次是部分农村中老年居民受地域物产和经济条件的影响，除了普及营养知识外，政府还要指导和帮助他们调整产业结构，实施惠民工程来改善他们的饮食营养状况。

从这组中老年人群另外的研究结果得知，他们知道“膳食指南”的占6.1%，知道一些但不全面的占65.6%，不知道的占28.2%；涉及营养基础知识、营养食品卫生、中国居民平衡膳食宝塔、营养相关疾病知识的问卷平均得分率为69.2%。平均体质指数为23.71±4.89，其中偏瘦或营养不良的占6.75%，超重的占28.22%，肥胖的占12.88%，体重正常的只占51.2%。营养保健知识缺乏，导致膳食结构不合理，营养不平衡是中老年人发生营养代谢性慢性疾病的主要原因，要控制中老年人的慢性疾病，还必须从普及营养保健知识和营养干预工作入手。

经统计分析，男女中老年居民之间吃蛋及其制品的构成、不同年龄的中老年居民之间吃奶及其制品的构成、不同文化程度的中老年居民之间定时用餐、吃早餐、吃豆及其制品和吃奶及其制品的构成有统计学差异。这些结果提示我们，对中老年人进行合理膳食干预指导时要考虑到性别、年龄和文化程度的因素，既要有整体的方案，又要有针对个体的措施，传播知识的方式方法也要适合中老年人的需求和爱好，才能收到良好的效果。

人口普查结果表明，我市已进入老龄化社会，需要全社会都来关心老年人的健康问题。政府要把对老年人的营养保健纳入公共卫生服务的内容，医疗卫生服务机构要对老年人给予更多的关爱，卫生专业技术人员要主动为老年人提供服务，家庭成员要为老年人营造良好的生活氛围，老年人自己也要重视健康，珍惜生命，多学习和应用营养保健知识，才能健康长寿。

参考文献

（略）

Association of dietary glycemic index and dietary fiber with HbA1c level among Chinese middle-aged and elderly patients with type 2 diabetes

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Abstract:

Objective: It has been suggested that dietary factors play an important role in diabetic control in patients with type 2 diabetes. However, little is known about the situation in Chinese population, whose diets are typically high in fiber and in glycemic index (GI) value.

Methods: 934 middle-aged and elderly patients with type 2 diabetes and 918 healthy volunteers from Pudong New Area of Shanghai, China, were interviewed to elicit demographic characteristic and lifestyle factors in Oct-Dec, 2006. Dietary habits were assessed with a validated food frequency questionnaire. Anthropometric measurements, bio-specimen collection and biochemical assays were conducted at the interview according to a standard protocol.

Results: Generally, prevalent diabetic patients had lower levels of energy and macronutrients intake than healthy adults. The average levels of the nutrients intake did not vary by the duration of diabetes among patients, while the average levels of several metabolic factors, such as fasting glucose, glycolated hemoglobin A1c (HbA1c), systolic blood pressure and high density lipoprotein cholesterol, increased with increasing duration of the disease. HbA1c level was linear correlated with dietary fiber and average GI intake, and was consistently observed lower in patients with higher fiber or lower GI intake regardless of duration of the disease.

Conclusions: Dietary fiber and GI intake may play an important role in glycemic control among Chinese patients with type 2 diabetes.

Keywords: type 2 diabetes; dietary fiber; glycemic index; glycolated hemoglobin A1c

INTRODUCTION

Diabetes is an important risk factor for micro-vascular and macro-vascular complications, and thus increases premature death in the general population. Aggressive control of hyperglycedemia, dyslipidemia and hypertension, either by medicine or by lifestyle intervention, is crucial to decrease the incidence of stroke, myocardial infarction and renal disease, as well as the related premature death [1,2]. So far, numerous intervention studies have examined the impact of dietary intake on glycemic control, and suggested that lower intake of dietary fat[3], glycemic index[4,5], carbohydrate[6-8] and higher intake of dietary fiber[9,10] improved glycemic control status and thus reduced the risk of diabetic complications. Evidence from observational studies is also available. A large cross-sectional study involving 5675 non-diabetic Danish men and women suggests that dietary fiber intake may be of great importance in preventing type 2 diabetes and controlling glucose level[11]. By following-up 7822 US women with type 2 diabetes in the Nurses´ Health Study for 26 years, He, et al[12] found that the highest versus the lowest fifths of intakes of whole grain, cereal fiber, bran, and germ were associated with 16% to 31% lower all-cause mortality.

Chinese people consume more abundant types of foods, and have a higher level of dietary fiber and GI intake comparing with their western counterparts[13]. It is reported that intake of dietary fiber among Chinese diabetic patients reached recommended level of the American Diabetes Association (ADA)[14]. However, the situation of glycemic control and prevalence of complications in diabetic patients in China is not satisfactory[15].

To evaluate the association of dietary factors with diabetic control status among Chinese patients with type 2 diabetes, we conducted a cross-sectional study including 934 middle-aged and elderly patients with type 2 diabetes from Pudong New Area of Shanghai, China. Our results may help to better understand the role of dietary factors in the progression of type 2 diabetes.

1 MATERIALS AND METHODS

1.1 Study participants

A total of 979 middle-aged and elderly subjects diagnosed with type 2 diabetes were randomly selected from the T2DM administration rosters in communities of Shanggang, Zhoujiadu, Huamu, Puxin, Weifang, Jinyang, Meiyuan and Jichang of Pudong New Area of Shanghai in Oct, 2006. All patients were diagnosed with type 2 diabetes by doctors according to ADA criteria: 1) Fasting plasma glucose ≥7.0 mmol/L; or 2) Two-hour plasma glucose ≥ 11.1 mmol/L during an oral glucose tolerance test; 75 g glucose load should be used; or 3) a random plasma glucose concentration ≥ 11.1 mmol/L in persons with symptoms of hyperglycemia or hyperglycemic crisis. Subjects with severe type 2 diabetes complications and those present with cognitive deterioration were excluded. Of 934 patients interviewed, 41.7% were male. The mean age of the participants was 64.5 (SD, 10.1) years old.

At the same time, a total of 918 adult volunteers free of diabetes were recruited from communities mentioned above. The mean age of these volunteers was 57.7 (SD, 9.9) years old, and 291 (31.7%) participants were male.

The study was approved by Fudan University Institutional Review Board (IRB00002408, FWA00002399).

1.2 Data collection

After obtaining written consent, a structured in-person interview was conducted by trained interviewers to elicit information on demographic characteristics, diagnosis of hypertension, presence of dyslipidemia, use of tobacco and alcohol. Smoking was defined as at least 1cigarette per day for at least 6 months, and alcohol use was defined as drinking alcohol at least 3 times a week for more than 6 months.

Dietary habit was assessed using an interviewer-administered food frequency questionnaire (FFQ) modified based on a validated FFQ[16]. The FFQ specifies 103 food items, covering 90% of food items commonly consumed in Shanghai. For each food item, participants were asked to report how frequently (daily, weekly, monthly, annually or never) and how long (months per year) they consumed the food, followed by a question on the amount of consumption in liang (1 liang = 50 g) per unit of time in the previous 12 months. For liquid foods such as milk, juice and beverage, the amount of intake was reported in milliliter (ml) and was transformed into gram in the analysis. The daily intakes of oil, salt and sugar were calculated as the average level consumed by each family member of the participant.

Nutrient content from the Chinese Food Composition Tables was applied to estimate nutrient intake from all food items and groups and, and to obtain glycemic index (GI) values for some foods[17]. We also referenced Foster-Powell et al 's report to obtain GI values for some foods[18]. Each food's GL was calculated by multiplying the food's GI value by the carbohydrate content of the food and the average amount of the food consumed per day. Total dietary GL was then produced by summing these products over all food items. Dietary GI was derived by dividing the dietary GL by the amount of carbohydrate intake, thus yielding a weighted average GI for each individual's diet[19]. We excluded from the analysis the women who had total energy intake < 500 kcal/d or > 3500 kcal/d and men with energy intake of < 800 kcal/d or > 4000 kcal/d.

1.3 Phenotype measurements

At the interview, each participant was measured for his/her body height, weight, waist circumference, hip circumference, systolic blood pressure (SBP), and diastolic blood pressure (DBP) according to a uniform and standardized protocol. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2).

After at least 10 hours of overnight fasting, a 1 ~ 1.5 ml venous blood specimen was collected in a vacuum tube containing sodium fluoride for the measurement of plasma glucose and HbA1c, and a 3 ~ 3.5 ml non-anticoagulated venous blood specimen was collected for the measurement of total cholesterol (TC), triglyceride (TG), high density lipoprotein cholesterol (HDLC) and low density lipoprotein cholesterol (LDLC).

Enzymology methods were used to measure the fasting plasma glucose level (GOD-PAP), concentrations of TG (GPO-PAP) and TC (CHOD-PAP) on an Automatic Biochemical Analyzer (HITACHI 7170A, Hitachi, Ltd, Tokyo, Japan). Level of HDLC and LDLC were measured using a selective inhibition method. HbA1c was tested using ion exchange chromatography on DS5 Glycated Hemoglobin Analyzer (DREW DS5, Drew Scientific Co. Ltd, Cumbria, UK). Quality control of the assays was assessed internally and externally. The interassay coefficient of variation was < 1.82% for FPG (SD < 0.23 mmol/L), < 1.38% for TG (SD < 0.02 mmol/L), < 1.54% for TC (SD < 0.08 mmol/L), < 1.6% for HDLC (SD < 0.01 mmol/L), < 5.3% for LDLC (SD < 0.21 mmol/L), and 6.13 % for HbA1c (SD < 0.77).

1.4 Statistical analysis

Statistical analyses were conducted utilizing SAS statistical software 9.2 (SAS Institute Inc., Cary, NC). Differences on demographic factors by glycemic control status were evaluated using χ^2 test for categorical variables or non-parameter Wilcoxon test for continuous variables. A generalized linear regression model was applied to compare the average levels of biochemical measurements and levels energy, dietary protein, fat, carbohydrate, fiber and GI intake by duration of type 2 diabetes. Partial correlation analysis was conducted to evaluate the liner correlations of HbA1c levels with intake levels of dietary factors. Metabolic phenotypes, including BMI and WHR, and dietary factors were all natural log (ln) transformed to approximate normal distribution. All statistical tests were based on two-sided probability.

2 RESULTS

Among 934 prevalent diabetic patients, 488

(52.3%) had an HbA1c level of ≥ 7.0 % (table 1). These patients, compared with those having an HbA1c level of < 7.0 %, were more likely to have a lower education level, younger age at diagnosis of diabetes, longer duration of the disease and lower prevalence of hypertension. No significant difference was observed between the two groups with regard to age, sex, smoking, alcohol consumption, family history of diabetes, presence of dyslipidemia and history of coronary heart disease.

Table 1 Comparisons of demographic characteristics of 934 type 2 diabetes patients by glycemic control status

Characteristics	HbA1c < 7.0 % (N = 446)	HbA1c ≥ 7.0 % (N = 488)	*P* value
Age, years (mean, SD)	64.6 (10.1)	64.4 (10.2)	0.806
Sex, male, n (%)	191 (42.8)	198 (40.6)	0.487
Educational level, college or above, n (%)	45 (10.1)	25 (5.1)	0.004
Family history of diabetes, yes, n (%)	130 (29.2)	168 (34.4)	0.084
Diagnosis age of DM (mean, SD)	56.4 (10.4)	54.2 (10.0)	0.002
Duration of DM (mean, SD)	8.2 (6.3)	10.2 (6.3)	<0.001
Prior history of hypertension, n (%)	265 (59.4)	253 (51.8)	0.02
Prior history of dyslipidemia, n (%)	55 (12.3)	42 (8.6)	0.062
Prevalence of coronary heart disease, n (%)	73 (16.4)	59 (12.1)	0.061
Current smoking, n (%)	72 (16.1)	85 (17.4)	0.603
Current alcohol consumption, n (%)	54 (12.1)	64 (13.1)	0.635

Missing values (2 for age, 1 for education and diagnosis age of DM, 3 for duration of DM) were excluded.
[a] χ^2 test for categorical variables or non parameter Wilcoxon test for continuous variables.

As shown in table 2, the diabetic patients seemed to remain a stable dietary habit along with the duration of the disease. The patients, either with a shorter or a longer duration of type 2 diabetes, had lower levels of dietary energy, carbohydrate, protein, fat, GI, GL and fiber intake than those free of diabetes, although the difference in fiber intake did not reach significance (Table 2).

Table 2 Average levels of dietary factors in type 2 diabetes patients by duration of the disease

Dietary factors *	Duration of type 2 diabetes, years			*P* value **	All patients (N = 934)	Healthy adults (N = 918)	*P* value ***
	<5	5–9	≥10				
Energy, kcal/d	1559.7(1.4)	1505.9(1.3)	1462.4(1.3)	0.130	1503.0(1.4)	1766.1(1.3)	<0.001
Carbohydrate, g/d	252.8(1.4)	244.9(1.4)	234.5(1.4)	0.636	242.8(1.4)	292.5(1.4)	<0.001
Protein, g/d	58.5(1.5)	55.7(1.5)	55.3(1.5)	0.300	56.3(1.5)	64.0(1.4)	<0.001
Fiber, g/d	9.2(1.7)	8.4(1.7)	8.8(1.7)	0.060	8.8(1.7)	10.2(1.6)	0.354
Fat, g/d	36.0(1.6)	34.4(1.6)	34.4(1.6)	0.651	34.9(1.6)	39.1(1.6)	<0.001
Average GI	60.0(1.1)	60.3(1.2)	58.9(1.2)	0.205	59.7(1.2)	60.4(1.1)	0.004
Average GL	83.2(1.4)	79.1(1.4)	77.2(1.4)	0.485	79.5(1.4)	95.9(1.4)	<0.001

* Continuous variables were all natural LOG transformed before entering models
** Generalized linear model adjusting diagnosis age, gender, BMI, hypoglycemic drug use and energy intake
*** Generalized linear model adjusting age, gender and energy intake

Conversely, the average levels of FPG, HbA1c, HDLC and SBP increased with increasing duration of type 2 diabetes after adjusting for age at diagnosis, sex, and hypoglycemic drug use (P for trend <0.05) (table 3). No similar significant trend was observed for average levels of TC, TG, LDLC, DBP and BMI.

We further evaluated the relationships between HbA1c level and dietary factors by a linear correlation analysis. As shown in table 4, HbA1c level was negatively correlated with dietary fiber intake ($r = -0.073$, $P = 0.026$), and positively associated with dietary GI intake ($r = 0.071$, $P = 0.031$). No significant linear correlation was observed for HbA1c level with levels of energy, carbohydrate, protein, fat and GL intake.

Table 3 Average levels of indicators for diabetic control status among prevalent diabetic patients by duration of the disease

Indicators *	Duration of DM, years			P value **
	<5 (N = 229)	5-9 (N = 315)	≥ 10 (N = 387)	
FPG, mmol/L	7.2 (1.3)	8.1 (1.4)	8.5 (1.4)	0.011
HbA1c (%)	6.9 (1.2)	7.4 (1.2)	7.7 (1.2)	<0.001
TC, mmol/L	4.4 (1.2)	4.4 (1.2)	4.4 (1.2)	0.913
TG, mmol/L	1.5 (1.8)	1.4 (1.7)	1.4 (1.8)	0.674
LDLC, mmol/L	2.7 (1.4)	2.7 (1.3)	2.7 (1.4)	0.629
HDLC, mmol/L	1.2 (1.3)	1.2 (1.3)	1.3 (1.3)	0.015
SBP, mmHg	132.9 (1.1)	134.4 (1.1)	136.5 (1.1)	<0.001
DBP, mmHg	82.5 (1.1)	82.6 (1.1)	82.2 (1.1)	0.910
BMI	25.7 (1.2)	25.9 (1.1)	25.2 (1.1)	0.283

* Continuous variables were all natural LOG transformed before entering models

** Generalized linear model adjusting diagnosis age, sex, and hypoglycemic drug use

Table 4 Partial correlation coefficients of HbA1c level with dietary factors among diabetic patients *

Dietary intake	HbA1c	
	r	P-value
Dietary energy, kcal/d	0.026	0.437
Dietary carbohydrate, g/d	-0.009	0.795
Dietary protein, g/d	-0.010	0.769
Dietary fiber, g/d	-0.073	0.026
Dietary fat, g/d	0.033	0.319
Average GI	0.071	0.031
Average GL	-0.014	0.679

* Adjusted for diagnosis age, sex and hypoglycemic drug use for energy, GI and GL, and additionally adjusted for energy intake for other dietary factors

Figure 1 shows the average levels of HbA1c by dietary fiber and average GI intake among diabetic patients with different duration of the disease. Regardless of the duration of type 2 diabetes, HbA1c level was consistently observed higher in patients consuming lower level of fiber or higher level of average GI.

3 DISCUSSION

In this cross-sectional study including 934 Chinese prevalent patients with type 2 diabetes from Shanghai, China, we observed a stable after-diagnosis dietary habit, upward trend of HbA1c level along duration of the disease, a significant linear correlation of HbA1c level with dietary fiber or GI intake, and a lower average level of HbA1c related with higher fiber intake or lower GI intake. Our findings have implications in improving diabetic control status and preventing complications for Chinese diabetic patients.

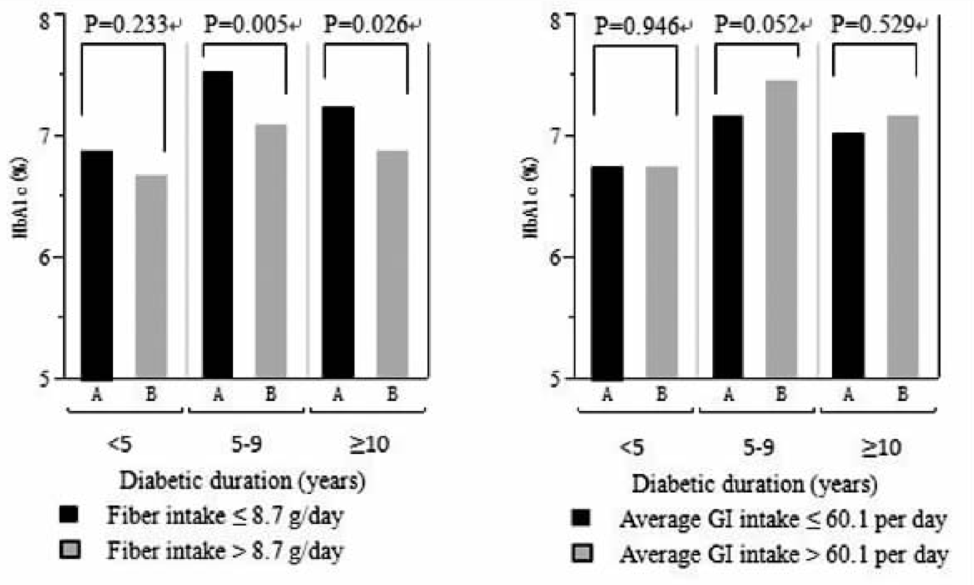

Figure 1　Average levels of HbA1c in subjects with different dietary fiber or GI intake by duration of type 2 diabetes. The groups of low (A) or high (B) intake were classified by the medians of intake. The medians were 8.7g/d for dietary fiber intake and 60.1/d for average GI intake. Means of HbA1c level were adjusted for diagnosis age, gender, energy intake and hypoglycemic drug use using GLM models.

First, in this study, diabetic patients with an HbA1c level of ≥ 7.0% was diagnosed with type 2 diabetes 2.2 years younger than those with lower HbA1c level, but had a 2 years longer duration of the disease. The situation is consistent with previous studies, in which younger age at diagnosis and longer duration were regarded as independently predictors for poor glycemic control in diabetic patients[20-22], and suggests that more attention should be paid to the younger patients.

Second, the significant difference in dietary habit between patients and healthy adults suggest that a diabetic patient was able to greatly change his/her diet habit due to the diagnosis of the disease. The stable dietary habit along duration of the disease in patients, on the other hand, indicates that a new dietary habit, once established, would remain unchanged for a long time. These results implicate the importance of the time point of diagnosis in establishing a new "good" dietary habit. Dietary intervention and health education should be extensively elicited at the time point.

As the main finding of the study, our finding that it was dietary fiber and GI intake, but not carbohydrate and GL intake, were closely associated with HbA1c level indicates that, in this population, the quality of the carbohydrates consumed may play a more important role than the quantity of carbohydrates consumed in the progression of type 2 diabetes. Dietary GI and GL are two physiological indexes of the metabolic effects of dietary carbohydrates[18,23]. While GI is used to characterize foods that contain carbohydrates according to their postprandial blood glucose response and hence their effect on blood insulin levels[23-25], GL was introduced to quantify the overall estimate of postprandial glycemia by combining the GI value and the quantity of carbohydrates consumed[18,25]. Our findings are supported by several previous studies. Results from a meta-analysis found that a low-GI diet significantly improved glycemic control by reducing HbA1c levels among diabetic patients[26]. A lower GI diet had beneficial effect in achieving better glycemic control in diabetic patients[27]. Dietary fiber intake was also related to improved glycemic control status in two intervention studies[10,28], and a high cereal fiber diet intake had similar effects in changes of HbA1c levels as a low-GI diet did[4]. On the other hand, the effect of carbohydrate and dietary GL intake on HbA1c levels was attenuated by adjusting dietary fiber intake[11], although a 6 month low carbohydrate diet with 30% of energy intake from carbohydrate was shown to decrease HbA1c level from 10.9% to 7.4% among 33 severe diabetic outpatients[8]. With respect to dietary GL intake, a cross-sectional study with 901 diabetic outpatients indicated diets low in GL was associated with lower HbA1c and postmeal glucose levels[29], which is inconsistent with our results.

Finally, we observed that HbA1c level was consistently associated with dietary fiber and GI intake regardless of duration of the disease, suggesting that dietary intervention may make a difference at any time at the duration of the disease.

In this study, we did not find associations between HbA1c levels and dietary protein intake, inconsistent with several studies[30,31]. The null association with dietary fat is also inconsistent with a randomized clinical trial, in which both a low-fat vegan diet and a traditional diet according to the ADA guidelines decreased HbA1c and LDLC levels in 99 individuals with type 2 diabetes after a 22 week follow up[3]. Another randomized clinical trial, however, observed that low-carbohydrate diet led to better glycemic control than a low fat diet[32]. Due to the nature of the cross-section study design of our study, we could not elucidate the effect of these macronutrients in glycemic control. A well designed randomized controlled trial is warranted in Chinese diabetic patients.

In summary, this small-scale cross-sectional study indicates the potential role of dietary fiber and GI in glycemic control, and provides public health implications to improve diabetic control status in Chinese diabetic patients.

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DISCLOSURE STATEMENT

None declared

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退休矿工膳食行为和营养知识调查分析

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摘　要：目的：了解内蒙古某煤矿退休矿工营养膳食行为、知识和对营养膳食的态度，为改善退休矿工的营养状况、提高退休矿工健康水平提供依据。**方法：**选取内蒙古某煤矿的退休矿工作为研究对象，采取随机整群抽样的方法对 1006 名退休矿工进行问卷调查。**结果：**退休矿工膳食结构不合理，每天坚持吃早餐的人男女分别为 69.1%、66.7%，而有时吃的男女分别为 21.9%、22.1%，关注饮食健康得占调查总人数得 70.2%，男性矿工和女性矿工在关注饮食健康程度上有差异。**结论：**许多老年慢性病的发生发展都与膳食密切相关，退休矿工中存在不科学膳食习惯和不健康膳食行为及营养问题，应开展膳食指导及营养干预。

关键词：退休；矿工；膳食；营养；健康

老年慢性病如高血压、糖尿病等的发病率呈逐年上升趋势，因此老年人的健康问题越来越受到社会的关注。许多老年慢性病的发生发展都与膳食密切相关，科学的营养理念与合理的饮食习惯对于预防和控制这些疾病具有重要的意义。以体力劳动为主的矿工在国家建设中起着重要的作用。为了了解退休矿工营养知识、态度、行为等营养健康情况，给退休矿工的营养保健提供参考，我们于 2009 年对某煤矿的退休矿工膳食营养状况进行调查，报告如下。

1　对象与方法

1.1　对象

按照某煤矿各矿区的分布情况，采取整群抽样的方法选取内蒙古某矿区共 1006 名退休矿工作为研究对象，其中男性 645 人，女性 461 人，年龄 55—90 岁之间。

1.2　方法

自行编制调查问卷，主要内容包括一般情况（即年龄、性别、民族、籍贯、退休前的职业、文化程度等）和有关营养保健有关问题，用自行设计的问卷采取当场回收的方式进行调查，调查内容包括现阶段早餐的食用频率，膳食种类等。共回收有效问卷 1006 份。

2　结果与分析

2.1　早餐食用频率

早餐是起床后结束饥饿状态的第一次正式用餐，前一天晚餐提供的能量和营养素消耗殆尽所以早餐对保障人体健康、维持体能、提高学习和工作效率至关重要。长期不吃早餐不仅影响学习和工作，同时也会引发一些疾病，如胆结石、胃炎等症。从调查（表 1）来看，每天坚持吃早餐的人男女分别为 69.1%、66.7%，而有时吃和的男女分别为 21.9%、22.1%。早餐提供的能量和营养素在全天的地位是午餐和晚餐不能代替的，经常不吃早餐会引起能量和营素摄入不足[1]。

表 1　退休矿工早餐食用频率分布比例

性别	N	每天	有时	很少	不吃
男	640	442（69.1）	140（21.9）	40（6.3）	18（2.8）
女	357	238（66.7）	79（22.1）	30（8.4）	10（2.8）