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NUTRITIONAL HABITS AMONG HYPERTENSIVE PATIENTS WITH NORMAL GLUCOSE TOLERANCE (NGT) AND IMPAIRED GLUCOSE TOLERANCE (IGT) – A PILOT STUDY

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The aim of our study was to estimate the intakes of energy and macronutrients by patients with hypertension and normal (NGT) or impaired glucose tolerance (IGT). Thirty six patients with medically treated essential hypertension, 18 with NGT and 18 with IGT, were included in the study. Over 80% of individuals with NGT and 70% with IGT were overweight or obese, and approximately 60% of them had waist circumferences confirming the presence of abdominal obesity. More than 70% of patients had metabolic syndrome traits in both, NGT and IGT group. Low energy intake (20 kcal/kg BW), normal protein and fat intakes (0.9-1.1 g/kg BW and 0.8-0.9 g/kg BW, respectively) and appropriate carbohydrates intake (45-48% of total energy) were observed among patients. There were no significant differences in energy and nutrients intake between NGT and IGT subjects, except for protein density and percentage of energy from protein. To prevent or delay diabetes, nutrition counseling for IGT patients, as well as monitoring of the adherence to a healthy life style, should be considered.

INTRODUCTION

Impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) are considered prediabetes, intermediate stages between the normal state and frank diabetes. Progression from normal glucose tolerance to full-blown type 2 diabetes was describes by Haffner *et al.* [1990] as the "tick clock phenomenon". IGT has been reported as a risk factor of death from cardiovascular disease (CVD) [Tominaga *et al.,* 1999]. Patients with IGT are at significantly increased risk of death and morbidity due to stroke, myocardial infarction, and large-vessel occlusive disease [Singleton *et al.,* 2003]. This clinically identifiable state has also been associated with an increased prevalence of hypertension, dyslipidemia and elevated C-reactive protein [Diabetes Prevention Program (DPP), 2005]. The American Diabetes Association recommends screening for IGT or IFG in men and women age ≥45 years, principally in those with overweight or obesity [ADA, 2006a]. Early detection of IGT, lifestyle modifications, including appropriate diet and exercise modification, can reduce the risk of developing diabetes.

The objective of the present study was to evaluate nutritional habits of hypertensive patients with normal or impaired glucose tolerance with special attention given to nutritional factors which may influence metabolic parameters.

MATERIALS AND METHODS

A total of 36 medically-treated patients with essential hypertension were included in the study. There were 18 (7 men and 11 women) with normal glucose tolerance (NGT) and 18 (13 men 5 women) with impaired glucose tolerance (IGT). Patients were recruited from the Outpatient Clinic of Hypertension at the National Institute of Cardiology in Warsaw. Subjects were between 37 and 79 years of age. Mean age of IGT subjects was 64 years (sd = 7.3) and that of NGT subjects was 57 years (sd = 11.5).

Anthropometric measurement, including height, body weight, waist and hip circumferences were done, following standardized procedures [WHO, 1995]. Body mass index (BMI) was derived by dividing a subject's weight (kg) by the square of his height (m^2). Overweight was defined as a BMI ≥ 25kg/m^2 according to WHO classification [2000]. IGT was determined as a plasma glucose level between 7.8 and 11.1 mmol/L measured 2 h after 75 g glucose load, as recommended by The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus [1997]. Body fat mass was determined by bioelectrical impedance using BIA 101S, AKERN – RJL bioanalyser (Italy) according to Lukaski *et al.* [1985]. Metabolic Syndrome (MetS) was diagnosed using NCEP ATP III criteria [2001].

Analysis of eating habits was performed using 3-day food records (including 1 weekend day and 2 weekdays) [Johnson, 2002]. Energy and nutrients intake were calculated using computer program Dietetyk, based on Food Composition Tables [Kunachowicz *et al*., 1998]. A questionnaire was used to obtain information on demographic and socioeconomic aspect. Additional self-reported data were collected for smoking habits, presence of chronic disease and activity level. The study was approved by the local ethics committee. Statistical comparison of normally distributed parameters between two groups was performed using the unpaired Student's *t* test. For parameters without normal distribution

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TABLE 1. Characteristic of patients with NGT and IGT.

Characteristic	NGT Mean ± sd	IGT Mean ± sd	p
Number	18	18	
Age (years)	57.4 ± 11.5	64.0 ± 7.3	0.04[b]
BMI (kg/m^2):			
Men	30.6 ± 4	28.2 ± 4	NS[c]
Women	29.9 ± 5	30.0 ± 5	NS[c]
Waist-to-hip ratio:			
Men	0.99 ± 0.06	0.96 ± 0.09	NS[c]
Women	0.86 ± 0.05	0.89 ± 0.06	NS[c]
Fasting glucose (mmol/L)	5.4 ± 0.4	6.4 ± 0.7	0.00[b]
2h post-OGTT glucose (mmol/L)	not available	8.6 ± 0.3	
Systolic Blood Pressure[a] (mmHg)	132 ± 6	133 ± 8	NS[b]
Diastolic Blood Pressure[a] (mmHg)	82 ± 4	82 ± 2	NS[b]
Years hypertensive (years)	14.1 ± 9.8	12.8 ± 7.0	NS[c]
Regular exercises (%)	33.3	27.8	NS[d]
Current smoker (%)	27.8	11.1	NS[d]
Family history of diabetes (%)	27.8	5.5	0.05<p<0.10[d]

[a] on drug therapy, [b]Student t test, [c]Mann-Whitney test, [d]Chi^2 test

TABLE 2. Nutritional status of patients with NGT and IGT.

	NGT (n=18)	IGT (n=18)	p
BMI ≥ 25 kg/m^2 (%):	88.9	72.7	NS[d]
Body fat mass (kg):			
Men	27.2 ± 8.2	27.1 ±7.7	NS[c]
Women	31.1± 9.8	30.9 ± 10	NS[c]
Abdominal obesity[a] (%)	66.7	38.9	0.05<p<0.10[d]
Metabolic syndrome[b] (%)	72.2	77.8	NS[d]

[a] waist circumference >102 cm in men, >88 cm in women, [b]according to Adult Treatment Panel III, [c]Student t test, [d]Chi^2 test

the non-parametric Mann–Whitney test was applied. The Chi^2 test was used to categorize variables. A p value of ≤ 0.05 was considered an indicator of statistical significance.

RESULTS

Tables 1 and 2 present the general characteristics, nutritional and health status of hypertensive patients with normal (NGT) or impaired glucose tolerance (IGT). The NGT subjects were younger than the IGT patients ($p<0.05$). No statistically significant differences were found when comparing BMI, body fat mass and WHR between groups. Over 80% of NGT patients and 70% of IGT individuals were overweight or obese. Abdominal obesity, confirmed by waist circumferences, was found among 66% and 40% of individuals with NGT and IGT, respectively. The IGT subjects displayed a higher fasting glucose level ($p<0.05$), whereas familial history of diabetes was found in less than 6% of them. Greater than 70% of patients met the ATP III criteria for MetS in both, NGT and IGT group. There was no significant difference in the prevalence of MetS between the NGT and IGT group. Hypertension was well controlled in all patients. Financial difficulty, which could influence food choice, was declared by 16.7% of IGT individuals and 44.4% of NGT subjects.

All individuals consumed 3 and more meals a day, and snacking was a habit among both, NGT and IGT subjects. As a snack the majority of individuals preferred sweet products to savoury items or fruits/vegetables. Most frequently eaten snacks in the IGT group were cookies/pastries, chocolates and ice-cream (52.9%), while NGT patients favored home made cakes (64.7%). Half the IGT subjects and one third of the NGT patients did not add sugar to hot beverages. Refined sugar amounted to less than 7% of total calories in both, IGT and NGT group. Seventeen percent of NGT subjects and 33% of IGT individuals were taking vitamin supplements.

There was no significant difference in energy and nutrient intakes between NGT and IGT subjects, except for protein density and percentage of energy from protein (Table 3). Low energy content (20 kcal/kg BW), normal protein and fat intakes (0.9-1.1 g/kg BW and 0.8-0.9 g/kg BW, respectively)

TABLE 3. Comparison of energy and nutrients intakes between NGT and IGT patients.

Nutrient	NGT (mean ± sd)	IGT (mean ± sd)	P[a]
Energy (kcal/kg BW)	20.2 ± 5.8	20.9 ± 6.7	NS
Protein (g/kg BW)	1.1 ± 0.4	0.9 ± 0.4	NS
Protein g/1000 kcal	51.9 ± 9.6	45.5 ± 9.5	0.02
Fat (g/kg BW)	0.8 ± 0.3	0.9 ± 0.3	NS
Fat g/1000 kcal	39.8 ± 1.6	41.5 ± 8.9	NS
Carbohydrates (g/kg BW)	2.5 ± 1	2.4 ± 0.9	NS
Carbohydrates (g/1000 kcal)	115.7 ± 24	118.5 ± 33	NS
Fiber (g/1000 kcal)	11.6 ± 3.7	12.3 ± 3.2	NS

[a] Student t test

and a low carbohydrates intake (<48% of total energy) were observed among patients. A high intake of Saturated Fatty Acids (SFA) was found as well (Table 4).

DISCUSSION

TABLE 4. Energy derived from macronutrients (%) in the diet of NGT and IGT patients.

Nutrient	NGT (mean ± sd)	IGT (mean ± sd)	P
Protein	20.1 ± 3.8	18.2 ± 3.8	0.04[a]
Carbohydrates	45.2 ± 9	47.6 ± 13	NS[a]
Refined sugar	6.6 ± 2	6.5 ± 2	NS[b]
Fat	34.7 ± 7.6	33.9 ± 8.0	NS[b]
Fatty acids:			
SFA	12.6 ± 2.8	11.7 ± 2.8	NS[b]
MUFA	15.8 ± 4.6	15.5 ± 4.4	NS[b]

[a] Student t test, [b]Mann-Whitney test, SFA – Saturated Fatty Acids, MUFA – Monounsaturated Fatty Acids

Baron [2001] suggested that postprandial glycemic changes (glycation and oxidative stress), as well as postprandial changes in lipids, may have a particular impact on the vasculature, and may have a pathogenic potential for causing macrovascular disease. So, IGT which is officially termed pre-diabetes, would be considered disease entities deserving therapeutic intervention. Tominaga *et al*. [1999] emphasized that IGT, even without any symptoms, needs to be recognized and treated to prevent the occurrence of CVD.

For individuals who have pre-diabetes the American Diabetes Association [ADA, 2006b] recommends individualized Medical Nutrition Therapy (MNT) provided by registered dietitian. The goals of an nutritional intervention include the achievement and maintenance of optimal metabolic outcomes, such as blood pressure, glucose, and lipids levels, as close to normal as possible, to prevent or reduce the risk of complications [Moore, 2005]. Patients with IGT should be given counseling of weight loss (5 -10% of body weight) as well as instruction for increasing physical activity (30 minutes daily) [ADA, 2006b]. In our study, besides general counseling provided by physician, patients did not receive any special dietetic recommendation.

Patients with IGT are often characterized by high levels of body fatness, especially by increased accumulation of visceral adipose tissue. Furthermore, the IGT state is also associated with alteration in plasma lipoprotein-lipid concentration [Pascot *et al.,* 2000]. Weight loss improves metabolic control, but efforts to achieve and maintain an ideal body weight are often unsuccessful [Moore, 2005]. In our study the majority of patients were overweight or obese, although an average energy intake was only 20 kcal/kg BW. It is well known that the obese subjects are inclined to underestimate their dietary intake. Several studies found that the obese underestimate their energy intake to a degree ranging from 30% to 47% [Johnson, 2002], hence monitoring nutrition in these patients is necessary.

IGT is often associated with MetS which includes obesity (especially abdominal), dyslipidemia of the high-trygliceride and/or lower-HDL type, and hypertension [ADA, 2006a]. Numerous studies concluded that a reduced intake of fat, particularly saturated fat, may reduce the risk for diabetes by producing an energy-independent improvement in insulin resistance, as well as by promoting weight loss [WHO/FAO, 2003]. In our study saturated fats supplied more than 12% of total energy and it was associated with a high total fat intake (more than recommended value of 25%). Diets high in fat are usually highly palatable and energy dense, but are assumed to contribute to obesity. Very-low-fat-diets are not recommended because they usually require increases in carbohydrate intake that may worsen hypertriglyceridemia [Moore, 2005].

A key strategy in achieving glycemic control is monitoring carbohydrates intake. Carbohydrates usually account for 50% or more of the energy consumed. Low-carbohydrate diets (restricting total carbohydrates to <130 g/day) are not recommended because of uncertain impact on the CVD risk profile. What is more, these diets reduce the consumption of foods reach in vitamins, minerals and fiber [ADA, 2006b]. In our study the diet of both, NGT and IGT subjects contained the appropriate level of carbohydrates as compared to values of 45-65% recommended by ADA [2006b].

IGT individuals, similarly to general population, should consume at least 25 to 30 g of fiber daily or 14 g per 1000 kcal [WHO, 2003]. A daily intake of fiber by NGT and IGT individuals in our study was low, thus they should be encouraged to choose fiber-rich foods, such as whole-grain cereals, fruits and vegetables.

Yamaoka & Tango [2005] in meta-analysis of randomized trials evaluated the efficacy of lifestyle education for preventing type 2 diabetes. They concluded that diet and exercise, specially tailored for patients' needs, significantly reduced the rate of progression from IGT to type 2 diabetes.

CONCLUSIONS

No statistical differences were found between NGT and IGT patients in terms of several nutritional features and nutritional status. However patients with both, hypertension and impaired glucose tolerance require nutrition therapy to decrease future diabetes and CV events. Special attention should be paid to nutrients such as saturated, monounsaturated and *trans* fatty acids, carbohydrates, refined sugar and dietary fiber. A comprehensive nutritional education should be offered for motivated patients.

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ZACHOWANIA ŻYWIENIOWE PACJENTÓW Z NADCIŚNIENIEM TĘTNICZYM PIERWOTNYM ORAZ PRAWIDŁOWĄ LUB NIEPRAWIDŁOWĄ TOLERANCJĄ GLUKOZY – BADANIA PILOTAŻOWE

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Celem badań była analiza sposobu żywienia leczonych ambulatoryjnie pacjentów z nadciśnieniem tętniczym pierwotnym oraz współistniejącym zespołem nietolerancji glukozy (IGT). Do badań zakwalifikowano 36 pacjentów, w tym 18 z IGT oraz 18 bez IGT, w wieku od 37 do 79 lat. Nadwagę lub otyłość (wg kryteriów BMI) stwierdzono u ponad 70% pacjentów. Nie stwierdzono istotnych różnic w wartości energetycznej diet pacjentów w obu grupach, ani różnic w spożyciu składników odżywczych z wyjątkiem białka. Całodzienne racje pokarmowe badanych osób charakteryzowała dość niska podaż energii (około 20 kcal/kg mc), zgodna z zaleceniami podaż białka i tłuszczu (odpowiednio 0.9 – 1.1 i 0.8 – 0.9 g/d) oraz węglowodanów (45 – 48% całkowitej energii). Ze względu na ryzyko wystąpienia cukrzycy typu 2, sposób żywienia pacjentów z nietolerancja glukozy powinien być indywidualnie ustalony i monitorowany przez dietetyka.