.

Dietary patterns have been showed to be associated with nutrient intakes and linked to chronic diseases including obesity (1), diabetes (2), and metabolic syndrome (3) in adults. However, the association between dietary patterns and nutritional adequacy or health outcomes is not well studied in young children. Only a handful of studies have investigated the association between dietary patterns and nutrients intakes in young children (4-6), and limited studies have assessed the association between dietary pattern and overweight/obesity among children (1, 7-11). None of these studies were conducted among preschool children in Australia and no published studies have examined the association between overall dietary patterns and biomarkers of nutritional status in preschool children, in particular, key micronutrients that are essential for optimal growth and development like iron and zinc.

Preschool children are at a stage of life when dietary habits are developed, and it is an important stage for establishing healthy eating patterns as dietary patterns established in early childhood often carry though to adulthood. Australia is one of the countries with a high burden of obesity. Early prevention of overweight/obesity is an important strategy as obesity in childhood increases the risk of developing obesity in adulthood. Although many factors contribute to the etiology of obesity, unhealthy eating habits and sedentary lifestyles are among the main contributors of world obesity epidemic. The aims of this study were to: 1) characterise dietary patterns; 2) examine the association between dietary patterns and intakes of macronutrients and key micronutrients, and iron and zinc status; 3) examine the association between dietary patterns and risk of childhood obesity, in preschool children from a representative population sample in Australia.

Methods

Study population

This study was performed using dietary survey data collected in a Food Intake and Nutritional Status of preschool children – the FINS study (12), which is a cross sectional survey of preschool children. Three hundred preschool children aged 1-5yrs were recruited between 2005 and 2007, using a stratified sampling strategy to obtain a representative population sample. For the present study, we excluded children who were still breastfed at the time of dietary assessment (n=12). The final sample for the present study included 288 children.

Dietary intake

Dietary intake was assessed using a 3-day weighed food diary and nutrients intake was calculated using the FoodWork Professionals software (Xyris Software Pty Ltd, QLD, Australia). Energy intake was compared with the estimated energy requirement (EER) for children (13). In order to assess contribution of different food groups to each nutrient and intakes of foods from different food groups, the 3-day food record collected in the FINS study was recoded into 29 food groups to determine dietary patterns. The food groups were identified based on AusNut food grouping as well as food groups that have been shown to be important in constructing dietary patterns in children from literature review. It covers the 14 main food groups in AusNut Food Group with sub-grouping to differentiate healthy and less healthy options within each food group. For example, dairy food group was separated into low fat and full cream fat dairy products; red meat was separated from processed meat and meat products.

Intake of each of the 29 food groups was used to construct dietary patterns. Dietary patterns were identified by factor analysis, the most common approach (14, 15), using Principal Component Analysis method. Factors were rotated with an orthogonal (varimax) rotation to improve interpretability and minimise the correlation between the factors. The number of factors retained from each food classification method was determined by eigenvalue (>1), scree plot, factor interpretability. Using this approach, each identified dietary pattern represents a group of highly correlated food consumed by the participants. Labelling of the factors was primarily descriptive and based on our interpretation of the pattern structures underlining by foods with factor loading score of ≥ |0.3|. Participants were assigned pattern-specific factor scores. Scores for each pattern were calculated as the sum of the products of the factor loading coefficients and standardised daily intake of each food associated with that pattern. Factor loadings of each food represent the correlation coefficient between the food and the identified food patterns.

Outcome measures

Iron and zinc status were assessed using standard methods reported elsewhere (12).Weight, length/height and BMI were measured and z-scores were calculated using WHO ANTHRO 2005 Version 3.1 (WHO, Geneva, Switzerland). Children were classified as overweight if their BMI z-score was between 85^{th} – 95^{th} percentile and obese if their BMI z- score was above the 95^{th} percentile.

Covariates

Duration of breastfeeding was recorded by maternal recall and treated as a continuous variable in the analysis. Mother's education was coded into four categories based on self- report:1) did not complete high school; 2) completed high school; 3) diploma; 4) degree.

Statistical analysis.

Factor scores were divided into tertiles, implying increased intake from tertile 1 (T1) to tertile 3 (T3). Chi square test was used to compare differences between categorical variables. ANOVA was used to compare difference in continuous variables between groups. Multivariable logistic regression was used to determine the association between food pattern and overweight or obesity adjusted for age, gender, mother's education, and duration of breastfeeding. The effect is expressed as odd ratio (OR) with 95% confidence interval (CI). All the analyses were performed using STATA 12 (Stata Corporation, College Station). Statistical significance was considered when $p<0.05$ (two sided).

Results

Three dietary patterns were identified by factor analysis. Factor loadings for the three dietary patterns are presented in Table 1. The ‘Home-made’ pattern was characterised by grains, fruit, vegetable, and red meat. There were high negative loadings on infant formula and infant cereals. The ‘Processed’ pattern loaded heavily on snack foods, preserves, beverages, biscuits and cakes. This pattern had negative loadings on infant cereals and milk. The ‘Alternative’ pattern contained eggs, fish, composite foods where vegetable is a key ingredient, polyunsaturated margarines and low fat dairy products, and was inversely loaded with vegetables, game and other carcass meat. The three patterns explained 19.6% of the variance in intake (Table 1). Because of the small number of participants and similarity of dietary patterns between genders, we did not present gender specific dietary patterns.

Mean intake of macronutrients and key micronutrients according to tertiles of dietary pattern scores are reported in Table 2a, 2b and 2c for the ‘Home-made’, ‘Processed’ and ‘Alternative’ dietary pattern, respectively. All nutrient intakes were adjusted for energy using the residual method (16). Age and energy intake were positively associated with tertiles of all three dietary patterns scores. Approximately 25% of the children had energy intake ≥ 120% EER. There was no significant difference in the percentage of children with energy intake ≥ 120% EER across tertiles of all three patterns. For the ‘Home-made’ dietary pattern, intakes of protein, iron, zinc and fibre were positively associated while total fat intake was negatively associated with tertiles of dietary pattern scores (Table 2a). In contrast, intakes of iron, zinc, protein as well as total fat were negatively associated while intake of carbohydrate was positively associated with tertiles of the ‘Processed’ dietary pattern scores (Table 2b). Calcium intake was negatively associated with tertiles of dietary pattern scores for both the ‘Home-made’ and the ‘Processed’ patterns (table 2a & 2b). Intakes of carbohydrate, protein, total fat and key micronutrients were not significantly associated with tertiles of dietary pattern scores for the ‘Alternative’ dietary pattern (Table 2c). Mother’s education level was inversely associated with pattern scores for the ‘Processed’ dietary pattern (Table 2b), those having mothers with degree were less likely to have a high intake of ‘Processed’ dietary pattern, but the association was not significant for the ‘Home-made’ (Table 2a) or the ‘Alternative’ (Table 2c) dietary pattern.

The prevalence of overweight and obesity was 17.4% and 14.2%, respectively. The OR for obesity increased across tertiles of the ‘Home-made’ dietary pattern scores (Table 3). Using dietary pattern score as continuous variable, each 1 SD increase in the ‘Home-made’ pattern score was associated with a 73% increase in OR of obesity and 35% increase in OR of overweight and obesity combined (Table 3).The “Processed’ and the ‘Alternative’ patterns were not associated with the risk of overweight and/or obesity. Additional adjustment for mother’s education did not attenuate the above associations (Table 3).

Mean haemoglobin, serum iron, ferritin and zinc concentrations according to tertiles of dietary pattern scores are presented in Table 4. There was no significant association between dietary pattern scores and biomarkers of iron or zinc status.

Summary and discussion

In a cross-sectional survey, we investigated the associations between dietary patterns, nutrient intake, and risk of overweight and obesity in a representative population of preschool children in Adelaide. Based on intake assessed from a 3-day weighed food diary, three dietary patterns were identified. The Home-made dietary pattern was characterised by grains, fruit, vegetable, and red meat. The Processed dietary pattern was characterised by snack foods, preserves, beverages, biscuits and cakes. The Alternative dietary pattern was characterised by eggs, fish, composite foods where vegetable is a key ingredient, polyunsaturated margarines and low fat dairy products.The Home-made dietary pattern was associated with increase intakes of iron and zinc while the Processed dietary pattern was associated with decrease intakes of iron and zinc. Despite these associations, dietary patterns were not associated with biomarkers of iron or zinc status. This finding suggests that while the intakes of iron and zinc are generally adequate in our otherwise well-nourished population of preschool children, intakes of iron and zinc are not a main determinant of their status. While there are no studies that have examined the association between overall dietary patterns and iron or zinc status in young children, a handful of studies have investigated the association between iron or zinc status and intakes of particular foods or food groups. A national survey of over 900 British preschool children reported no association between iron status and cereal consumption (17). In a study among 6 years old children (n=139), meat and fish intake was positively associated while cow's milk intake was negatively associated with iron status (18). Consumption of sweetened beverages was found to be negatively associated with serum zinc concentration while consumption of >15g/d of meat was positively associated with zinc level in toddlers from low SES participated in a nutritional intervention program in US (19).

The positive association between the 'Home-made' dietary pattern and overweight/obesity was unexpected as this pattern had high loading of grain, fruit and vegetable which are often linked to healthy diet. Red meat intake has been linked with increased risk of obesity in adults and saturated fat intake from processed red meat is thought to be the contributing factor. Although red meat had a high factor loading score in the Home- made dietary pattern in our study this dietary pattern was not associated with total fat or saturated fat intake. However, the Home-made dietary pattern score was positively associated with protein intake, whether this contributes to the risk of obesity in our study population warrens further investigation as high protein intake was found to be positively associated with body fat among 6-8 years old children in Finland (20). Our study is a cross-sectional survey, the dietary pattern of the overweight/obese children may have been changed from an unhealthy to a healthier eating pattern as a result of intervention for weight management. If this is the case, the 'reverse causation' may explain the association observed in our study. Further longitudinal research is needed to understand the relationship between dietary patterns and weight status. An inverse association between mother's education and the Processed dietary pattern is consistent with findings from a Netherlands study, but no significant association between this dietary pattern and overweight/obesity in our study is in contrast to the Netherlands study (5).

It is difficult to directly compare the results from different studies that examining association between dietary patterns and risk of overweight or obesity partly because the characteristics of the dietary patterns identified are often different in some aspects even among dietary patterns that are characterised as ‘healthy’ or ‘unhealthy’. Nevertheless, a ‘healthy’ eating pattern has been associated with lower risk of overweight in Korean preschool children (21)and in older Norwegian children (8) while an energy dense high fat dietary pattern was associated with adiposity in school children in the ALSPAC study (9). Among Australian adolescents, a high fat and sugar dietary pattern was also inversely associated with BMI (though not statistically significant) (22), but no consistent or intuitive association between dietary patterns and weight status was found among American teenage in the EAT project (10).

Our study included preschool children from a representative population sample and the measurement of height and weight was objectively assessed. However, we did not collect data on physical activity levels or sleep duration which may confound the association observed as these factors have been shown to be related to childhood obesity (23, 24). The small sample size may limit the power to detect associations between dietary patterns and outcomes of interest. Furthermore, interpretation of the association between dietary patterns and risk of overweight and obesity is limited due to the cross-sectional design of the study as ‘reverse causation’ cannot be excluded. Longitudinal follow up will help to elucidate the relationship between dietary patterns in childhood and risk of overweight and obesity.

References

1. Newby PK. Are dietary intakes and eating behaviors related to childhood obesity? A comprehensive review of the evidence. J Law Med Ethics. 2007; 35:35-60
2. Schulze MB, Hu FB. Dietary patterns and risk of hypertension, type 2 diabetes mellitus, and coronary heart disease. Curr Atheroscler Rep. 2002; 4:462-7
3. Baxter AJ, Coyne T, McClintock C. Dietary patterns and metabolic syndrome--a review of epidemiologic evidence. Asia Pac J Clin Nutr. 2006; 15:134-42
4. Smithers LG, Golley RK, Brazionis L, Emmett P, Northstone K, Lynch JW. Dietary patterns of infants and toddlers are associated with nutrient intakes. Nutrients. 2012; 4:935-48
5. Kiefte-de Jong JC, de Vries JH, Bleeker SE, Jaddoe VW, Hofman A, Raat H, et al. Socio-demographic and lifestyle determinants of 'Western-like' and 'Health conscious' dietary patterns in toddlers. Br J Nutr. 2012:1-11
6. Shin KO, Oh SY, Park HS. Empirically derived major dietary patterns and their associations with overweight in Korean preschool children. Br J Nutr. 2007; 98:416-21
7. Shang X, Li Y, Liu A, Zhang Q, Hu X, Du S, et al. Dietary pattern and its association with the prevalence of obesity and related cardiometabolic risk factors among Chinese children. PLoS One. 2012; 7:e43183
8. Oellingrath IM, Svendsen MV, Brantsaeter AL. Tracking of eating patterns and overweight - a follow-up study of Norwegian schoolchildren from middle childhood to early adolescence. Nutr J. 2011; 10:106
9. Ambrosini GL, Emmett PM, Northstone K, Howe LD, Tilling K, Jebb SA. Identification of a dietary pattern prospectively associated with increased adiposity during childhood and adolescence. Int J Obes (Lond). 2012; 36:1299-305
10. Cutler GJ, Flood A, Hannan PJ, Slavin JL, Neumark-Sztainer D. Association between major patterns of dietary intake and weight status in adolescents. Br J Nutr. 2012; 108:349-56
11. Craig LC, McNeill G, Macdiarmid JI, Masson LF, Holmes BA. Dietary patterns

of school-age children in Scotland: association with socio-economic indicators, physical activity and obesity. Br J Nutr. 2010; 103:319-34

12. Zhou SJ, Gibson RA, Gibson RS, Makrides M. Nutrient intakes and status of preschool children in Adelaide, South Australia. Med J Aust. 2012; 196:696-700

13. NHMRC. Nutrient reference values for Australia and New Zealand including recommending dietary intakes. Canberra2006

14. Newby PK, Tucker KL. Empirically derived eating patterns using factor or cluster analysis: a review. Nutr Rev. 2004; 62:177-203

15. Hu FB. Dietary pattern analysis: a new direction in nutritional epidemiology. Curr Opin Lipidol. 2002; 13:3-9

16. Willett WC, Howe GR, Kushi LH. Adjustment for total energy intake in epidemiologic studies. Am J Clin Nutr. 1997; 65:1220S-8S; discussion 9S-31S

17. Gibson SA. Iron intake and iron status of preschool children: associations with breakfast cereals, vitamin C and meat. Public Health Nutr. 1999; 2:521-8

18. Gunnarsson BS, Thorsdottir I, Palsson G. Associations of iron status with dietary and other factors in 6-year-old children. Eur J Clin Nutr. 2007; 61:398-403

19. Schneider JM, Fujii ML, Lamp CL, Lonnerdal B, Zidenberg-Cherr S. The prevalence of low serum zinc and copper levels and dietary habits associated with serum zinc and copper in 12- to 36-month-old children from low-income families at risk for iron deficiency. J Am Diet Assoc. 2007; 107:1924-9

20. Eloranta AM, Lindi V, Schwab U, Tompuri T, Kiiskinen S, Lakka HM, et al. Dietary factors associated with overweight and body adiposity in Finnish children aged 6-8 years: the PANIC Study. Int J Obes (Lond). 2012; 36:950-5

21. Shin KO, Oh SY, Park HS. Empirically derived major dietary patterns and their associations with overweight in Korean preschool children. Br J Nutr. 2007; 98:416-21

22. McNaughton SA, Ball K, Mishra GD, Crawford DA. Dietary patterns of adolescents and risk of obesity and hypertension. J Nutr. 2008; 138:364-70

23. Shi Z, Taylor AW, Gill TK, Tuckerman J, Adams R, Martin J. Short sleep duration and obesity among Australian children. BMC Public Health. 2010; 10:609

24. Touchette E, Petit D, Tremblay RE, Boivin M, Falissard B, Genolini C, et al.

Associations between sleep duration patterns and overweight/obesity at age 6.
Sleep. 2008; 31:1507-14

Table 1 Factor loadings of each food group for the three dietary patterns identified

	Food group	Home-made	Processe	Alternative
1	Beverages	0.042	**0.436**	-0.073
2	Cereals & cereal products	0.063	0.065	0.033
3	Savoury biscuits	-0.020	0.233	0.230
4	Cakes cake mixes	-0.206	0.216	0.173
5	Grains & starches	**0.456**	0.238	0.186
6	Eggs	0.006	-0.053	**0.582**
7	Butters	-0.011	0.095	-0.259
8	Polyunsaturated margarines	0.235	0.198	**0.518**
9	Fish	0.261	-0.189	**0.400**
10	Other sea & freshwater foods	-0.137	0.195	-0.074
11	Canned/processed fruit	-0.144	**0.303**	-0.043
12	Fresh fruit	**0.394**	0.033	0.002
13	Infant formulae	-0.299	-0.082	0.165
14	Infant cereals	-0.243	**-0.313**	-0.085
15	Vegetarian meat Alternatives	-0.034	-0.156	0.072
16	Game and other carcass	0.274	0.179	**-0.395**
17	Beef/pork/lamb	**0.682**	-0.042	0.019
18	Offal & offal products	0.060	**0.368**	0.028
19	Frozen milk products	-0.049	**0.352**	-0.194
20	Milk	-0.053	**-0.383**	-0.198
21	Low fat & fat modified cheeses	-0.009	0.023	**0.345**
22	Processed foods	0.020	**0.504**	-0.013
23	Savoury sauces	0.278	-0.099	0.031
24	Seeds and seed products	**0.513**	-0.003	0.047
25	Sugars	0.224	-0.052	-0.048
26	Preserves	-0.125	**0.680**	0.012
27	Vegetables	**0.490**	0.048	**-0.347**
28	Vegetable in Composite food	-0.192	0.065	**0.402**
29	Artificial sweeteners			
Variance explained		7.0%	6.7%	5.9%

Table 2a Energy adjusted macro and key micronutrients intakes*according to tertiles of the 'Home-made' dietary pattern scores (n=288)

	T1		T2		T3		P
	Mean	SD	Mean	SD	Mean	SD	
Age	2.5	1.2	2.9	1.1	3.5	1.1	<0.001
Energy	4777.4	1458.8	5088.8	1192.2	5668.2	1202.3	<0.001
intake	150.0	19.4	149.4	16.6	149.9	23.6	0.979
Carbohydrat	47.2	8.2	48.0	7.5	54.6	10.0	<0.001
e Protein	47.6	7.7	46.8	6.5	43.2	9.2	0.003
Fat	23.8	6.1	23.2	4.8	19.9	4.5	<0.001
Mono fat	4.2	1.6	4.2	1.2	4.6	2.0	0.079
Poly fat	14.7	3.3	15.3	2.5	14.6	4.2	0.281
Saturated fat	6.8	2.4	6.5	1.5	7.4	2.2	0.006
Iron	6.0	1.4	6.0	1.1	7.0	1.8	<0.001
Zinc	858.2	256.8	797.4	237.8	716.0	261.3	0.001
Ca	10.0	3.3	11.1	3.0	13.5	4.3	<0.001
Fibre	25.0		25.0		25.0		1.000
Energy intake >120% EER (%)	29.2		30.9		29.5		0.964
Mother with high education (%)	49.0		49.0		46.9		0.946
Girls (%)							

*All nutrient intakes were energy adjusted using the residual method(16).

Table 2b Energy adjusted macro and key micronutrients intakes* according to tertiles of the 'Processed' dietary pattern scores (n=288)

	T1		T2		T3		P
	Mean	SD	Mean	SD	Mean	SD	
Age	2.2	1.1	3	1.1	3.6	0.9	<0.001
Energy	4515.7	1150.4	5102.5	1127.4	5916.1	1346.8	<0.001
intake	142.8	16.9	150.2	19.0	156.3	21.6	<0.001
Carbohydrat	52.8	6.7	50.6	9.5	46.4	10.0	<0.001
e Protein	48.0	7.6	44.8	7.8	44.8	8.5	0.007
Fat	24.2	5.9	21.6	5.3	21.0	4.6	<0.001
Mono fat	4.1	1.6	4.3	1.6	4.6	1.7	0.068
Poly fat	15.1	3.1	14.7	3.5	14.9	3.6	0.690
Saturated fat	6.9	2.5	7.2	2.1	6.5	1.7	0.055
Iron	6.7	1.3	6.4	1.6	5.8	1.6	<0.001
Zinc	952.5	246.6	770.9	208.3	648.3	222.6	<0.001
Ca	10.8	3.2	12.8	4.6	11.0	3.3	<0.001
Fibre	21.9		29.2		24.0		0.486
Energy intake >120% EER (%)	32.6		36.5		20.2		0.038
Mother with high education (%)	51.0		47.9		45.8		0.768
Girls (%)							

*All nutrient intakes were energy adjusted using the residual method(16).

Table 2c Energy adjusted macro and key micronutrients intakes* according to tertiles of the 'Alternative' dietary pattern scores (n=288)

	T1		T2		T3		P
	Mean	SD	Mean	SD	Mean	SD	
Age	2.8	1.2	2.8	1.2	3.2	1.1	0.074
Energy	4963.5	1210.8	5062.2	1291.7	5508.6	1450.2	0.010
intake	151.0	19.4	148.8	18.5	149.5	22.0	0.755
Carbohydrat	50.0	9.0	51.4	8.8	48.4	9.7	0.070
e Protein	45.6	8.3	45.5	7.5	46.5	8.4	0.680
Fat	23.2	5.9	22.8	5.4	20.8	4.8	0.006
Mono fat	3.9	1.3	4.0	1.0	5.2	2.1	<0.001
Poly fat	14.2	3.2	14.9	2.8	15.6	4.1	0.017
Saturated fat	6.6	2.0	6.8	1.7	7.3	2.5	0.053
Iron	6.3	1.3	6.5	1.4	6.3	1.8	0.507
Zinc	807.2	273.4	802.3	239.0	762.1	260.8	0.415
Ca	11.5	4.3	11.3	3.3	11.8	3.9	0.675
Fibre	19.8		22.9		32.3		0.115
Energy intake >120% EER (%)	22.1		31.3		36.2		0.100
Mother with high education (%)	53.1		45.8		45.8		0.506
Girls (%)							

*All nutrient intakes were energy adjusted using the residual method(16).

Table 3 Odds ratio for overweight and/or obesity according to tertile of dietary pattern scores (n=288)

	T1	T2	T3	p for trend [a]	Continuous
Obesity					
Home-made	7[b]	17	17		
Model 1	1	**2.74(1.08-**	**2.74(1.08-**	0.003	1.57(1.16-2.13)
Model 2	1	**2.77(1.04-**	**3.03(1.09-**	**0.003**	**1.71(1.19-**
Model 3	1	**2.94(1.10-**	**3.12(1.11-**	**0.003**	**1.73(1.20-**
Processed Pattern	12	**19**	**10**		
Model 1	1	1.73(0.79-	0.81(0.33-	0.113	0.74(0.52-
Model 2	1	1.77(0.76-	0.98(0.35-	0.326	0.80(0.51-
Model 3	1	1.71(0.73-	1.05(0.37-	0.430	0.83(0.52-
Alternative Pattern	11	14	16		
Model 1	1	1.32(0.57-	1.55(0.68-	0.382	1.15(0.84-1.57)
Model 2	1	1.40(0.59-	1.80(0.76-	0.268	1.20(0.87-
Model 3	1	1.38(0.57-	1.80(0.75-	0.280	1.20(0.86-
Overweight/obesit					
Home-	26	33	32		
Model 1	1	1.41(0.76-	1.35(0.73-2.50)	0.079	1.25(0.97-
Model 2	1	1.45(0.75-	1.51(0.75-3.04)	**0.038**	**1.36(1.02-**
Model 3	1	1.43(0.74-	1.50(0.74-3.02)	**0.047**	**1.35(1.00-**
Processed	29	35	27		
Model 1	1	1.33(0.73-	0.90(0.49-1.69)	0.276	0.87(0.67-
Model 2	1	1.41(0.74-	1.01(0.48-2.15)	0.471	0.89(0.64-
Model 3	1	1.36(0.71-	0.96(0.45-2.05)	0.437	0.88(0.63-
Alternative Pattern	31	31	29		
Model 1	1	1.00(0.55-	0.91(0.49-1.67)	0.195	0.84(0.64-
Model 2	1	1.07(0.57-	1.03(0.55-1.94)	0.403	0.89(0.67-
Model 3	1	1.09(0.58-	1.02(0.54-1.94)	0.354	0.88(0.66-

[a] Calculated using factor scores as continuous variable.
[b] Values are number of cases. Model 1: without adjustment
Model 2: adjusted for age, gender, duration of breastfeeding and other dietary patterns.
Model 3: further adjustment for mother's education

Table 4Marginal means* of iron and zinc status according to tertiles of dietary pattern scores

	T1	T2	T3	*p* value
Home-made Pattern				
Hb (g/dL)	12.2 (12.0-12.4)	12.2 (12.0-12.4)	12.4 (12.2-12.6)	0.562
Iron (umol/L)	14.1 (12.7-15.4)	13.9 (12.6-15.1)	12.9 (11.6-14.2)	0.471
Feritin (ug/L)	24.5 (20.9-28.0)	26.5 (23.3-29.7)	26.3 (22.8-29.7)	0.685
Zinc (ug/dL)	67.1 (64.0-70.1)	66.5 (63.9-69.2)	64.9 (62.1-67.6)	0.559
Processed Pattern				
Hb (g/dL)	12.2 (12.0-12.5)	12.3 (12.1-12.5)	12.2 (12.0-12.6)	0.876
Iron (umol/L)	13.2 (11.8-14.6)	13.7 (12.4-14.9)	13.9 (12.6-15.3)	0.804
Feritin (ug/L)	25.8 (22.3-29.4)	25.1 (21.8-28.3)	26.4 (22.8-30.0)	0.865
Zinc (ug/dL)	66.1 (63.1-69.2)	66.6 (63.9-69.3)	65.5 (62.6-68.4)	0.862
Alternative Pattern				
Hb (g/dL)	12.3 (12.1-12.5)	12.2 (12.0-12.4)	12.3 (12.1-12.5)	0.587
Iron (umol/L)	13.3 (12.0-14.5)	13.9 (12.7-15.1)	13.7 (12.4-14.9)	0.777
Feritin (ug/L)	23.8 (20.4-27.1)	27.4 (24.2-30.6)	26.0 (22.7-29.3)	0.308
Zinc (ug/dL)	66.2 (63.4-69.1)	66.6(64.0-69.1)	65.4 (62.7-68.1)	0.828

*Marginal means adjusted for age, gender, duration of breast feeding, mother’s education level from linear regression.