Comparison of energy and nutrient intakes among patients with type 2 diabetes by gender and age groups

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ABSTRACT

Background: Type 2 diabetes is a non-communicable disorder that requires changes in diet, among other aspects of lifestyle, in its management. Patients are normally advised on dietary intakes based on required dietary energy and nutrient intakes to normalise their conditions.

Methods: The cross-sectional study recruited 100 adult type 2 diabetes patients by convenience sampling from Komfo Anokye Teaching Hospital, Kumasi, Ghana. The energy and nutrient intakes of patients were measured according to age and gender. The 24-hour recalls on three days per patient were used to access dietary intakes with references to Composition of Foods Commonly Used in Ghana, and the West African Food Composition Table. Meal skipping was noted. Anthropometric, blood pressure and biochemical measurements of patients were taken and related to their meal frequency lifestyle. The comparison of dietary intakes between males and females within age groups was done in reference to Recommended Daily Allowance (RDA) and Estimated Average Requirement (EAR), which are constituents of Dietary Reference Intakes (DRI).

Results: Meal skipping was associated with a larger waste circumference. The mean daily protein intake (P = 0.001) and calcium intake (P = 0.004) of males were significantly higher than those of the females. Similarly, patients less than 60 years of age were more likely to consume more energy and nutrients (except calcium) than their older counterparts, though no significant differences were recorded. Mean quantities of carbohydrate, iron, and vitamin C consumed were above the DRI for both males and females. For dietary fibre, this was true only for females. The DRI for other nutrients was not met. For respondents <60 years, 45.5 %, 68.6 % and 72.7 % of males met their RDAs for protein, iron and vitamin C respectively while 41.7 %, 5.6 % and 80.6 % of their female counterparts met their RDA for these nutrients. For respondents ≥ 60 years, 46.7 %, 80 % and 66.7 % of males vs. 31.6 %, 63.2 %, and 92.1 % of females met their RDAs for protein, iron and vitamin C respectively. Only 2.8% of females < 60 years and 6.7 % of females ≥ 60 years met the RDA for vitamin E, while no males did. While 52.8 % of females < 60 years and 47.4% of those ≥ 60 years respectively met their RDAs for fibre, only 40 % males < 60 years met their RDA for fibre. All respondents met the RDA for carbohydrate except 2.6 % of females ≥ 60 years. For vitamin A, apart from 2.8 % of females < 60 years, no respondent met the RDA and for calcium none did.

Conclusion: Both males and females had mean intakes of carbohydrate, iron, and vitamin C in excess of their DRI. The situation was problematic for other nutrients. Public and personal health and nutrition education should be intensified to promote adequate nutrient intakes among both male and female and younger and older age groups in diabetes patients in Ghana.

KEYWORDS: diabetes, nutrient, energy, age, gender, meal

INTRODUCTION

The prevalence of type 2 diabetes among adults is estimated at 6.5 % in Ghana (Asamoah-Boaheng et al., 2019). A major type of the non-communicable disorder, type 2 diabetes, is caused by mainly genetic and lifestyle factors. Though there have been advances in understanding genetic factors, lifestyle factors remain relevant in the development and progression of type 2 diabetes (Chikwere and Iddrisu, 2018).

Diet is a major factor of lifestyle considered in the management of patients with type 2 diabetes. Gender differences (Regitz-Zagrosek et al., 2006) and age (Rizvi, 2009) play significant role in diabetes risks and complications including biochemical outcomes (Kwon and Chung, 2013). Patients are advised by healthcare professionals on dietary intakes to ameliorate the condition, avoid worsening, and reducing the effects of associated conditions. Diet counselling considers energy and nutrient intakes during nutrition assessment of patients. Heilbronn et al. (1999) suggested that energy restrictions improved the biochemical outcomes of type 2 diabetes patients thereby ameliorating their conditions and associated complications. It has been reported earlier that type 2 diabetes patients do not follow the dietary and nutritional guidelines for certain foods and nutrients (Nelson et al., 2002) and this is evident in their dietary patterns (Chikwere et al., 2014; Naja et al., 2012), even though patients often leave the diet counsellor with great enthusiasm to follow the nutrition regimen given them. Shah and Garg (2019) in a review, reported associations between dietary and energy intakes and type 2 diabetes. The aim of this study is to find energy and nutrient intakes of type 2 diabetes patients in relation to their age groups and gender.

METHODS

A total of 100 patients with type 2 diabetes were selected by convenience sampling from the Outpatient Department (OPD) at the Diabetes Centre, Komfo Anokye Teaching Hospital, Kumasi, Ghana. Patients who were easily accessible were selected from this centre. These were patients who came on normal regular visits to the centre for health care. Patients were approached individually for their consent; those who consented to be participants of the study were added. Ethical approvals were obtained from institutions concerned.

Inclusion and exclusion criteria

Only type 2 diabetes patients (NCEP, 2002) who were already receiving dietary advice from the OPD of the diabetes centre were included in the study. Lactating mothers and pregnant women, patients < 20 years of age, and in-patients were excluded from the study.

Anthropometric, blood pressure and biochemical measurements

The weights of the participants were taken, using an electronic scale and their heights measured with a stadiometer. The BMI for each participant was then calculated as weight in kg divided by height in metres squared. The waist circumference was measured (in centimetre), with a tape measure. Blood pressure was measured by standard methods using a mercury sphygmomanometer and a stethoscope. Measurements were done by trained personnel. Venous blood concentrations of serum lipid profile (total cholesterol, HDL-cholesterol, LDL-cholesterol and triglycerides), fasting blood glucose (FBG), and uric acid was determined from 2 ml blood samples collected by a phlebotomist. The total cholesterol:HDL-cholesterol (TC:HDL-C) ratio was calculated.

Dietary intake

Meal frequency was determined by asking patients whether they skipped meals in the last 7 days or not. Meal skipping was assessed in relation to the statistical means of measured anthropometric indices, blood pressure, lipid profile and uric acid.

The 24-hour recall technique was used to obtain dietary intakes by interview at the hospital. The interviewers were skilled human nutrition students who were trained by dieticians/nutritionists at the diet clinic of the hospital. Two weekdays and one weekend day 24-hour recalls of all foods and the portion sizes were taken for each patient. Respondents were asked to recall all meals, drinks, snacks, and sweets. For easy remembrance, responses were taken under the headings: 'Breakfast', 'Mid-morning', 'Lunch', 'Mid-afternoon', 'Supper', and 'Bedtime'. Respondents were asked to describe all foods consumed yesterday, from waking to sleeping. Respondents were prompted for foods in situations where the participant seemed to exhibit forgetfulness. Common local measures, procured from a local market, were shown to the participants to measure quantities of their intakes. The portion sizes were demonstrated by graduated food models. The compositions of meals and snacks were taken and quantified for nutrient analysis. The average intake, from the 3 days, was calculated and this represented the normal dietary intake of the participants. Various foods and ingredients were bought from different sales outlets in the Kumasi metropolis. Various quantities were weighed and the average taken to aid in the quantification of participants' intakes for the nutrient analysis. The weighing was done with an electronic balance at the Molecular Biology laboratory, Department of Biochemistry and Biotechnology, KNUST. The total energy, macronutrients and micronutrients were then estimated using Food weights/Handy measures Tables (Dietetic Group of the Dreyfus Health Foundation, Ghana, 1995), Composition of Foods Commonly Used in Ghana (Eyeson and Ankrah, 1975), and the West African Food Composition Table (Stadlmayr et al., 2012). Dietary reference intake (DRI) was used as a comparative reference for the nutrient intakes of the participants.

Data analysis

Statistical analyses were done using SPSS 20 (IBM Corp., USA) and Microsoft Excel 2016. Means and standard deviations were obtained and compared by one-way ANOVA. Percentages as well as graph were obtained in MS Excel. P-values at $P<0.05$ were considered to be statistically significant.

RESULTS

The ages of the participants ranged between 20-80 years. Only 26 % of the participants were males (Table 2). All the patients were already on diet therapy, which generally aimed to restrict energy intakes. The diet regimen also avoided high sugar, high fat and high salty foods, and fasting.

Associations of meal skipping with anthropometric indices, blood pressure, lipid profile and uric acid

While 37.8 % of the females skipped meals, 26.9 % of males did. Breakfast was the most skipped. Meal skipping was analysed in relation to statistical means of measured anthropometric, blood pressure and biochemical measurements (Table 1). The mean waist circumference of patients who skipped meals was significantly higher (*P*=0.036) than that of patients who did not. The mean values of BMI, DBP, TC, TG, LDL-C, TC:HDL-C, and uric acid were non-significantly higher among subjects who skipped meals than among those who did not.

Table 1: The association between meal skipping and anthropometric indices, blood pressure, lipid profile and uric acid

Variables	Meal skipping		***P*-value**
	Yes (n = 35)	No (n = 65)	
BMI (kg/m^2)	28.00±6.13	26.95±5.56	0.388
WC (cm)	100.3±14.8	93.9±13.9	0.036
SBP (mmHg)	133.8±18.4	135.9±18.6	0.607
DBP (mmHg)	81.8±11.9	78.7±11.6	0.218
FBG (mmol/L)	9.5±4.4	10.7±5.2	0.263
TC (mmol/L)	5.3±1.3	5.1±1.3	0.548
TG (mmol/L)	1.6±0.9	1.5±0.7	0.633
HDL-C (mmol/L)	1.5±0.3	1.5±0.4	0.622
LDL-C (mmol/L)	3.1±1.0	2.9±1.1	0.491
TC:HDL-C	3.7±0.9	3.5±0.9	0.413
Uric acid (µmol/L)	420.9±173.7	390.5±160.4	0.435

Values are recorded as Mean ± Standard deviation. Body mass index (BMI), waist circumference (WC), fasting blood glucose (FBG), systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C).

Daily energy and nutrient intake by gender and age group

The mean daily intakes of protein (*P*=0.001) and calcium (*P*=0.004) of males was significantly higher than that of females. Except for vitamins A and C, the intakes of other nutrients among males were higher than among females, though not significantly (Table 2).

Forty-two percent and 48.6 % of males and females were below 60 years of age respectively; while 57.7% of males and 51.4 % of females were either 60 or more years old. The energy and nutrient intakes of the patients were estimated by age groups, as presented in Table 3. Though not significant, the daily energy, protein, carbohydrate, iron, vitamin A, vitamin C and fibre intakes were higher, but calcium intake was lower, in the patients who were less than 60 years of age.

The mean intakes for carbohydrate, iron, and vitamin C by males and females were well over 100% of the DRIs. The RDA for fibre was as well met by over 100% among females. The DRI for other nutrients were not met by mean intakes (Table 4).

The percentages of males and females meeting RDA for individuals below or above 60 years of age are presented in Figure 1. No one in any category met the RDA for calcium; except for 2.8 % of females under 60 years, no other category met the RDA for vitamin A and very few of any category met the RDA for vitamin E. Nearly all respondents met the RDA for carbohydrate and the majority did for vitamin C and all but younger females (who have a higher RDA) did for iron. For other nutrients, in general the majority in all groups failed to consume their RDA.

Table 2: Mean daily energy and nutrient intake by gender

Energy/Nutrients	Male (n = 26)	Female (n = 74)	Total (N = 100)	*P*-value
Energy (kcal)	1867.3±575.9	1641.2±484.4	1700.0±516.4	0.540
Protein (g)	55.2±16.0	43.2±15.0	46.3±16.1	0.001
Fat (g)	47.4±32.7	39.0±19.1	41.2±23.5	0.117
Carbohydrate (g)	309.8±89.2	290.0±88.0	295.2± 88.3	0.329
Calcium (mg)	289.1±84.5	234.3±80.9	248.5±85.0	0.004
Iron (mg)	10.7±2.8	9.5±3.6	9.8±3.5	0.126
Vitamin A (μg)	219.4± 101.6	273.2± 187.8	259.2±170.8	0.168
Vitamin C (mg)	123.0±56.3	136.3±59.6	132.8±58.8	0.326
Vitamin E (mg)	7.7±6.2	6.3±3.0	6.6±4.1	0.136
Fibre (g)	24.0±8.5	24.0±7.8	24.0±7.9	0.991

Values are recorded as Mean ± Standard deviation

Table 3: Daily energy and nutrient intake by age groups

Energy/ Nutrients	Age groups			
	< 60 years (n = 47)	**≥ 60 years** (n = 53)	**Total** (N = 100)	***P*-value**
Energy (kcal)	1763.2±540.2	1644.0±492.8	1700.0±516.4	0.251
Protein (g)	47.3±17.0	45.4±15.4	46.3±16.1	0.562
Fat (g)	41.1±19.8	41.2±26.6	41.2±23.5	0.975
Carbohydrate (g)	307.5±96.0	284.2±80.2	295.2±88.3	0.189
Calcium (mg)	247.2±88.9	249.7±82.1	248.5±85.0	0.883
Iron (mg)	10.5±4.3	9.3±2.4	9.8±3.5	0.089
Vitamin A (μg)	283.2±215.1	237.9±116.8	259.2±170.8	0.187
Vitamin C (mg)	133.4±61.7	132.3±56.7	132.8±58.8	0.926
Vitamin E (mg)	6.6±3.0	6.7±4.9	6.6±4.1	0.928
Fibre (g)	24.7±8.7	23.4±7.1	24.0±7.9	0.414

Values are recorded as Mean ± Standard deviation.

DISCUSSION

The patients in the current study were already receiving dietary counselling from dieticians and nutritionists in the hospital. They were also receiving public health nutrition education bi-weekly. Generally, these patients were given what was termed a ‘diabetic diet’ which restricts energy intakes from fats and oils, animal protein and starches; stating clearly the number of servings of fruits and vegetables to be consumed. This diet also discouraged fasting, and high sugar, high fat, high salty foods intakes.

Table 4: Comparison of mean dietary intakes to dietary reference intakes (DRIs) by gender and where applicable by age group

Nutrients	EAR		RDA	
	Male (%)	Female (%)	Male (%)	Female (%)
Protein (g)	NR	NR	56(98.6)	46(93.9)
Carbohydrate (g)	100(**309.8**)	100(**290.0**)	130(**238.1**)	130(**223.1**)
Calcium (mg)	800/1000 (36.1/28.9)	800/1000 (29.3/23.4)	1000/1200 (28.9/24.1)	1000/1200 (23.4/19.5)
Iron (mg)	6(**178.3**)	5/8.1(**190**/**117.3**)	8(**133.8**)	8/18(**118.8**/52.8)
Vitamin A (µg)	625(35.1)	500(54.6)	900(24.4)	700(39.0)
Vitamin C (mg)	75(**164**)	60(**227.2**)	90(**136.7**)	75(**181.7**)
Vitamin E (mg)	12(64.2)	12(52.5)	15(51.3)	15(42)
Fibre (g)	NA	NA	30/38(80/63.2)	21/25(**114.3**/96)

ND: not determined; NA: not available; NR: not relevant to study; EAR: Estimated Average Requirements; RDA: Recommended Dietary Allowances; (%) represents the percentage of RDA or EAR met by males and females

Clarifications for EAR or RDA having two values separated by /: RDA for calcium (in males)> 70 y:1,200; RDA for calcium (in females) 51 to >70 y:1,200; EAR for calcium (in males) >70 y: 1000; EAR for calcium (in females) 51 to >70 y: 1000; EAR for iron (in females)19-50y: 8.1; RDA for iron (in females) 19-50y:18; RDA for total fibre (in males) 19-50 y: 38; RDA for total fibre (in females) 19-50 y: 25; RDA for total fibre (in males) > 50y: 30; RDA for total fibre (in females) > 50y: 21

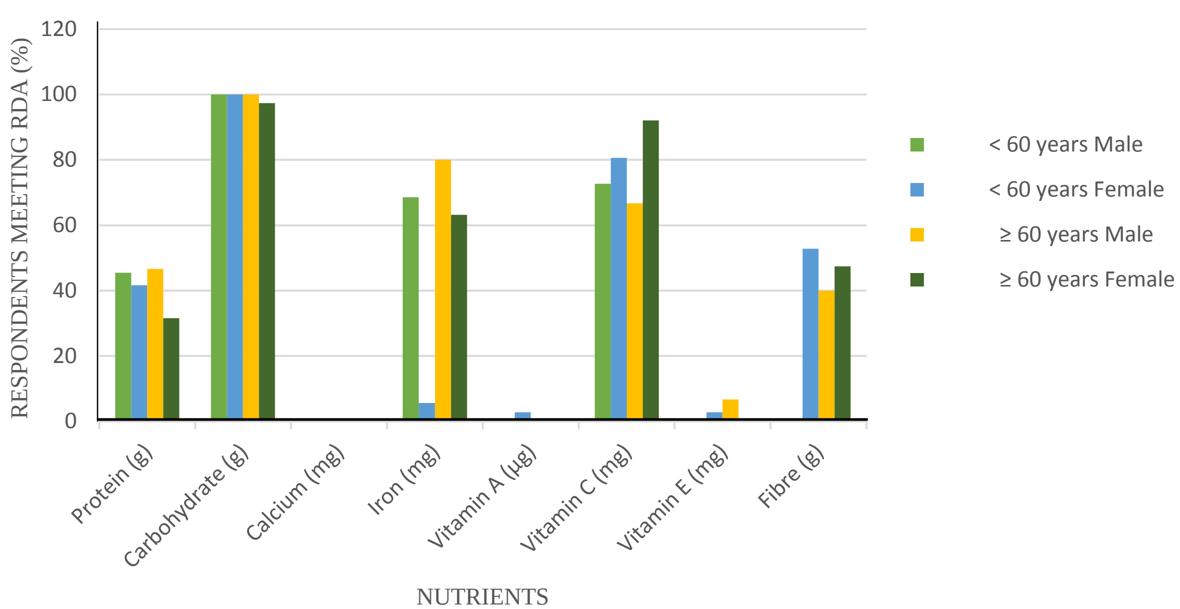

Figure 1. Comparison of nutrient intakes by gender within age groups by RDA

The daily energy and certain nutrient intakes of the male diabetics were higher than those of the female diabetics; however, dietary fibre, vitamin A and vitamin C intakes were higher among the females. Similar results were reported by Medagama et al. (2015) for energy and macronutrient intakes. Patients under 60 years of age had energy and nutrient intakes higher than the older diabetics, supporting the findings of Medagama et al. (2015) in Sri Lanka. Shah et al. (2018) also found lower energy and nutrient intakes among type 2 diabetics compared to the non-diabetic controls. However, micronutrient intakes reported by Shah et al. were higher than that found in this study. There appears to be restrictive pattern of energy intake among diabetes patients. Markovic et al. (1998) suggested that energy restriction has beneficial effects on the metabolic outcomes of obese type 2 diabetics.

Most of these patients took foods which perhaps are low in fibre but rather rich in simple carbohydrates and fats. This may result in hyperlipidaemic conditions in these patients, as argued by Banini et al. (2003) and Danquah et al. (2012). Intake of dietary fibre improves glycaemic control and associated cardiometabolic factors and complications in patients with type 2 diabetes (Fujii et al., 2013). The mean vitamin C intakes of these patients were very high but vitamins A and E were very low. Vitamins A, C, and E are among non-enzymatic antioxidants which may attenuate diabetes and its complications through various mechanisms by reducing oxidative stress, but this is not well-established (Johansen et al., 2005). It might be more beneficial to consider the dietary antioxidants in totality rather than singly, as high intakes of total antioxidant reduced the risk of type 2 diabetes and insulin resistance in older adults (van der Schaft et al., 2019). Suggestive as it may be, dietary antioxidants have beneficial effects in type 2 diabetes patients, hence intakes should be encouraged. Odum et al. (2012) reported low serum concentrations of vitamins C and E for type 2 diabetes patients.

Females < 60 years of age were more likely to meet the mean RDA for the nutrients under study with only the RDA for calcium not met. For most nutrients, none were consumed by a majority of individuals in any category. The deficient (as well as the excess) intakes of nutrients present a possible risk for malnutrition, which has associated complications, among type 2 diabetes patients (Yildirim et al., 2018; París et al., 2013). Dietary assessment is thus important in various stages in the management of diabetes to identify those at risk of malnutrition due to poor or imbalanced dietary intakes with reference to DRIs. Nutrition education should be intensified to encourage type 2 diabetes patients to follow the dietary regimen given them.

The waist circumference of diabetics who skipped meals was significantly higher than that of patients who did not skip meals. Meal skipping should not be encouraged in diabetes patients (Melanson, 2008), as this worsens their condition. A regular eating pattern was associated with a favourable cardiovascular disease risk profile in a study by Farshchi et al. (2005). In the current study, breakfast was the most skipped of the 3 major meals, as seen in many other studies. In a study by Wennberg et al. (2014), skipping breakfast in adolescence resulted in central obesity and hyperglycaemia in adulthood. They suggested that people who skipped breakfast were more likely to have an unhealthy lifestyle. Cahill et al. (2013) argued that skipping breakfast may affect risk of coronary heart disease through pathways associated with cardiovascular disease risk factors. In the current study however, there was no significant difference between meal skippers and nonmeal skippers in terms of anthropometric, blood pressure and biochemical measurements taken. Apart from FBG, which is a diagnostic parameter for diabetes, all the measured parameters met the reference guidelines (ADA, 2019; NCEP, 2002) for the management of diabetes.

Adopting plant-based diets (Iddrisu and Chikwere, 2020), low-fat dairy, vegetable and fish oils could ameliorate the effects of the condition of patients with type 2 diabetes, through increasing dietary intakes of micronutrients. Globalisation has led to the influx of Western foods in Ghana and the consumption of same. In addition to other factors such as meal skipping, dietary composition must be considered very crucial in diabetes management (Jarvandi et al., 2011) in individualised nutrition plans (Gray and Threlkeld, 2019). Conditions of persons with diabetes may differ from person to person; due to this, energy and fat intakes are normally based on the diet counsellor's assessment of the patient. This way, the dietary requirements of the patients will be met even when based on gender and age groups. Nonetheless, public health nutrition education is still relevant to emphasise the need to adopt dietary lifestyle that discourages meal skipping and Western dietary patterns.

The results of the present study may thus indicate either inadequate dietary advice or a level of non-compliance with dietary advice and presents a basis to strengthen the public health nutrition education in diabetes. Cohort and longitudinal studies are however recommended in future studies for more knowledge on the topic.

Limitations

This study was limited by its cross-sectional design, sampling method, and was dependent on participants' memory. The respondents may have withheld information regarding reports on certain diets. Since diabetes patients visiting the hospital are advised to avoid high sugar, high fat and salty foods, and restrict servings of energy foods and fruits, some bias in their reportage to suit the interviewers is inevitable. Nevertheless, the respondents were not familiar with interviewers until the time of interview.

CONCLUSIONS

Among type 2 diabetes patients, males and patients less than 60 years of age are more likely to have higher intakes of energy and nutrients compared to their female and older counterparts respectively. Patients who skip meals have relatively higher waist circumference compared to those who do not skip meals. Carbohydrate was over-consumed while other nutrients were under-consumed. Interventions are needed to improve adherence to dietary recommendations to nutrients associated with lower risk of diabetes especially among the more susceptible populations (Eilat-Adar et al. (2008).

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