

Original Article

Validation of the Leeds Food Preference Questionnaire in Arabs

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The Leeds Food Preference Questionnaire (LFPQ) is a computerised procedure that assesses liking, wanting and relative preferences for shared characteristics of food. This study adapted the LFPQ (LFPQ-A) to assess its cross-cultural validity in an Arab sample by examining its performance for food characteristics of fat (high or low) and taste (sweet or non-sweet), under fasted and fed states. Individual differences in eating behaviour were examined by testing for associations between the LFPQ-A outcomes and subscales of the Three Factor Eating Questionnaire (TFEQ). Thirty healthy males (age: 36.3±10.0 years; body mass index: 29.7±5.3 kg/m²) participated in the study. All participants attended the laboratory in the morning following an overnight fast, and performed the LFPQ-A under fasted and fed conditions (after a standardised test meal). Results showed that implicit wanting and relative preference for non-sweet foods decreased in the fed compared to the fasted state, whereas scores for sweet foods increased. Explicit liking and explicit wanting were also higher for non-sweet foods in the fasted condition, and decreased to a greater extent in the fed condition compared to a lesser decrease for sweet foods. Scores on all LFPQ-A outcomes for high-fat non-sweet foods were positively associated with TFEQ Disinhibition. Outcome scores for low-fat non-sweet foods were positively associated with TFEQ Restraint. The LFPQ-A showed outcomes that were consistent with studies performed in Western samples, therefore the current study helps to confirm the validity of the LFPQ-A as a measurement of liking and wanting and preference for food among Arabs.

Key Words: food preferences, liking and wanting, fat preferences, Arabs, obesity

INTRODUCTION

Food palatability and the sensory preference for food may contribute to over consumption and constitute a risk factor of weight gain.¹ When non-obese individuals were exposed to similar foods with different nutrient compositions, high-fat food was rated the most pleasant while high-protein food was rated the least pleasant.² Taste contributes to satiety, satiation and the thermic effect of food as well as its reward value.³ A liking for sweet taste seems to be an innate characteristic in humans,⁴ and increasing the sweetness of high fat foods increases their palatability.³ The energy-density of food can affect its palatability and consequently the amount of food consumed.^{5,6} Evidence suggests that the effect of energy density on energy intake is stronger than other stimuli such as macronutrient composition and visual presentation.⁷

Variation in food culture can affect fat and sweet preferences,⁸ which are influenced by genetic and environmental factors.^{9,10} For example, variations in taste receptor genes accounted for a portion of variance in appetite traits and individual differences in preferences for sweet flavours in children,¹¹ which means that environmental forces may

sometimes override the genotypic effects in adults.¹² Genes can also affect the pleasantness of fat in adults.¹³ Specific nutrient preferences for certain local cuisines, are affected by environmental factors such as tradition, flavouring ingredients, cooking and presentation, and are therefore expected to contribute to differences in nutrient and taste preferences cross cultures.⁴ Taste can be affected by numerous factors that increase cross-cultural variations. For example, African Americans as compared to European Americans showed a greater desire for intense sweet taste to compensate for feelings of stress.¹⁴ These genetic and environmental variations

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in taste preference increase the importance of the cross-cultural validity of food preference instruments.

The Leeds Food Preference Questionnaire (LFPQ) is a computer-based measure of liking, wanting and relative preference for shared characteristics of food, and has been utilised extensively in primarily Western samples and is described in greater detail elsewhere.¹⁵ Briefly, the LFPQ assesses responses to an array of foods that are categorised according to fat content (high or low) and taste (sweet or non-sweet). Previous research with the LFPQ has demonstrated that explicitly rated liking for food is reduced in a fed compared to a fasted state,¹⁶ and that explicit liking for a recently eaten food decreases in a manner consistent with sensory specific satiation.¹⁷ Liking and wanting for high fat sweet or non-sweet tastes predict ratings of palatability and subsequent intake of those foods when presented in a test meal.¹⁸ Moreover relative preference and implicit wanting (assessed by latency of choice) are shown to be the strongest predictors of laboratory food choice.¹⁹ Furthermore, the LFPQ measure of implicit wanting has been shown to be sensitive to states of macronutrient imbalance,²⁰ and to individual differences in disordered eating behaviour traits such as trait binge eating,²¹ and Disinhibition.²² The aim of the present study was to examine the sensitivity of an Arabic version of the LFPQ (LFPQ-A) to detect expected changes in responses of explicit liking and wanting, implicit wanting and relative preference under fasted and fed conditions, and to investigate the relationship between LFPQ-A and eating behaviour traits (Restraint, Disinhibition and Hunger) assessed by the Three Factor Eating Questionnaire (TFEQ).²³

METHODS

Participants

Thirty healthy males were recruited from University of Dammam and Dammam region. Exclusion criteria were being diabetic and smoking cigarettes. Participants' nationalities were seven Saudis, eleven Egyptians, four Palestinians, five Sudanese and three Jordanians. Participants' average age was 36.3±10.0 years, and body mass index (BMI) was 29.7±5.3 kg/m².

Study design

The experiment was set in a private air-conditioned room at Faculty of Education, University of Dammam. All participants arrived at the laboratory, following an overnight fast, between 8 am and 11 am. Upon their arrival, an informed consent form was provided, and height and weight were measured. Fasted food preferences were then undertaken with the LFPQ-A. To bring participants to a fed state, a standardised test meal was provided. Approximately 10 minutes after consuming the breakfast, LFPQ-A and TFEQ measures were undertaken in the fed state. The whole visit for each participant was 45 minutes. Study design was approved in the provision of the Declaration of Helsinki by Institutional Review Board at University of Dammam (IRB-2014-14-315).

Test meal

The test meal consisted of 250 gram (≈600 kcal) of cheese, chicken and spinach pie, 200 mL (120 kcal) fruit

juice and 300 mL water. The test meal was provided freshly every day, and was fixed at the same amount for all participants. The suitability of the amount provided in the meal was piloted before the experiment commenced. Participants were instructed to consume the meal in its entirety.

LFPQ outcome measures

The LFPQ is a computer-based paradigm using the E-Prime experiment generator.²⁴ The procedure uses 16 photographic food stimuli chosen to vary along two major dimensions: fat (high or low) and taste (sweet or non-sweet), such that there were four categories including high-fat sweet (HFSW), high-fat non-sweet (HFNS), low-fat sweet (LFSW) and low-fat non-sweet (LFNS).

Explicit liking and explicit wanting

Explicit liking and wanting were assessed using 100-mm visual analogue scale (VAS) anchored at each end with "not at all" and "extremely". For the assessment of explicit liking, participants responded according to "How pleasant would it be to taste some of this food now?" and for the assessment of explicit wanting, participants responded according to "How much would like to eat some of this food now?"

Implicit wanting

Implicit wanting and relative preference were assessed by a forced choice methodology. In this task, a food stimulus from each of the four food categories was paired with a stimulus from another category to form one trial in which the subjects were given the standardised instruction "Which food do you most want to eat now." Each choice, made via key-press on the keyboard, triggers the next randomised pair of stimuli and so on until all possible pairs of combinations have been presented. Participants are required to respond as quickly and as accurately as possible. Participants' reaction times are covertly recorded and mean response times for each food type are calculated. A frequency-weighted algorithm is used to calculate the implicit wanting score, and is influenced by both selection (positively contributes to the score) and non-selection (negatively contributes to the score) of a food. A positive score indicates a more rapid preference for a given food category relative to the alternatives in the task and a negative score indicates the opposite. A score of zero would indicate that the category is equally preferred.

Arab-version of LFPQ (LFPQ-A)

To create the LFPQ-A, the original LFPQ was translated into Arabic by one of the authors, who is bilingual. The translation was reviewed and confirmed by a teacher of English as a second language from the staff of University of Dammam. In addition, a culturally appropriate set of food images were created and validated for use in this population. Specifically, 80 popular Arabic foods were professionally photographed according to standardised operating procedures. Twenty food images were chosen to represent each category based on combinations of fat and sweet taste. These food images were then shown and discussed with three qualified nutritionists and images were excluded from the set if they were thought to

be misleading due to their different preparations and ingredients, were not immediately recognisable, or were repetitive. The final set of 24 food images with 6 foods in each category were then validated in an online questionnaire (https://www.surveymonkey.com/s/Food_Perception), that determined participants' perceptions of the amount of fat, the intensity of sweet, and the amount of calories, rated using 7-point Likert scales. The average means of participants' responses were compared with the reference mean using one-sample t-test, and the reference mean was determined at 6 for the high content of fat, sweet and calorie, and was determined at 2 for the low content of fat, sweet and calorie. The final four food images selected for each category were taken from the outcome of these results and are shown in Table 1.

Arabic-version of TFEQ

The 51-item TFEQ, which was translated and approved by Department of Nutrition at American University at Beirut, has been used in the current study. Scoring data followed the same procedure suggested by the original instrument that forms the three subscales Cognitive restraint, Disinhibition and Hunger experience.²³

Appetite measures

Subjective appetite sensations including hunger, desire to eat and fullness were measured using a paper-based VAS, which were translated and approved by the Department of Nutrition at American University at Beirut. All participants used this procedure four times in the experiment day including fasted condition immediately before and after LFPQ-A test and fed condition immediately before and after LFPQ-A test. Scoring data followed the same procedure of the original instrument using the measure by millimetre (mm) to indicate participants' responses.²⁵

Statistical analysis

Data were analysed using SPSS version 20 for Windows and are presented as means with standard error. Before analysis the data were checked for normality and outliers. To assess

changes in liking and wanting for the four food categories across the fasted and the fed condition a 2 (fasted vs fed) × 2 (high fat vs low fat) × 2 (sweet vs non-sweet) repeated measures ANOVA was used. Associations with TFEQ variables were assessed using Pearson's correlations. Where appropriate, Greenhouse-Geisser probability levels were used to adjust for non-sphericity. Post-hoc analyses were conducted on significant interactions using the Bonferroni correction. An α -level of 0.05 was used to determine statistical significance.

RESULTS

Appetite measures in fasted-fed condition

Fasting hunger, desire to eat and fullness were 53.2±3.1, 53.5±3.9 and 28.5±3.5 mm respectively. Fed hunger, desire to eat and fullness were 13.7±3.1, 23.4±3.9 and 82.7±3.5 mm respectively. There were significant main effects of fasted-fed condition for hunger, fullness and desire to eat ($p<0.001$), with greater levels of hunger and desire to eat, and lower levels of fullness in the fasted compared to the fed state. The main effect of pre-post LFPQ test and the interaction with fasted-fed condition were non-significant.

Effect of fasted or fed condition on LFPQ-A outcome variables

Implicit wanting

Table 2 shows implicit wanting, explicit liking and explicit wanting for the four food categories in fasted and fed condition. There was a main effect of fat [$F(1, 29)=8.66, p<0.01, \eta^2=0.23$] with a greater implicit wanting for low fat compared to high fat foods. There was an interaction between condition and taste [$F(1, 29)=16.3, p<0.001, \eta^2=0.36$] with a greater implicit wanting for sweet compared to non-sweet foods in the fed condition. Finally, there was a three way interaction between condition, taste and fat [$F(1, 29)=10.8, p<0.01, \eta^2=0.27$]. When participants were fasted they had greater implicit wanting for LFNS and LFSW, however in the fed state there was a decrease in participants implicit wanting for HFNS and LFNS, and an increase in implicit wanting for HFSW and LFSW.

Table 1. Selected four food images in each category of Arabic-version of LFPQ

LFSW	HFSW	LFNS	HFNS
Dates	Ice cream	Carrot	Chicken burger
Watermelon	Cheese cake	Cucumber	Falafel
Rock melon	Chocolate bar	Lettuce	Creamy pasta
Jelly sweets	Basbosah	Steam rice	French fries

HFSW: high-fat sweet; HFNS: high-fat non-sweet; LFSW: low-fat sweet; LFNS: low-fat non-sweet.

Table 2. Implicit wanting, explicit liking and explicit wanting scores for the four food categories in the fasted and fed condition

Category	Fasted			Fed		
	IW	EL	EW	IW	EL	EW
HFNS	-4.3±6.6	46.8±3.9	45.7±3.9	-32.5±5.5	19.3±3.9	17.9±4.2
LFNS	6.9±7.1	55.5±4.4	55.1±4.2	5.8±6.0	32.1±5.6	31.4±5.3
HFSW	-15.5±6.6	37.2±3.8	34.0±3.8	6.2±7.5	35.9±4.5	34.0±4.5
LFSW	12.9±4.0	56.3±3.4	53.1±3.7	20.5±4.4	33.0±4.6	35.3±4.4

IW: Implicit Wanting; EL: Explicit Liking; EW: Explicit Wanting; HFSW: high-fat sweet; HFNS: high-fat non-sweet; LFSW: low-fat sweet; LFNS: low-fat non-sweet.

Table 3. Associations between implicit wanting, explicit liking and explicit wanting for the four categories in the fasted and fed condition with Restraint, Disinhibition, and Hunger

Condition	Category	Disinhibition			Restraint			Hunger		
		IW	EL	EW	IW	EL	EW	IW	EL	EW
Fasted	HFNS	0.29	0.49**	0.53**	-0.41*	-0.34	-0.32	0.27	0.35	0.38*
	LFNS	-0.23	0.04	0.07	0.55**	0.51**	0.49**	-0.48**	-0.17	-0.23
	HFSW	0.00	0.17	0.21	-0.29	-0.28	-0.31	0.22	0.19	0.23
	LFSW	-0.11	-0.02	0.07	0.28	0.16	0.18	-0.05	0.00	0.05
Fed	HFNS	0.36*	0.51**	0.55***	-0.32	-0.20	-0.18	0.33	0.38*	0.39*
	LFNS	-0.18	-0.03	0.03	0.36*	0.48**	0.52**	-0.19	-0.24	-0.16
	HFSW	0.02	0.16	0.21	-0.20	-0.23	-0.17	0.03	0.06	0.12
	LFSW	-0.25	-0.02	0.03	0.25	0.12	0.16	-0.21	-0.06	-0.04

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

IW: Implicit Wanting; EL: Explicit Liking; EW: Explicit Wanting; HFSW: high-fat sweet; HFNS: high-fat non-sweet; LFSW: low-fat sweet; LFNS: low-fat non-sweet.

Explicit liking

There was a main effect of condition [$F(1, 29) = 32.4$, $p < 0.001$, $\eta^2 = 0.53$] and fat [$F(1, 29) = 5.93$, $p < 0.02$, $\eta^2 = 0.17$] with explicit liking being higher in the fasted compared to the fed condition, and explicit liking being greater for low fat compared to high fat foods. There were interactions between condition and taste [$F(1, 29) = 21.0$, $p < 0.001$, $\eta^2 = 0.42$] with a greater liking for sweet foods in the fed condition, and condition and fat [$F(1, 29) = 5.6$, $p < 0.05$, $\eta^2 = 0.16$] with greater liking for low fat foods in the fasted condition. Finally, there was a three way interaction between condition, taste and fat [$F(1, 29) = 21.0$, $p < 0.001$, $\eta^2 = 0.42$]. When participants were fasted they had greater explicit liking for HFNS, LFNS and LFSW, which significantly decreased in the fed state, whereas there was a smaller decline in explicit liking for HFSW from the fasted to the fed state.

Explicit wanting

There was a main effect of condition [$F(1, 29) = 28.3$, $p < 0.001$, $\eta^2 = 0.49$] and fat [$F(1, 29) = 7.60$, $p < 0.01$, $\eta^2 = 0.21$] with explicit wanting being higher in the fasted compared to the fed condition, and explicit wanting being greater for low fat compared to high fat foods. There were interactions between condition and taste [$F(1, 29) = 28.3$, $p < 0.001$, $\eta^2 = 0.49$] with a greater wanting for sweet foods in the fed condition and for non-sweet foods in the fasted condition, and condition and fat [$F(1, 29) = 4.22$, $p < 0.05$, $\eta^2 = 0.13$] with greater wanting for low fat foods in the fasted condition. Finally, there was a three way interaction between condition, taste and fat [$F(1, 29) = 19.1$, $p < 0.001$, $\eta^2 = 0.40$]. When participants were fasted they had greater explicit wanting for HFNS, LFNS and LFSW, which significantly decreased in the fed state, whereas there was a smaller decline in explicit liking for HFSW from the fasted to the fed state.

Associations with TFEQ eating behaviour traits

Table 3 shows that implicit wanting for LFNS was positively associated with TFEQ Restraint in the fasted and fed condition. In addition, implicit wanting for LFNS was negatively associated with TFEQ Hunger in the fasted condition, and implicit wanting for HFNS was negatively associated with TFEQ Restraint in the fasted condition, and positively associated with TFEQ Disinhibition in the fed condition. Explicit

liking for LFNS was positively associated with TFEQ Restraint in the fasted and fed condition. In addition, explicit liking for HFNS was positively associated with TFEQ Disinhibition and TFEQ Hunger under both conditions. Explicit wanting for LFNS was positively associated with TFEQ Restraint in the fasted and fed condition. In addition, explicit wanting for HFNS was positively associated with TFEQ Disinhibition and TFEQ Hunger under both conditions.

DISCUSSION

The Leeds Food Preference Questionnaire (LFPQ) is a computerised procedure that assesses liking, wanting and relative preferences for food. The current study adapted the LFPQ to assess its feasibility and cross-cultural validity in an Arab sample under fasted and fed states. The current study demonstrated that implicit wanting for non-sweet foods decreased in the fed compared to the fasted state, whereas implicit wanting for sweet foods increased. Explicit liking and explicit wanting were also higher for non-sweet foods in the fasted condition, and decreased to a greater extent in the fed condition compared to sweet foods. Scores on all LFPQ-A outcomes for HFNS were positively associated with TFEQ Disinhibition. Furthermore, all outcome scores for LFNS were positively associated with TFEQ Restraint. Most dietary studies in the Arab World,²⁶ including in Saudi Arabia,²⁷ have used food diaries, food frequency questionnaires, and 24-hr recall methods. These methods are not specifically designed to examine food preferences (i.e. the manipulation of preferring specific food taste). With the increasing prevalence of obesity in the Arab World especially in the Gulf Cooperation Council Countries, it is important to have a reliable method that examines liking, wanting and food preferences that can better improve our understanding of the aetiology of obesity. The current adapted LFPQ-A should be considered in the effort of improving Arabic dietary guidelines such as Food Dome.²⁸

Consistent with previous research, the current study found that participants' ratings of explicit liking and explicit wanting for all LFPQ-A food categories were greater in the fasted compared to the fed state. In the fed state, we found that there was a marked decrease for non-sweet compared to sweet foods, a finding that is in accordance with previous research that has used the LFPQ in Western societies.^{16,29} For example, Cameron, Goldfield, Finlayson, Blundell, Doucet,²⁹ demonstrated that participants explicit liking for

sweet foods was maintained across a test meal. In the current study, the maintained explicit liking for sweet foods in the fed condition may be attributable to the concept of sensory-specific satiation due to the savoury nature of the test meal participants consumed.³⁰ When we examined the outcome of the implicit wanting trials, it was found that participants had a greater implicit wanting for sweet compared to non-sweet foods in the fed condition, a finding which was also in accordance with previous research.¹⁶ In contrast to some previous studies, there was a preference for low fat food stimuli in fasting condition. Higher scores for low fat foods when hungry could be attributed to the frequent exposure of intermittent fasting. Muslims fast a month of Ramadan every year, and some Muslims optionally fast for more days for religious obligations. Both fasting Ramadan,³¹ and intermittent fasting,³² increased hunger. However, intermittent fasting has a long standing effect on the nervous system,³³ which can increase brain availability of endogenous opioids and induce neuroendocrine activation and mild cellular stress response.³⁴ Thus, frequent exposure to intermittent fasting may have a chronic effect on food stimulation and food preferences, which requires further studies to prove this assumption.

When the associations between the LFPQ-A outcome measures and the trait variables on TFEQ were examined, it was demonstrated that higher Disinhibition scores were associated with greater ratings of explicit liking and explicit wanting, and increased implicit wanting for high-fat non-sweet foods. This finding is consistent with previous reports that have shown those who score high on Disinhibition tend to exhibit a greater liking,³⁵ and a greater wanting for high fat foods.³⁶ Further to this, greater Restraint scores were associated with increased ratings of explicit liking and explicit wanting for low-fat non-sweet foods, and greater implicit wanting for this food type, whereas there was a negative association between Restraint score and implicit wanting for high-fat non-sweet foods. The current study did not find associations between any of the TFEQ variables and LFPQ-A measures for sweet foods. Previous research has shown that those who display eating behaviour traits associated with overconsumption (e.g. Disinhibition, Binge Eating Scale) exhibit a greater preference for, and liking and wanting of sweet foods.^{15,37,38} Although the current study was conducted in an Arab rather than a Western sample, both cultures demonstrate a high preference for sweet foods. A recent study found that British adolescents consumed a greater amount of doughnuts, energy drinks and sweets/chocolates compared to Saudi adolescents, who consumed a greater amount of sugar-sweetened beverages.³⁹ Another study reported that 45% of university-age students in Saudi Arabia consumed soft drinks daily.⁴⁰ The average age of current cohort is 36 years old, and this could explain the lower preference of sweet. Preferences for sweet meals and beverages reach maximal levels in the late childhood. For example, the rate of sugar-sweetened carbonated beverage consumption among male and female children and adolescents in Riyadh in Saudi Arabia varied from five to nine servings per week, and the consumption of sugar-sweetened carbonated beverage, added sugar in hot beverages and total sugar intake increased in older male and female children.⁴¹ In addition, the current study was conducted solely in males, whereas previous research has focussed predominantly on females.

Wansink, Cheney, Chan,⁴² found that comfort foods differed between males and females; males preferred warm, meal related comfort foods such as casseroles or steak whereas females preferred more snack related comfort foods such as chocolate and ice cream.

The current study had some limitations that should be considered. For example, most Arabic studies examined dietary habits such as fruit eating and breakfast skipping, but there is limited data on food preferences including sweet and fat preferences. This raised the difficulty to interpret some of current trends that were different from Western society. The current study examined the validity of using LFPQ-A, and can be used to demonstrate food preferences in Arabs. Future studies should examine food preferences among females, children and the elderly. Food timing is another limitation of current study; future studies also need to examine food preference in the context of breakfast and lunch. Lunch is the main meal for Arabs, and food preferences could differ between breakfast and lunch. Further studies are required to fully understand food preferences and eating behaviour in Arabs.

In conclusion, the findings from the LFPQ-A with regards to appetitive state are consistent with findings reported using the LFPQ in Western samples. Thus, the current LFPQ-A is a valid, sensitive procedure that can be used to examine Arabs' liking and wanting for food.

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AUTHOR DISCLOSURES

There is no conflict of interests.

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Original Article

Validation of the Leeds Food Preference Questionnaire in Arabs

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在阿拉伯人对利兹食物偏好调查问卷的验证

利兹食物偏好问卷 (LFPQ) 是一种计算机程序, 用来评估喜欢、想要和相对偏好食物的共同特征。本研究采用 LFPQ (LFPQ-A) 在禁食和摄食状态下通过测试 LFPQ 对阿拉伯样品的脂肪 (高或低) 和口味 (甜或不甜) 等食物的特征, 来评估它的跨文化有效性。通过检测 LFPQ-A 结果与三因子饮食问卷分量表 (TFEQ) 之间的关系来检测饮食行为的个体差异。30 名健康男性 (年龄: 36.3 ± 10.0 岁, 体质指数: $29.7 \pm 5.3 \text{ kg/m}^2$) 参与了这项研究。所有参与者禁食一夜后早上来到实验室, 分别在空腹和进食 (标准化测试餐后) 状态下用 LFPQ-A 进行测试。结果表明: 与空腹状态相比, 进食后对非甜食隐性的想要和相对偏好分数降低, 而甜食的分数增加。对非甜食明确的喜欢和想要在空腹情况下得分更高, 在进食状态下降低的程度更大, 而甜食降幅较小。高脂肪非甜食物 LFPQ-A 所有结果的得分与 TFEQ 抑制解除呈正相关, 而低脂肪非甜食物结果的得分与 TFEQ 约束呈正相关。该 LFPQ-A 显示的结果与在西方的样本中进行的研究一致, 因此目前的研究有助于确认 LFPQ-A 作为阿拉伯人一种对食物的喜欢、想要和偏爱的度量的有效性。

关键词: 食物偏好、喜欢和想要、脂肪偏好、阿拉伯人、肥胖