Red meat and processed red meat consumption behaviour of healthcare professionals: do they participate in the World Health Organization's view of red meat carcasses and red meat carcinogens?

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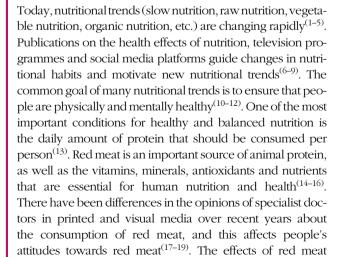
Abstract

Objective: This study investigated the consumption behaviours of healthcare professionals in relation to red meat and processed red meat products.
Design: This study included a questionnaire conducted through face-to-face interviews with 149 health professionals. The purpose of the questionnaire was to determine the extent to which health professionals agreed with the WHO classification of red meat and processed red meat on their list of carcinogenic products.
Setting: This research was carried out in İzmir, which is Turkey's third largest city. The survey was conducted in 2016 by holding face to face interviews with forty-three specialist doctors, sixteen doctors, twelve dentists, sixty-four nurses and fourteen pharmacists.
Subjects: Nationally representative sample of healthcare professionals in Turkey.
Results: People educated in healthcare are especially cautious about the consumption of processed red meat products. The results of the research revealed the importance of processing and cooking patterns in red meat consumption preferences.
Conclusions: The consequences of the research, in terms of breaking down prejudices and overcoming the anxieties of those with health concerns who do not consume red meat, are important. In fact, the results show that healthcare professionals consume red meat, but they are more careful in their consumption of processed red meat products. This result is in line with the WHO report.

Today, nutritional trends (slow nutrition, raw nutrition, vegetable nutrition, organic nutrition, etc.) are changing rapidly[1–5]. Publications on the health effects of nutrition, television programmes and social media platforms guide changes in nutritional habits and motivate new nutritional trends[6–9]. The common goal of many nutritional trends is to ensure that people are physically and mentally healthy[10–12]. One of the most important conditions for healthy and balanced nutrition is the daily amount of protein that should be consumed per person[13]. Red meat is an important source of animal protein, as well as the vitamins, minerals, antioxidants and nutrients that are essential for human nutrition and health[14–16]. There have been differences in the opinions of specialist doctors in printed and visual media over recent years about the consumption of red meat, and this affects people's attitudes towards red meat[17–19]. The effects of red meat

and processed red meat products on human health have become a globally controversial issue. These discussions have been motivated by WHO's report, 'Questions and Answers on the Carcinogenicity of Red Meat and Red Meat Consumption', published in October 2015[20].

The purpose of this study is to determine the red meat consumption behaviours of healthcare professionals who are conscious about the complications that may arise in the case of a lack of red meat, or an excess of red meat. Healthcare professionals have an important and reliable role for public health in terms of nutrition because of their professional knowledge. As a matter of fact, there are many studies on nutrition that have been conducted in different countries and reveal the attitudes, knowledge levels and confidence of healthcare professionals in giving advice to patients regarding nutrition[21–26]. The common results

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of the studies are that healthcare professionals have general knowledge about nutrition and they pay attention to their own nutrition.

This study investigates cattle and sheep meat, which make up a large proportion of red meat consumption[27–30] in Turkey. The research was carried out in the province of İzmir where most healthcare personnel are located[31]. İzmir is situated in the west of Turkey, and it is the third biggest city in the country in terms of population and economic indicators[32]. The interviews were held with specialist doctors, doctors, dentists, pharmacists and nurses[31,33] because they comprise 65·8 % of the total healthcare professionals working in İzmir,

The hypotheses of this research are as follows.

H₁: Health education affects the consumption of red meat and processed red meat products.

H₂: WHO's report on red meat and processed red meat products reflects the behaviour of healthcare professionals.

Method

The primary data of the study were collected with an appropriately prepared questionnaire. A five-point Likert scale was used to measure the attitudes and behaviours of healthcare professionals regarding red meat consumption. The Likert scale is a method that is used to allow the individual to express how much they agree or disagree with a particular statement[34,35]. A series of statements were read to the consumers from the questionnaire form and their opinions about these statements were measured through the following answers: 'strongly agree' / 'agree' / 'undecided' / 'disagree' / 'strongly disagree'. The reliability of the scale used in this study was tested with Cronbach's Alpha Reliability Coefficient. The Cronbach Alpha coefficient for the Likert scales used in this study was 0·821. The coefficient obtained shows that the survey questions have high reliability[36]. Sample size was calculated using the proportional sample size formula[37] shown below:

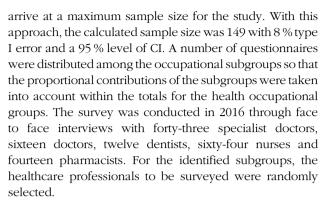$$ n = [N\, p\, (1-p)] \,/\, [(N-1)\, \sigma p_x^{\,2} + p\,(1-p)] $$

where n = the number of healthcare professionals surveyed (sample size),

N = the total number of healthcare professionals in İzmir (19 751),

$\sigma p_x^{\,2}$ = variance (σp_x = 1·96 for α = 0·05),

p = the proportion of healthcare professionals who consume red meat (50 %).

It was not possible to make a prediction about the consumption or non-consumption of red meat as there has been no similar work done to determine the red meat consumption behaviours of healthcare professionals. For this reason, the p value was taken to be 50 % in order to

arrive at a maximum sample size for the study. With this approach, the calculated sample size was 149 with 8 % type I error and a 95 % level of CI. A number of questionnaires were distributed among the occupational subgroups so that the proportional contributions of the subgroups were taken into account within the totals for the health occupational groups. The survey was conducted in 2016 through face to face interviews with forty-three specialist doctors, sixteen doctors, twelve dentists, sixty-four nurses and fourteen pharmacists. For the identified subgroups, the healthcare professionals to be surveyed were randomly selected.

Whether there were differences between groups in terms of the demographic characteristics and their consumption decisions was determined by using Chi-square analysis[38] for intermittent variables. In these analyses, the principle that the expected count of the cells should not be less than 1 and that cell numbers which have an expected count less than 5 should not be over 20·0 % of total cells was taken into consideration. The variables showing significant differences are given in the tables. Whether there is any difference between the sub-groups of healthcare in terms of consumption of red meat and processed red meat is tested by Chi-square analysis. For the significant results obtained by the Chi-Square analysis, Coefficient of Contingency (CC) was used to test the degree of dependence or relationship between the variables studied. CC is rated at 0–1, and the ratio of the relationship becomes stronger as it approaches 1[39].

Results

Read meat consumption

Only six of the surveyed people do not consume red meat. These six people who do not consume red meat are women and vegeterians. The distribution of red meat consumption by the occupational subgroups is given in Table 1. According to the table, three of those who do not consume red meat are specialist doctors, two are nurses and one is a dentist. In the decision not to consume red meat, it was determined that red meat having high cholesterol, hormones, residue, and a lack of taste were important factors, according to the five-point Likert scale average (3·83). Of the 143 people consuming red meat, 54 % consume red meat because they like the taste. Other reasons for consumption of red meat according to the five-point Likert scale average were consumption habits (3·88), the necessity for balanced nutrition (3·80) and the high protein content (3·77).

According to the results, red-meat eaters consume an average of 3·65 kg of red meat per month. This amount was published by the OECD for 2016; the per capita annual amounts of beef and veal (6·5 kg), and sheep meat (1·7 kg), are above the average consumption rate worldwide[40]. This amount of consumption is also more than the average for

Table 1 Red meat consumption by the occupational subgroups

		The occupational subgroups					
		Doctor	Specialist doctor	Dentist	Nurse	Pharmacist	Total
Do you consume red meat?	Yes	16	40	11	62	14	143
	No	0	3	1	2	0	6
Total		16	43	12	64	14	149

Table 2 Factors affecting red meat consumption by gender, age and occupation

	Factors affecting red meat consumption decision	Chi-square			
Variables		Value	Degree of freedom	P*	CC
Gender	Compliance with consumption habits	15·678	4	0·003	0·314
Age	Protein	22·117	12	0·036	0·366
	Habits	30·289	12	0·003	0·417
	A good value for money	64·169	12	0·000	0·557
Occupation	Taste	26·736	16	0·045	0·397
	Habits	39·362	16	0·001	0·465
	A good value for money	47·988	16	0·000	0·501
	Ease of preparation	38·451	16	0·001	0·460

CC: Coefficient of Contingency.
*$P < 0.05$ (significant).

Table 3 Consumer preferences for red meat selling points by gender, age and occupation

	Consumer preferences for red meat selling points	Chi-square			
Variables		Value	Degree of freedom	P*	CC
Gender	Delicatessen	10·015	4	0·040	0·256
Age	Butcher	25·751	12	0·012	0·391
Occupation	Supermarket	27·749	16	0·034	0·403
	Butcher	53·580	16	0·000	0·522
	I buy a live livestock and I slaughter	23·837	12	0·021	0·378

CC: Coefficient of Contingency.
*$P < 0.05$ (significant).

Turkey according to annual beef and veal (8·4 kg) and sheep meat (4·1 kg) consumption figures. This finding can be explained by the higher than average monthly income of healthcare professionals in Turkey.

Whether there is a difference between the consumption of red meat and some characteristics of the consumers is examined by Chi-square analysis. According to the results of the analysis, 'Compliance with consumption habits', 'Protein', 'A good value for money' 'Taste' and 'Ease of preparation' variables are not independent from gender, age and occupation (Table 2). According to the Coefficients of Contingency, it is seen that the factor 'A good value for money' for age and occupation has an effect on the red meat consumption decision. The same factor is very important for the decision regarding red meat consumption of consumers in the first age group (18–29 years).

When the factors affecting the consumption of red meat are examined in terms of the occupational subgroups, it is seen that the factor coded as 'A good value for money' on the red meat consumption decision of nurses is more significant than for the other occupational groups. It is thought that the lower monthly income of the nurses in the occupational groups is important for this result.

Of the red meat purchased by healthcare professionals, 73 % is veal. This is followed by lamb at 19 % and sheep meat at 7 %.

Red meat is sold at the retail stage in different forms. Most of the consumers who participated in the survey buy red meat as ground meat. This is followed by sliced meat and a tenderloin or chop. The least preferred type of red meat purchased by consumers is offal.

The most common place to buy red meat is the butchers. The reliability factor is very important for consumers when choosing where to buy red meat. They prefer to buy red meat from a butcher who they know and trust. According to the results of Chi-Square Analysis, there was a difference between the gender, age and occupation of the consumers in terms of the preferred red meat selling points (Table 3). Specialist doctors and nurses prefer to buy red meat from butchers more often than the other occupational subgroups. Similarly, the relationship between age and the choice of butchers was significant, and the dependency coefficient was found to be (0·391).

Compliance on the WHO report

WHO classified the consumption of red meat in the report that it published in October 2015 in Group 2A[20]. According to the International Agency for Research on Cancer (IARC), classification Group 2A includes probable carcinogenic agents in humans[41]. The IARC classification describes the strength of the scientific evidence about an agent being a cause of cancer rather than assessing the level of risk. In the case of red meat, the classification is based on limited evidence from epidemiological studies showing positive associations between eating red meat and

Table 4 The opinions of healthcare professionals on some expressions about red meat

	Scale average	Standard deviation
Red meat consumption is carcinogenic (*n* 143)	1·50	0·81
Frequent consumption of red meat negatively affects cardiovascular health (*n* 143)	2·08	1·20
Consumption of processed red meat is carcinogenic (*n* 143)	3·55	1·24

1: Strongly agree 2: agree 3: undecided 4: disagree 5: strongly disagree.

developing colorectal cancer, as well as strong mechanistic evidence. Limited evidence means that a positive association has been observed between exposure to the agent and cancer but that other explanations for the observations (technically termed chance, bias or confounding) cannot be ruled out[20].

In this survey, healthcare professionals who participated were asked whether they accepted the views expressed by the WHO. Table 4 shows the scale averages and standard deviations of the degrees of affirmation of these statements. According to the results, the response of healthcare professionals to the statement about 'red meat consumption is carcinogenic' results in a 1·50 scale average and the lowest score. The number of healthcare professionals who stated that they 'strongly disagree' with this was 66·4 %. None of the consumers stated that they 'strongly agree' with this statement. The responses of healthcare professionals to the statement about 'carcinogenic red meat consumption' show that healthcare professionals do not agree with the WHO classification. The second statement with the lowest level of agreement was 'frequent consumption of red meat negatively affects cardiovascular health' with a mean of 2·08. For this statement, 44·8 % stated that they 'strongly disagree', 21 % said that they 'disagree' and only 4·2 % 'strongly agree'. The highest scale average (3·55) corresponds to the statement 'consumption of processed red meat is carcinogenic'.

Of the 143 healthcare professionals who participated in the survey and consumed red meat, 52·8 % did not consume processed red meat products. In processed red meat consumption, unlike red meat consumption rates, consumption and non-consumption rates are close to each other. The results of the Chi-Square Analysis performed to determine whether there is a difference between the occupational subgroups and the consumption of the processed red meat products is shown in Table 5. According to the results of the analysis, the dependency coefficient for the relationship between the occupational subgroups and the consumption of the processed red meat products was 0·425.

When examined by gender, 64·3 % of the women did not consume processed red meat products, while in males this figure was 26·7 %. When examined by the

Table 5 Consumption of the processed red meat products by the occupational subgroups

	The processed red meat products		Chi-square			
	Consume	Not consume	Value	Degree of freedom	*P**	CC
Doctor	16	0				
Specialist Doctor	23	17				
Dentist	5	6	31·526	4	0·000	0·425
Nurse	16	46				
Pharmacist	8	6				

CC: Coefficient of Contingency.
*P < 0·05 (significant).

Table 6 Factors affecting the decision not to consume processed red meat products

Factors	Scale average	Standard deviation
Additive/chemicals (*n* 75)	4·69	0·84
Unhealthy (*n* 75)	4·61	1·04
Not tasty (*n* 75)	2·93	1·60
News in the media reducing confidence in these products (*n* 75)	2·40	1·52
High price (*n* 75)	2·11	1·46
Allergy (*n* 75)	1·20	0·64

1: Strongly agree 2: agree 3: undecided 4: disagree 5: strongly disagree.

sub-occupational groups, it was determined that 74·2 % of nurses consumed the fewest processed red meat products. This result can be explained by the fact that nurses are the group with the lowest monthly income level among the professional subgroups.

Seventy-five of the healthcare professionals interviewed in the survey do not consume processed meat products. Factors affecting their decision not to consume processed red meat products are shown in Table 6 by using the five-point Likert scale averages. Factors affecting healthcare professionals' decision not to eat processed red meat products are the additives/chemicals (4·69) and it being unhealthy (4·61).

Consumption of processed red meat is classified in Group 1 by WHO. Group 1 includes carcinogenic agents for humans[41]. Of the 143 healthcare professionals, 24·5 % said that they 'strongly agree' and 38·5 % of them 'agree' with the statement 'processed red meat consumption is a carcinogen'.

Again, this statement resulted in the highest level of agreement among healthcare professionals with a 3·55 scale average. It was seen that the opinions of the healthcare professionals participating in the survey regarding the processed red meat products and the consumption behaviour of these products are in line with the WHO classification that accepted processed red meat as a carcinogen.

Table 7 Factors affecting the decision not to consume processed red meat products by gender, age and occupation

| Variables | Factors | Chi-square | | | |
		Value	Degree of freedom	P*	CC
Gender	Not tasty	10·530	4	0·032	0·351
Age	Allergy	20·468	9	0·015	0·463
	Not tasty	27·645	12	0·006	0·519
	High price	46·498	9	0·000	0·619
Occupation	Not tasty	34·163	12	0·001	0·559
	High price	21·400	9	0·011	0·471

CC: Coefficient of Contingency.
*$P < 0.05$ (significant).

Table 8 Factors affecting the consumption decision for processed red meat products

Factors	Scale average	Standard deviation
Taste	3·88	0·98
Ease of preparation	3·28	1·37
Liked by children	3·07	1·67
Protein	2·81	1·30
Habits	2·69	1·25
Promotions	1·93	1·25

The factors that affect the decision of those who do not consume processed red meat products and the differences that are significant by gender, age and the occupational subgroups are shown in Table 7. According to the results of the analysis, 'not tasty' and 'high price' factors are the most important factors affecting the purchase decision in terms of age and occupation variables. When the results were evaluated in terms of the occupational subgroups, it was found that 'high price' had the most effect on the nurse group.

Factors affecting the consumption decision of sixty-eight (47·6 %) consumers who consumed processed red meat products are shown in Table 8 according to the scale average. The most important factors affecting the decision to consume processed red meat products are taste (3·88), ease of preparation (3·28) and liked by children (3·07).

The most commonly consumed processed red meat product is beef sausage with an average scale score of 2·84. This is followed by doner kebab (meat on spit) (2·13), veal sausage (1·73) and bacon (1·67). Of those who consume processed red meat products, 94·1 % pay attention to whether they are packaged when buying the products.

Discussion

The majority (96 %) of the healthcare professionals participating in the survey consume red meat. In the sample, there are six people who do not consume red meat. All those who do not consume meat are women. This result agrees with the results of previous studies on red meat consumption[42–44]. The fact that the factor coded as 'a good value for my Money' on the red meat consumption decision of nurses, with the lowest monthly income in the occupational subgroups, indicates that income level significantly affects the consumption of red meat. Another important finding is that reliability is very important in the choice of red meat buying point. Factors that affect the decision of those who do not consume processed red meat products are 'additive/chemical' and 'unhealthy'.

The consequences of this research, in terms of breaking down prejudices and overcoming the anxieties of those who do not consume red meat are important, because these people are concerned with their health. In fact, the research results showed that health-educated consumers consumed red meat, but they are more careful in their consumption of processed red meat products. This result is in line with the WHO report. The findings obtained reveal the importance of the consumption amount, and the processing and cooking methods[45] of red meat – as well as many other foods in terms of health.

Another consequence of this research is that children like these products and people's habits are key in their consumption decisions about processed red meat products. The importance of consuming red meat is extremely clear for health and especially for children's development. However, the consumption habits of young individuals in the family will affect their health throughout their entire lives[46–49]. All consumers should be informed about the importance of avoiding an unbalanced diet and instead aiming for healthy and balanced nutrition, and also be informed of the importance of the nourishing natural products in all food items, not just red meat. In addition, all consumers, irrespective of education level, should be given information about choosing fewer processed foods and about healthier options. This information should be given specifically to children and young people as they are developing, by educational programmes, families and in schools[50–53]. Adequate information provided through the internet and public spots[54,55] can be one of the easiest and cheapest ways to create healthy nutritional awareness in all sections of the community.

Conclusion

Nutritional habits are very important for public health. Healthcare professionals are the ones who evaluate the impact of nutrition on physical and mental health. They carry out their duties on the basis of their education and the continuity of the provision of health services in line with the knowledge and skills they have gained. The knowledge and skills of healthcare professionals, their approaches and recommendations within the framework

of preventive medicine activities are of vital importance for public health.

Protein intake for the healthy and balanced nutrition of children and young people is a prerequisite for creating healthy societies. It is well known that red meat is an important source of animal protein. However, many different information sources, especially the media, provide different information about the relationship between red meat consumption and health. This study shows that the consumption of red meat and processed red meat products by healthcare professionals – the most competent group in health and nutrition – is in line with the WHO report. This finding contains an important message and recommendation which should be passed on to the public regarding consumption of red meat and processed red meat products. The findings can be a guide for the public health policies and for raising awareness about healthy eating options. In addition, the findings of this study may be a control group for red meat consumption behaviour studies in the future and may allow comparisons.

Acknowledgements

References

1. Boland MJ, Rae AN, Verijken JM *et al.* (2013) The future supply of animal-derived protein for human consumption. *Trends Food Sci Technol* **29**, 62–73.
2. Garza GR (2014) Understanding the benefits of plant-based nutrition. *J Dent Hyg* **88**, 7–8.
3. Sabate J & Soret S (2014) Sustainability of plant-based diets: back to the future. *Am J Clin Nutr* **100**, 476–482.
4. Wang DD, Leung CW, Li Y *et al.* (2014) Trends in dietary quality among adults in the United States, 1999 through 2010. *JAMA Intern Med* **174**, 1587–1595.
5. Muharemovic K, Taboul N & Hakansson A (2016) Home cooking trends and dietary illness: nutritional compliance of recipes in a Swedish food magazine 1970-2010. *Scan J Public Health* **44**, 195–201.
6. Abbar S, Mejova Y & Weber I (2015) You tweet what you eat: studying food consumption through twitter. Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, Seoul, Republic of Korea, pp. 3197–3206.
7. Kinard BR (2016) Insta-grams: the effect of consumer weight on reactions to healthy food posts. *Cyberpsychol Behav* **19**, 481–486.
8. Singh MM, Parsekar SS & Bhumika TV (2016) Body image, eating disorders and role of media among Indian adolescents. *J Indian Assoc Child Adolesc Ment Health* **12**, 9–35.
9. Roudsari AH, Vedadhir A, Amiri P *et al.* (2017) Psycho-socio-cultural determinants of food choice: a qualitative study on adults in social and cultural context of Iran. *Iran J Psychiatry* **12**, 238–247.
10. Food and Agriculture Organization of the United Nations (2017) *The Future of Food and Agriculture: Trends and Challenges*. Rome: FAO.
11. World Health Organization (2017) *Global Monitoring Framework Operational Guidance for Tracking Progress in Meeting Targets for 2025*. Switzerland: WHO.
12. Pandit-Agrawal D, Khadilkar A, Chiplonkar S *et al.* (2018) Knowledge of nutrition and physical activity in apparently healthy Indian adults. *Public Health Nutr* **21**, 1743–1752.
13. Millward DJ (2013) The use of protein: energy ratios for defining protein requirements, allowances and dietary protein contents. *Public Health Nutr* **16**, 763–768.
14. Matina K, Stefanos T & Demosthenes P (2016) Red meat consumption and healthy ageing: a review. *Maturitas* **84**, 17–24.
15. Cashman KD & Hayes A (2017) Red meat's role in addressing 'nutrients of public health concern'. *Meat Sci* **132**, 196–203.
16. O'Connor LE & Campbell WW (2017) Red meat and health: getting to the heart of the matter. *Nutr Today* **52**, 167–173.
17. Apostolidis C & McLeay F (2016) Should we stop eating like this? Reducing meat consumption through substitutions. *Food Policy* **65**, 74–89.
18. McAfee A, McSorley E, Cuskelly GI *et al.* (2010) Red meat consumption on overview of the risks and benefits. *Meat Sci* **84**, 1–13.
19. Grunert KG (2006) Future trends and consumer lifestyles with regard to meat consumption. *Meat Sci* **74**, 149–160.
20. World Health Organization (2015) *Q&A on the Carcinogenicity of the Consumption of Red Meat and Processed Meat*. Switzerland: WHO.
21. Hankey CR, Eley S, Leslie WS, Hunter CM *et al.* (2003) Eating habits, beliefs, attitudes and knowledge among health professionals regarding the links between obesity, nutrition and health. *Public Health Nutr* **7**, 337–343.
22. Fogelman Y, Vinker S, Lachter J *et al.* (2002) Managing obesity: a survey of attitudes and practices among Israeli primary care physicians. *Int J Obes Relat Metab Disord* **26**, 1393–1397.
23. Dumic A, Miskulin M, Pavlovic N *et al.* (2018) The nutrition knowledge of Croatian general practitioners. *J Clin Med* **7**, 178.
24. Gupta S (2017) Dietary practices and nutritional profile of female nurses from government hospitals in Delhi, India. *Iran J Nurs Midwifery Res* **22**, 348–353.

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25. Nowson CA & O'Connell SL (2015) Nutrition knowledge, attitudes and confidence of Australian general practice registrars. *J Biomed Educ* Article No: 219198, 1–6.

26. Hoppe R & Ogden J (1997) Beliefs about obesity and current weight related interventions in practice nurses and GPs. *Int J Obes* **21**, 141–146.

27. Tunç B (2016) Red meat sector analysis. *Rural Dev* **6**, 44–49.

28. Karacan R (2017) The evaluation of demand for red meat in Turkey in terms of income distribution and consumption of white meat. *J Finance Policy Econ Comments* **54**, 67–73.

29. Tutkun M (2017) The red meat production in Turkey. *Sci Pap Ser D: Anim Sci* **60**, 278–283.

30. Uzmay A & Çınar G (2017) The likelihood of sheep meat consumption in Turkey. *Ital J Food Sci* **29**, 209–221.

31. General Directorate of Health Research (2016) *Health Statistics Yearbook*. 227. Turkey.

32. Population of provinces by years (2017) http://www. turkstat.gov.tr (accessed July 2017).

33. Eylemer S & Memisoglu D (2015) The borderland city of Turkey: Izmir from past to the present. *Eurolimes* **19**, 159–184.

34. Joshi A, Kale S, Chandel S *et al.* (2015) Likert scale: explored and explained. *Br J Appl Sci Technol* **4**, 396–403.

35. Niyaz ÖC & Demirbaş N (2018) Analysis of factors influencing the opinions of fresh fruits and vegetables consumers on food safety. *Anadolu J Agric Sci* **33**, 14–23.

36. Tavakol M & Dennick R (2011) Making sense of Cronbach's alpha. *Int J Med Educ* **2**, 53–55.

37. Newbold P (1995) *Statistics for Business and Economics*. USA: Prentice Hall International Editions.

38. Malhotra NK (1996) *Marketing Research: An Applied Orientation* 2nd ed. Upper Saddle River, New Jersey: Prentice-Hall.

39. Spiegel MR, Schiller JJ & Srinivasan RA (2013) *Probability and Statistic. Schaum's Outline Series*. USA: The McGraw-Hill Companies.

40. Organisation for Economic Co-operation and Development (2017) Meat consumption. OECD. https://data.oecd.org/agroutput/meat-consumption.htm (accessed July 2017).

41. International Agency for Research on Cancer (2017) IARC monographs on the evaluation of carcinogenic risks to humans. monographs.iarc.fr/EN/Classification (accessed July 2017).

42. Radman M, Camanzı L & Kolega A (2005) Preferences and buying behaviour of beef consumers in Tuscany. *J Cent Eur Agric* **6**, 99–106.

43. Uzundumlu AS, Işık HB & Kırlı MH (2011) Affecting factors' analysis of red meat and white meat consumption in Istanbul province Kucuk Cekmece district. *Alınteri J Agric Sci* **21**, 20–31.

44. Kızılaslan H & Nalinci S (2013) The meat consumption habits of households and the factors affecting their meat consumption in the province of Amasya. Master Thesis. Gaziosmanpasa University.

45. Reartes G, Di Paola Naranjo R, Eynard A *et al.* (2016) Cooking methods and formation of PhIP in the crust of the habitually consumed meat in Argentina. *Food Chem Toxicol* **92**, 88–93.

46. Kersting M, Alexy U, Schürmann S *et al.* (2016) Critical dietary habits in early childhood: principles and practice. In *Hidden Hunger: Malnutrition and the First 1000 Days of Life: Causes, Consequences and Solutions.* **115**, pp. 24–35 [Biesalski HK & Black RE, editors] *World Review of Nutrition and Dietetics*. Switzerland: Karger.

47. Maluccio J, Hoddinott J, Behrman JR *et al.* (2006) The impact of an experimental nutritional intervention in childhood on education among Guatemalan adults. IFPRI Food Consumption and Nutrition Discussion Paper 207, June.

48. Manios Y, Moschandreas J, Hatzis C *et al.* (2002) Health and nutrition education in primary schools of Crete: changes in chronic disease risk factors following a 6 – year intervention programme. *Br J Nutr* **88**, 315–324.

49. Branen L & Fletcher J (1999) Comparison of college students' current eating habits and recollections of their childhood food practices. *J Nutr Educ Behav* **86**, 304–310.

50. Hawkes C (2013) Promoting healthy diets through nutrition education and changes in the food environment: an international review of actions and their effectiveness. Background paper for the International Conference on Nutrition (ICN2), FAO.

51. Kaar JL, Shapiro ALB, Allison LB *et al.* (2016) Parental feeding practices, food neophobia and child food preferences: what combination of factors results in children eating a variety of foods. *Food Qual Prefer* **50**, 57–64.

52. Alderman H & Headey D D (2014) The nutritional returns to parental education. IFPRI Discussion paper 01379, October.

53. Ambrosini GL, Oddy WH, Robinson M *et al.* (2009) Adolescent dietary patterns are associated with lifestyle and family psycho-social factors. *Public Health Nutr* **12**, 1807–1815.

54. Bowen DJ, Wendy EB & Shirley AAB (2015) Identifying the effects of environmental and policy change interventions on healthy eating. *Annu Rev Public Health* **36**, 289–306.

55. Story M, Kaphingst KM, Robinson-O'Brien R *et al.* (2008) Creating healthy food and eating environments: policy and environmental approaches. *Annu Rev Public Health* **29**, 253–272.