ARCHIVOS LATINO AMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 69 N °6 (2019) pp. 229-235

Modelo matemático de evaluación integral de la inocuidad de la nutrición alimentaria basada en AHP

Mathematical Model of Comprehensive Evaluation of Food Nutrition Safety based on AHP

Huaping Li
Chongqing City Management College, Chongqing401331, China

Resumen
Se ha prestado cada vez más atención a la nutrición y la seguridad alimentaria de la leche. El contenido de aminoácidos en la leche fue mayor que el de la leche normal. Entre ellos, el contenido de aminoácidos esenciales en la leche de yak es 0.15% más alto que el de la leucina de la leche. En este artículo, el autor analiza el modelo matemático de evaluación integral de la seguridad de la nutrición alimentaria basada en AHP. El proceso de jerarquía analítica (AHP) es un tipo de método de toma de decisiones que descompone varios elementos relacionados con la toma de decisiones en objetivos, criterios, esquemas y otros niveles, en los que se llevan a cabo análisis cualitativos y cuantitativos. Cómo combinar AHP con el diseño del plan de muestreo de supervisión e inspección de inocuidad alimentaria, cómo incluir todos los factores importantes en el marco teórico, cómo aplicar AHP a la formulación del plan de evaluación integral de inocuidad alimentaria después de la formación del sistema teórico de El diseño del plan de evaluación integral de la inocuidad de los alimentos en la forma de operabilidad, será el seguimiento que debe estudiarse más y centrarse en los problemas resueltos.

Palabras clave: AHP; Seguridad alimenticia; Proteína láctea; Aminoácidos; Modelo estadístico

Abstract
More and more attention has been paid to the nutrition and food safety of milk. The content of amino acid in milk was higher than that in normal milk. Among them, the content of essential amino acids in yak milk is 0.15% higher than that in milk leucine. In this paper, the author analyse the mathematical model of comprehensive evaluation of food nutrition safety based on AHP.Analytic hierarchy process (AHP) is a kind of decision-making method that decomposes various elements related to decision-making into objectives, criteria, schemes and other levels, on which qualitative and quantitative analysis are carried out. How to combine AHP with the design of sampling plan of food safety supervision and inspection, how to include all the important factors in the theoretical framework, how to apply AHP to the formulation of food safety comprehensive evaluation plan after the formation of the theoretical system of the design of food safety comprehensive evaluation plan in the way of operability, these will be the follow-up needs to be further studied and focused on problems solved.

Key words: AHP; Food safety; Milk protein; Amino acid; Statistical model

1. Introduction

Analytic hierarchy process (AHP) is a decision-making method which combines qualitative analysis and quantitative calculation, which was put forward by Professor Saaty in the mid-1970s[1]. The basic idea is to decompose each factor related to the problem into several levels on the basis of in-depth analysis of complex problems, compare the two factors at the lower level to get their respective weights, then rank the factors at the upper level to get the weights, and finally rank the overall level to determine the optimal sequence as the basis for decision-making[2-3]. Domestic and foreign literature reports show that AHP has been widely used in natural science, environmental protection, agricultural development, medicine and health, food safety and risk assessment and other fields. Food safety supervision and sampling system is an important measure to ensure food safety and prevent food borne diseases in China[4].

At present, the qualified rate of food safety inspection results released by the government is very high, and the public has certain distrust of food safety and government supervision results, one of the main reasons is the lack of scientific and representative sampling plan[5]. Analytic hierarchy process is widely used in the domestic food field, including food safety supervision and evaluation, food safety supervision and sampling data analysis, food safety risk management, food safety risk evaluation, food health supervision and inspection, food safety change trend analysis, food health quality evaluation, food logistics safety risk, food poisoning investigation, etc. Based on the qualitative analysis of the influencing factors of food safety, Wu Yongxiang et al. Established the analytic hierarchy process model of food safety sampling plan[6-7]. Liu Lijie et al. Collated and evaluated the data of food and beverage sampling in Heilongjiang Province, and established the comprehensive evaluation index system of food microbial safety in Heilongjiang Province by using AHP. In 2011, the office of the food safety committee of the State Council applied the analytic hierarchy process in the determination of the work plan for the assessment and evaluation of food safety supervision of local governments, and the assessment indicators were scored by the food safety supervisors and technical experts of different departments of local governments at all levels[8]. The analytic hierarchy process (AHP) is used to analyze the management strategies of food safety risk sources in China, and the sequence and importance of the main measures to deal with food safety risk sources are successfully obtained.

Wei Jianhua et al. Conducted risk assessment on furan residues in exported aquatic products, and used analytic hierarchy process to explore the main types of exported aquatic products with furan drug residues risk, so as to provide reference for relevant departments to formulate risk management measures for exported aquatic products, so as to adapt the regulatory cost-benefit[9-10]. Zhou Hongliang and others analyzed the data of food sampling by AHP, and obtained the situation and trend of food safety in Shenzhen. In addition, AHP is also used to control the process of adding food additives to meat products, give an early warning of the abnormalities in the process of adding food additives, and then guide the whole production process; to comprehensively evaluate the impact factors of various links in the supply chain and processing technology on food quality and safety, and to evaluate the risk of food logistics safety. Wang Yining et al. Used the analytic hierarchy process to grasp the relative importance of the supervision of the production, logistics and sales links of the food supply chain, and sorted the supervision strength of each link, so as to provide guidance for the supervision. Zhang Qin and others used the analytic hierarchy process to rank the impact of fresh food supply chain risk, in order to provide reference for avoiding the risk in the current fresh food supply chain in China. Xu Xiaoyan and others used AHP to analyze the causes of food safety problems, established a food safety model, obtained the main factors affecting food safety, and provided a scientific basis for food safety management. In this paper, the methodology principle of AHP is introduced into the work plan of food safety comprehensive evaluation, and all kinds of qualitative and semi quantitative factors affecting food safety are transformed into quantitative indexes to form a systematic design theory of food safety comprehensive evaluation plan, so as to make the work plan more scientific and effective, and improve the authority and credibility of sampling results To provide reference for daily supervision.

2.Construction of application model of AHP

Analytic hierarchy process (AHP) is a decision analysis method for complex problems with multi criteria, multi-objective and unstructured features. The basic principle is: first of all, the complex problem is decomposed into various components called elements, and these elements are divided into several groups according to different attributes to form different levels[11-13]. Secondly, the importance of two elements is compared according to certain criteria, and a certain score is given to the importance degree by using the scale of 1-9, then the comparison judgment matrix of two elements is obtained, and the eigenvector is calculated by the square root method. Finally, the feature vector is obtained, the maximum feature value is calculated, and the weight scores of each item are determined after one-time inspection.

2.1 Establish hierarchical structure model

First of all, the complex problem is decomposed into various components called elements, and these elements are divided into several groups according to different attributes to form different levels[14].

2.2 Construct comparison judgment matrix

According to certain criteria, compare the two elements AI and AJ, which is more important, and give a certain value to the importance. Here, the scale of 1-9 is used, and their significance is shown in Table 1. For n elements, a comparison judgment matrix A is obtained[15-16]. The experts involved in the evaluation should be provincial experts familiar with the field of food safety supervision and sampling, and it is suggested that 7 or 9 experts should be included.

$$A = (a_{ij}) n \times n$$

$$a_{ij} = A_i / A_j$$

The judgment matrix should have the following properties: ① AIJ > 0; ② AIJ = 1 / Aji; ③ aii = 1

2.3 Calculating characteristic roots and eigenvectors

Because of the particularity of judgment matrix, the square root method is used to calculate the eigenvector. First of all, calculate the product of the elements in each row of the matrix to get:

$$M_i = \prod_{j=1}^{n} a_{ij}$$

Then, calculate the n-th root Bi of MI and get a new vector B:

$$B_i = \sqrt[n]{M_i}$$

$$B = (B_1, B_2, ..., B_n)^T$$

A kind ofBi

$$g_i = B_i / \sum_{k-1}^{n} B_k$$

The final eigenvector is

$$G = (g_1, g_2, ..., g_n)^T$$

Calculate the maximum eigenvalue $\lambda_{\max}$

Table 1 scale of judgment matrix

Scale aij	The i-factor is just as important as the j-factor
1	The i factor is slightly more important than the j factor
3	The i factor is more important than the j factor
5	The i factor is more important than the j factor
7	The i factor is absolutely more important than the j factor
9	The scale value corresponding to the intermediate state between the above two judgments
2,4,6,8	If the j factor is compared with the i factor, the judgment value is aji = 1 / aij, aii = 1
reciprocal	The i-factor is just as important as the j-factor

First, the product of discriminant matrix A and eigenvector G is calculated

$$A \times G = \begin{bmatrix} 1 & a_{12} & ... & a_{1n} \\ a_{21} & 1 & ... & a_{2n} \\ ... & ... & ... & ... \\ a_{n1} & a_{n2} & ... & 1 \end{bmatrix} \times \begin{bmatrix} g_1 \\ g_2 \\ ... \\ g_n \end{bmatrix} = \begin{bmatrix} \omega_1 \\ \omega_2 \\ ... \\ \omega_n \end{bmatrix}$$

Then calculate the maximum eigenvalue $\lambda_{\max}$.

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(AG)_i}{nW_i}$$

2.4 conduct consistency inspection

The index of consistency test is the consistency ratio C.R, which is defined as:

$$C \cdot R = (C \cdot I)/(R \cdot I)$$

Where, C.I is the consistency index.

$$C \cdot I = (\lambda_{\max} - n)/(n-1)$$

R.I is the average random consistency index, which is related to the matrix order and calculated according to the values listed in Table 2.

The test standard is that when C.R < 0.1, the judgment matrix can be considered acceptable.

Table 2 R.I value query table

Order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R.I	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46	1.49	1.52	1.54	1.56	1.58	1.59

3. Comprehensive assessment of food safety

The design of food safety comprehensive evaluation program should first determine seven aspects: sample size, monitoring area, food varieties, inspection items, monitoring links, monitoring time and sample size distribution. The above contents are affected by various qualitative, semi quantitative and quantitative factors in the determination process, such as the determination of sample size needs to consider the previous food pollution status, the size of the monitoring area, the number of population covered by the monitoring area, the allowable statistical error value, etc.; the determination of the monitoring area needs to consider the coverage of the city, county, District, street and township, so as to focus on food production Gathering area, centralized trading market of food and edible agricultural products, areas with frequent food problems, large-scale collective catering places, and coverage of key areas such as rural areas, urban and rural areas, primary and secondary school campuses and surrounding areas; the determination of food varieties requires comprehensive consideration of factors such as food consumption data and food risk level; inspection[17].

The determination of inspection items needs to consider food standards, previous monitoring results, hazard risk degree of the project, etc.; the monitoring links need to consider various links such as production, circulation, catering services, etc.; the monitoring time needs to consider different time of decentralized sampling, seasonality of special food, time attribute of risk items, etc.; the distribution of sample quantity needs to consider all the above factors comprehensively. Among all the influencing factors, qualitative and semi quantitative factors are the main ones, and the traditional method is to judge people based on the work experience of the plan drafter[18-19]. Therefore, the knowledge, skills and experience of the drafter play an important role in the quality of the final plan. The basic principle of AHP is to transform the above qualitative and semi quantitative factors into quantitative indicators, and determine the contents of the plan by a set of fixed theoretical system[20].

3.1 application of sample size distribution among different factors

3.1.1 construction of comparison matrix

First of all, there are six main factors that affect the sample size distribution of the supervision and sampling work plan, and the scoring system for the importance degree of each factor is given by experts, as shown in Table 3.

Definition: factor 1: sampling results of food safety supervision (recent 3 years)
Factor 2: food consumption data
Factor 3: food safety risk monitoring results (food and Drug Department)
Factor 4: other departments / systems can refer to the results of sampling inspection
Factor 5: food safety risk monitoring results (health sector)
Factor 6: impact of food safety hot events and degree of concern

3.1.2 calculating characteristic roots and eigenvectors

M value, b value and g value are calculated according to the formula of square root method of application model. The maximum eigenvalue is 6.2592.

3.1.3 one time inspection

$$C \cdot I = \frac{\lambda_{\max} - n}{n-1} = \frac{6.2592 - 6}{6-1} = 0.0518$$

Table 3 judgment matrix

A-a	A1	A2	A3	A4	A5	A6
A1	1	2	4	3	1	7
A2	1/2	1	3	2	1/2	6
A3	1/4	1/3	1	2	1/4	5
A4	1/3	1/2	1/2	1	1/3	5
A5	1	2	4	3	1	7
A6	1/7	1/6	1/5	1/5	1/7	1

Looking up table 2, we get the 6-order matrix average randomness R.I = 1.26.

$$C \cdot R = \frac{C \cdot I}{R \cdot I} = \frac{0.0518}{1.26} = 0.0411$$

$C \cdot R = 0.0411 < 0.10$ Therefore, the inspection is qualified and the assignment is reasonable.

3.1.4 determine the scores of each item

Sorting weight vector ω B = 0.2992,0.1835,0.0981,0.0917,0.2992, 0.0283}

3.1.5 sample size distribution

Based on the ranking weight vector, the total sample size of monitored food is n, the minimum sample size is N1, and the remaining amount to be allocated is N2. According to the supervision sampling results, the allocated sample size accounts for 29.92% of the remaining sample size, i.e. N2 * 29.92%, according to the food consumption data, the allocated sample size accounts for 18.35% of the remaining sample size, i.e. N2 * 18.35%, according to the food safety risk monitoring results of the food and drug department 9.81% of the remaining samples are allocated, i.e. N 2 * 9.81%; 9.17% of the remaining samples are allocated according to the sampling results available to other departments / systems, i.e. N 2 * 9.17%; 29.92% of the remaining samples are allocated according to the food safety risk monitoring results of the health department, i.e. N 2 * 29.92%; samples are allocated according to the impact of food safety hot events and the degree of concern The quantity accounts for 2.83% of the remaining samples, that is, N2 * 2.83%.

3.2 distribution and application of sample size in different sampling links

First of all, there are four types of sampling links, and the scoring system for the importance degree of each factor is given by experts. See Table 4 for details.

Definition: factor 1: Supermarket

Factor 2: retail stores

Factor 3: other places

Factor 4: meat and vegetable market

Table 4 judgment matrix

A-a	A1	A2	A3	A4
A1	1	5	7	9
A2	1/5	1	3	7
A3	1/7	1/3	1	5
A4	1/9	1/7	1/5	1

Sorting weight vector ω B = 0.6403,0.2176,0.1061,0.0360}

Based on the ranking weight vector, the total sample size of monitored food is n, the sample size of supervised sampling supermarket is n * 64.03%, the sample size of retail store is n * 21.76%, the sample size of other places is n * 10.61%, and the sample size of meat and vegetable market is n * 3.60%.

4. Application of analytic hierarchy process in food industry

4.1 Applications in risk assessment of food supply chain

Gao Feng et al. Used the fuzzy analytic hierarchy process to analyze and evaluate the food supply chain of an enterprise, established the hierarchical structure; constructed the two comparison judgment matrix; calculated the relative importance of elements under a single criterion; made a judgment on the consistency test of the matrix; calculated the combination weight of elements at all levels; evaluated the consistency of the calculation results of the overall arrangement of levels. Finally, it is found that among the factors that affect the product supply chain, the supplier factor has the largest impact and the seller factor has the smallest impact

There are many risk factors in food supply chain and index system. They set up a complete food supply chain through the comprehensive evaluation of each index by fuzzy analytic hierarchy process.

4.2 Application in the evaluation of core corporate social responsibility in food supply chain

Based on the analysis of the connotation of corporate social responsibility, Li nianqin et al. Set up corresponding evaluation indexes from the perspective of the whole food supply chain, put the supply chain responsibility into the management system of food core corporate social responsibility, and used AHP method to carry out the main research on this issue, mainly through interviews, e-mail and other ways to invite relevant experts and scholars to each evaluation index After scoring and comparing the importance of the subject matter, and then taking its arithmetic mean, nine judgment matrices are obtained. The analytic hierarchy process (AHP) is used to give different weights to guide the food core enterprises to distinguish the primary and secondary, to fulfill social responsibility, to improve the social responsibility of food supply chain, and to realize the sustainable development of enterprises.

4.3 Application in the selection and evaluation of food suppliers

When evaluating and selecting strategic cooperative suppliers that have an important impact on food retailers, Li and others established the hierarchical structure model of food suppliers and the mathematical evaluation model of agricultural product suppliers. Through the AHP method to evaluate the agricultural products suppliers, the paper constructs the basic selection model of agricultural products suppliers, and finally through empirical research. The results show that the quality, transaction speed, service attitude and cost of agricultural products are the key criteria for choosing food suppliers. It can also help retailers better choose suppliers of agricultural products.

4.4 Application in the research of food safety risk source management countermeasures in China

According to the AHP model and the principle of independence, Gong Yuxia chose natural risk, technical risk, management risk, circulation risk, production risk and publicity risk as the elements of the criteria layer, eight items of strengthening food safety legislation as the scheme layer, and constructed the AHP hierarchical structure of food safety risk sources according to the actual research data and expert suggestions Compare the judgment matrix with pairwise. It is believed that the application of AHP to rank the sources of food safety risks and the measures to solve them can effectively solve the food safety problems.

4.5 Applications in analysis of influencing factors of food safety

Liu Jing provides an improved method of AHP based on the background of food safety, and carries on the AHP from two directions.Firstly, the traditional analytic hierarchy process is constructed to obtain a set of weights; secondly, the underlying factors of food type are exchanged with the intermediate factors, and another set of weights is obtained through the analytic hierarchy process; finally, the weights obtained from two different directions are analyzed and calculated to get better results. The results show that the main influencing factors of food safety are geographical environment, biological factors, internal factors of food (i.e. the toxic content of food itself) and chemical factors. This improved method can greatly reduce the impact of subjective factors of decision-makers and greatly improve the accuracy of decision-making.

4.6 Application in comprehensive evaluation of total packaging cost

Gong Guifen et al. Based on the comprehensive investigation of the influencing factors of the total packaging cost, selected three indexes of the cost of packaging materials, the cost of packaging use and the cost of packaging circulation to determine the relevant indexes and the weights of all levels of indexes of the comprehensive evaluation of the total packaging cost, and applied the analytic hierarchy process to the comprehensive evaluation of the total cost of the cabinet packaging scheme, providing a new evaluation method. The results show that the ranking results of AHP model are identical with those of AHM model.

4.7 Application in the study of packaging scheme evaluation model

Gong Guifen and others used the combination of expert score and AHP to determine the weight of each evaluation index. First, the evaluation form will be distributed to packaging engineering experts to score the importance of evaluation indicators at all levels and the performance of each scheme in the evaluation factors, and then average the scoring results as the basis for subsequent evaluation. According to the scoring results, according to

AHP method is used to compare the importance of the same level evaluation standard in order to determine the evaluation of the same level packaging scheme. The model based on AHP is used to compare and evaluate several different packaging schemes. In the process of evaluation, the qualitative problem is quantified by mathematical method, which makes the evaluation result more intuitive. The evaluation model makes the evaluation process of complex packaging scheme more hierarchical, digital and easier to grasp the weight of evaluation index.

5. Conclusion

The advantage of designing food safety comprehensive evaluation scheme based on AHP is that the monitoring content is not determined by the subjective experience of the drafter, but by a set of mature scheme design theory system, which covers various factors affecting the work efficiency of food safety comprehensive evaluation, and has strong scientific and reasonable. At present, the government invests a huge amount of money in food safety supervision and evaluation every year, and the scientific and reasonable development of the annual sampling program can undoubtedly greatly improve the effectiveness of this work. How to combine AHP with the design of food safety supervision and sampling plan, how to include all the important factors in the theoretical system framework, and how to apply AHP to the formulation of government food safety comprehensive evaluation plan after the formation of the theoretical system of the design of food safety comprehensive evaluation plan. These will be further studied and Problems to be solved.

References

[1] Dominguez CS, Cabrera DLA, Rodriguez PM, Borges AC, Carrillo FL, Almeida GD et al (2010). Association between glycemic index, glycemic load, and fructose with insulin resistance: the CDC of the Canary Islands study. Eur J Nutr 49(8):505–512.
[2] Sartorelli DS, Franco LJ, Damiao R, Gimeno S, Cardoso MA, Ferreira SR (2009). Dietary glycemic load, glycemic index, and refined grains intake are associated with reduced beta-cell function in prediabetic Japanese migrants. Arq Bras Endocrinol Metabol 53(4):429–434.
[3] Brand-Miller J, Dickinson S, Barclay A, Celermajer D (2007). The glycemic index and cardiovascular disease risk. Curr Atheroscler Rep 9(6):479–485
[4] Griffith JA, Ma Y, Chasan-Taber L, Olendzki BC, Chiriboga DE, Stanek ER et al (2008). Association between dietary glycemic index, glycemic load, and high-sensitivity C-reactive protein. Nutrition 24(5):401–406.
[5] Liu S, Manson JE, Buring JE, Stampfer MJ, Willett WC, Ridker PM (2002). Relation between a diet with a high glycemic load and plasma concentrations of high-sensitivity C-reactive protein in middle-aged women. Am J Clin Nutr 75(3):492–498.
[6] Villegas R, Liu S, Gao YT, Yang G, Li H, Zheng W et al (2007). Prospective study of dietary carbohydrates, glycemic index, glycemic load, and incidence of type 2 diabetes mellitus in middle-aged Chinese women. Arch Intern Med 167(21):2310–2316.
[7] Mosdol A, Witte DR, Frost G, Marmot MG, Brunner EJ (2007). Dietary glycemic index and glycemic load are associated with high-density-lipoprotein cholesterol at baseline but not with increased risk of diabetes in the Whitehall II study. Am J Clin Nutr 86(4):988–994.
[8] Davis JN, Alexander KE, Ventura EE, Kelly LA, Lane CJ, Byrd-Williams CE et al (2007). Associations of dietary sugar and glycemic index with adiposity and insulin dynamics in overweight Latino youth. Am J Clin Nutr 86(5):1331–1338.
[9] Esposito K, Maiorino MI, Di Palo C, Giugliano D (2010). Dietary glycemic index and glycemic load are associated with metabolic control in type 2 diabetes: the CAPRI experience. Metab Syndr Relat Disord 8(3):255–261.
[10] Du H, van der DL A, van Bakel MM, van der Kallen CJ, Blaak EE, van Greevenbroek MM et al (2008). Glycemic index and glycemic load in relation to food and nutrient intake and metabolic risk factors in a Dutch population. Am J Clin Nutr 87(3):655–661.
[11] Cornier M, Dabelea D, Hernandez TL, Lindstrom RC, Steig AJ, Stob NR et al (2008). The metabolic syndrome. Endocr Rev 29(7):777–822.
[12] Mittendorfer B (2005). Insulin resistance: sex matters. Curr Opin Clin Nutr Metab Care 8(4):367–372.
[13] Chiasson JL, Josse RG, Gomis R, Hanefeld M, Karasik A, Laakso M (2003). Acarbose treatment and the risk of cardiovascular disease and hypertension in patients with impaired glucose tolerance: the STOP-NIDDM trial. JAMA 290(4):486–494.
[14] Ceriello A (2000). The post-prandial state and cardiovascular disease: relevance to diabetes mellitus. Diabetes Metab Res Rev 16(2):125–132.
[15] Brand-Miller JC (2003). Glycemic load and chronic disease. Nutr Rev 61(5 Pt 2):S49–S55.
[16] Barclay AW, Petocz P, McMillan-Price J, Flood VM, Prvan T, Mitchell P et al (2008). Glycemic index, glycemic load, and chronic disease risk—a meta-analysis of observational studies. Am J Clin Nutr 87(3):627–637.
[17] Cornejo-Monthedoro A, Negreiros-Sanchez I, Del AC, Ysla-Marquillo M, Mayta-Tristan P (2017). Association between dietary glycemic load and metabolic syndrome in obese children and adolescents. Arch Argent Pediatr 115(4):323–330.
[18] Juanola-Falgarona M, Salas-Salvado J, Buil-Cosiales P, Corella D, Estruch R, Ros E et al (2015). Dietary glycemic index and glycemic load are positively associated with risk of developing metabolic syndrome in middle-aged and elderly adults. J Am Geriatr Soc 63(10):1991–2000.
[19] Silva FM, Steemburgo T, de Mello VD, Tonding SF, Gross JL, Azevedo MJ (2011). High dietary glycemic index and low fiber content are associated with metabolic syndrome in patients with type 2 diabetes. J Am Coll Nutr 30(2):141–148.
[20] Venn BJ, Green TJ (2007). Glycemic index and glycemic load: measurement issues and their effect on diet-disease relationships. Eur J Clin Nutr 61(Suppl 1):S122–S131.