Int J Diabetes & Metab (2011) 19: 101-105

Gender associated differences in diet and anthropometric measures in Cape Breton Caucasians with well-controlled type 2 diabetes

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Abstract

Diet and anthropometic measures are important indicators of risk of various complications in type 2 diabetics. The purpose was to assess the hypothesis that there would be gender differences in anthropometric measures and dietary intakes for energy and energy-yielding nutrients including oleic acid in the study population of well-controlled (HbA1c < 8 %) Caucasian type 2 diabetics. Males (n=18) and females (n = 14) participated. Subjects came in for two visits each 3 months apart. Males differed from females only in height (m) (1.72 ± 0.02 vs 1.59 ± 0.01), hip circumference (cm) (103.0 ± 1.4 vs 117.8 ± 3.9), waist to hip ratio (0.99 ± 0.01 vs 0.87 ± 0.01 and waist to height ratio (0.591 ± 0.010 vs 0.640 ± 0.018)**.** Despite a higher intake for total calories in males and similar intakes for the energy yielding nutrients including oleic acid in the study population of type 2 diabetics, males and females had similar weights and waist circumferences while males had greater waist to hip ratios, lesser waist to height ratios and very a strong trend toward lesser BMI. Females are further away from recommended anthropometric targets and as such appear to be at greater risk of complications from type 2 diabetes.

Keywords: *human, anthropometric measures, dietary intakes, gender, type 2 diabetes*

Introduction

Cape Breton Island and in particular the Cape Breton regional municipality in the province of Nova Scotia, Canada suffers from among the highest rates of obesity[1] and type 2 diabetes in Canada, the consequence of which are seen in the overall economy and in the competition for healthcare dollars with other health issues. Consequently it is important to control this disease as much as possible so as to reduce its economic and social impact. There appear to be no reports that collectively assess gender equity for type 2 diabetes in terms of all the anthropometric measures mentioned in this paper. Such information is of clear importance for the medical, economic and social impacts and management of this disease.

Increased waist, waist to height and waist to hip ratios, as well as BMI enhance the risk of complications (glucose intolerance, hypertension, dyslipidaemia, inflammation) associated with type 2 diabetes in men and women.[2,3,4,5,6,7] The waist to height ratio is particularly good discriminator[4,8] in determining who is a greater or lesser risk of such complications.

Clearly calories and perhaps oleic acid intake play a role in Oleic acid intake has been suggested to control appetite and hence cause weight loss.[9] It was hypothesized that there would be gender differences in weight, BMI, waist and hip circumferences, waist to hip circumference ratio and the waist to height ratio and dietary intakes for energy and energy yielding nutrients including oleic acid in the study population of well-controlled (HbA1c < 8 %) Caucasian type 2 diabetics. The purpose of this study was to assess this hypothesis.

There have never been any studies done in human type 2 diabetics on the impact of gender on the equity of all the anthropometric measures and dietary intake examined in this paper.

Materials and Methods

Subjects were well controlled, metabolically stable (HbA1c < 8 percent) type 2 diabetic Caucasians (males 59.5 ± 1.7 years of age and females 60.7 ± 2.9 years of age (mean ± SEM) who were responding to a Sydney, Nova Scotia newspaper advertisement and two area physicians. This study received approval from the Cape Breton University Human Ethics Review Committee. To assess whether there was stability in the anthropometric measures and therefore reliability in such data, subjects came for visit 1 and, 3 months, later for visit 2. On each visit, body weight and height, waist and hip circumference were determined. Waist and hip circumference measures were performed as per Lemieux *et al.*[10] Subjects were questioned on three separate days between visits 1 and 2 about what foods including drinks they had consumed on each of those days, the quantity of those items consumed and how t he food items

Received on:30/05/2010
Accepted on: 21/12/2011

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Table 1: Chararacteristics of subjects (all Caucasian). Data (N = 32) is reported as mean ± standard error of the mean (S.E.M.).

	Males visit 1	Males visit 2	Females visit 1	Females visit 2	Males –mean of visits 1 and 2	Females-mean of visits 1 and 2
N	18	18	14	14	18	14
Age (years)	59.5 ± 1.7	60.7 ±2.9	60.7 ±2.9	60.7 ±2.9	59.5 ± 1.7	60.7 ±2.9

Table 2 : Anthropological measures. Data (N = 32) is reported as mean ± standard error of the mean (S.E.M.).

	Males visit 1	Males visit 2	Males Average of Visits 1 and 2	Female Visit 1	Female Visit 2	Female Average of Visits 1 and 2
Weight (kg)	90.7 ± 3.5	90.5 ± 3.4	90.6 ± 3.4	86.6 ±4.4	85.3 ± 4.6 fv1vs fv2 p=0.028	85.9 ± 4.5
Height (m)	1.72 ± 0.02	1.72 ± 0.02	1.72 ± 0.02	1.59 ±0.01	1.59 ±0.01	1.59 ±0.01 fv12 vs mv12 p=0.000
Waist (cm) circumference	101.5 ± 2.1	102.4 ±2.2	101.9 ± 2.2	104.0 ± 3.1	99.5 ± 3.2 fv1vs fv2 p=0.005	101.8 ± 3.1
Hip (cm) circumference	103.9 ± 1.5	102.2 ± 1.3	103.0 ± 1.4	120.5 ± 3.9 mv1vs fv1 p=0.001	115.0 ± 3.9 fv1vs fv2 p=0.001 mv2 vs fv2 p=0.007	117.8 ±3.9 fv12 vs mv12 p=0.002
BMI (kg/m^2)	30.3 ± 0.7	30.3 ± 0.8	30.3 ± 0.7	34.3 ± 1.6 mv1vs fv1 p=0.040	33.8 ± 1.7	34.0 ±1.6 fv12 vs mv12 p=0.050
Waist to hip ratio	0.98 ± 0.01	1.00 ± 0.01 mv1 vs mv2 p=0.005	0.99 ± 0.01	0.87 ± 0.01 mv1vs fv1 p=0.000	0.87 ± 0.01 mv2 vs fv2 p=0.000	0.87 ±0.01 fv12 vs mv12 p=0.000
Waist to height ratio	0.588±0.009	0.593±0.010	0.591 ±0.010	0.655 ±0.018 mv1vs fv1 p=0.000	0.626 ± 0.020 mv2 vs fv2 p=0.000	0.640 ±0.018 fv12 vs mv12 p=0.000

fv1 = female visit 1; fv2 = female visit 2; fv12 = average of female visits 1 and 2; mv1 = male visit 1; mv2 = male visit 2; mv12 = average of male visits 1 and 2

Table 3: Dietary intakes. Data (N = 32) is reported as mean ± standard error of the mean (S.E.M.).

	Males N=18 Day 1	Males N = 18 Day 2	Males N = 18 Day 3	Females N = 14 Day 1	Females N = 14 Day 2	Females N = 14 Day 3
Calories (kcal)	1565 ± 356	1898 ± 511	1786 ±399	1342 ± 188	1230 ± 362	1333 ± 192*
Protein (g)	60.6 ± 8.0	67.5 ± 13.8	64.7 ± 9.1	70.1 ± 13.6	61.5 ± 17.8	79.7 ± 12.4
Carbohydrate (g)	164.3 ± 58.1	225.9 ±66.5	216.1 ± 53.5	173.5 ±38.8	173.1 ± 60.2	164.7 ± 28.4
Fat (g)	59.6 ± 17.1	81.9 ±22.3	77.7 ± 19.9	43.1 ±3.5	34.1 ± 11.2	41.4 ± 5.5
Saturated fat (g)	16.3 ± 4.0	24.1 ± 6.9	20.2 ± 4.5	14.1 ±2.8	12.6 ± 4.1	13.1 ± 3.0**
Monounsaturated fat (g)	10.8 ± 3.2	20.4 ± 10.3	16.7 ±6.9	13.7 ±2.3	7.5 ± 2.6	10.5 ± 3.2
Polyunsaturated fat (g)	5.3 ± 1.6	8.8 ±3.9	10.4 ±5.5	5.5 ± 1.3	2.8 ±0.9	5.6 ± 2.0
Fibre (g)	17.5 ± 4.6	18.8 ± 5.0	17.9 ± 4.7	15.0 ±1.8	14.1 ± 4.5	13.8 ± 2.2

* males consumed a higher amount of calories on each of the three days compared to females (p = 0.028); ** trend toward higher consumption of saturated fat by males compared to females over the three day period (p= 0.096)

were prepared. Dietary analysis was performed by the Food Processor software. Subjects received no nutritional counseling at any time during the study.

Statistical analyses

The data in table 2 was assessed by paired t-test for visit 1 versus visit 2 for males and again for females. Further the data in table 2 was assessed by unpaired t- test comparing the average of visits 1 and 2 for females versus the same for males. The data in table 3 was analyzed by a two way (sex versus day) general linear model. The statistical analyses were done using the Minitab software (version 15).

Results

Subject characteristics are found in Table 1. Anthropometic measures are found in table 2 and dietary data is found in table 3. Anthropometric measures were consistent from visit 1 to visit 2 with the exception of females who showed a very minor drop in weight and waist and hip circumferences and males who showed a very minor increase in the waist to hip ratio. Males were not significantly heavier than females and had similar waist circumferences, higher waist to hip and lesser waist to height ratios and a trend toward lower BMI. Dietary consumption was consistent from days 1 to 2 to 3 between and within each of males and females on most dietary measures. Only calories consumed were significantly and consistently higher in males and there was a trend toward a higher consumption of saturated fat in males. The oleic acid consumption was similar for both males and females. Consistency in the anthropometric data (visits 1 to 2) and in the dietary data (days 1, 2, and 3) render the data stable and hence valid.

Discussion

There is growing concern about anthropometric measures in terms of exacerbation of various phenotypic expressions of type 2 diabetes. Control of these anthropometric measures is key to diabetic management and dietary intake is key to management of anthropometric measures.

Males and females had statistically identical weights, BMI and waist circumferences though there was a very strong trend to higher BMIs in females. The trend toward higher BMIs in females consistent with Wauters *et al*[11], de Azerado-Passos *et al*[12] and Sekikawa *et al*[13] though inconsistent with Shah *et al*[14] and Le *et al*.[15] This trend is not surprising given statistically gender identical weights and higher waist to height ratios in females. However, Shah *et al*[14] and Le 2005[15] observed Nepalese and Vietnamese persons respectively indicating that gender differences may be ethnically based. The BMIs are greater and waist to hip ratios are about the same for Caucasian males and females in the current study compared to Widjaja *et al*[16] and Morris and Rimm.[17] The higher waist to hip ratios seen in males in the current study and in Han *et al*[18]differ inexplicably from a lack of gender difference in this ratio seen by Wauters *et al*[11] in similar type 2 diabetics. Regardless, the elevated waist to hip ratio in males confers no advantage in type 2 diabetic management [19] while the lower waist to height ratio would appear to place the males in better position to manage their type 2 diabetes. Indeed as indicated by Lee et al[4] it would appear from the waist to height ratio data from the current study that females are perhaps at particular risk of complications of type 2 diabetes given their significantly higher waist to height ratios. The waist to height ratio gender imbalance is consistent with Lorenzo *et al*[20] Mannuci *et al*[21], Haddaegh *et al*[22] and Tulloch-Reid *et al*.[23] However Lorenzo *et al*[20] have indicated that no single measure of obesity confers discriminatory advantage in prevalence differences in type 2 diabetes among different populations. This is consistent with Poll *et al*[24] who found no good relation of any of these measures with fat volume. However the consensus is that higher BMI, waist circumference, waist to height ratios and waist to hip ratios are generally speaking reasonable indicators of increased risk of complications arising from type 2 diabetes. The anthropometric measures were statistically stable from visit 1 to visit 2 with the exception of females who showed a very minor drop in weight and waist and hip circumferences and males who showed a very minor increase in the waist to hip ratio. These minor changes have never been shown to contribute to decreased risk of type 2 diabetic complications and in any event still did not place either males or females within the guidelines for anthropometric measures.[25]

The impact of diet did not confer any gender advantage in anthropometric measures. Caloric intakes were similar to those reported in male type 2 diabetics but lower in females compared to values reported by Rivellese *et al*. (2008).[26] Despite the higher caloric intake and a trend to higher saturated fat intake by males, a better anthropometric profile was not achieved by females suggesting that females in particular need to much more aggressively manage their anthropometric features by an appropriate combination of diet, exercise and medications. It is evident that the females despite a significantly lower caloric consumption are further away from target levels of various anthropometric measures.[25,3,27,28] Similar dietary intakes of oleic acid indicate that males and particularly so females are not consuming this fatty acid in a manner advantageous to reductions in anthropometric measures key to better management of risk of complications arising from type 2 diabetes. The exercise patterns must have differed for males and females over the course of the study explaining the inconsistency of some anthropometric measures within and between genders. That said it is clear that neither males nor females are meeting anthropometric guidelines and thus remain at significantly risk of serious complications of type 2 diabetes and thus both need to better manage their anthropometric features by a combination of diet, exercise and medications.

It is concluded that males and in particular type 2 diabetic females as represented by this study must much more aggressively pursue medication and lifestyle changes including diet and exercise to meet recommendations for waist circumferences, waist to hip and waist to height ratios, and BMI. It is further concluded that females in particular, are, insofar as anthropometric measures indicate, at a much greater risk of the complications of type 2 diabetes. It may be that higher intakes of oleic acid are appropriate to assist in correcting deviations from recommended levels for various anthropometric measures. This study was never meant to be an attempt to be representative of all type 2 diabetics of Cape Breton. It does suggest however that a much wider survey of such patients is in order.

Acknowledgments

Dr. E. Barre gratefully acknowledges Cape Breton University internal grants (Research Assistance Programme, Summer Stipend Research Assistance, and a Canadian Institutes of Health Research (CIHR) grant to Cape Breton

University) which allowed this research. Ms. Pat Collins, R.N. of the Cape Breton University Health Centre is thanked for help with blood taking and anthropometric measures. The authors also acknowledge the contribution of Dr. J. Wawrzyszyn of Sydney, Nova Scotia for drawing this study to the attention of his patients. We also thank Dr. E. Rudiuk of Cape Breton University for his assistance with statistical analyses.

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