THE ASSESSMENT OF THE LEVEL OF KNOWLEDGE ABOUT DIETARY FIBRE AMONG THE PORTUGUESE POPULATION

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Abstract

The aim of this work was to assess the degree of knowledge about dietary fibre (DF), as influenced by factors such as age, gender, level of education and living environment. For this, a descriptive cross-sectional study was undertaken by means of a questionnaire and the total number of respondents was 382. The results revealed that the participants had a not satisfying global level of knowledge (3.59 ± 0.64, on a scale from 1 to 5). The overall knowledge was found lower for young adults aged 19 to 30 years, when compared to adults aged over 31 and up to 65 years, being this difference statistically significant (p=0.030). However, no statistical significant differences were found between genders, levels of education or living environments. The low level of knowledge demonstrated by the enquired alerts for the need to plan some additional actions to further inform the Portuguese population about dietary fibre.

Key words: *dietary fibre, fibre rich foods, knowledge, sources of fibre, survey*

1. INTRODUCTION

The term "dietary fibre" (DF) corresponds to a heterogeneous group of chemically different plant components with a common characteristic of being indigestible (Hollmann et al., 2013). DF comprises a set of compounds that include carbohydrate polymers in addition to non-carbohydrate components (Yan et al., 2015), such as cellulose, hemicelluloses, pectins, gums, mucilages and lignin. The American Association of Cereal Chemists in 2001 (AACC, 2001), defined DF as "the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the large intestine. DF includes polysaccharides, oligosaccharides, lignin, and associated plant substances" (Hong et al., 2012). The definitions of dietary fibre adopted by Codex and European Union include resistant carbohydrates naturally present in plant materials and have the potential to embrace a variety of extracted and synthesised resistant carbohydrate substances (Englyst et al., 2013).

Fibre is an important component of the human diet, being ingested from diet cereals, fruits and legumes. The recommended ingestion of DF is 25–30 g/day (Hollmann et al., 2013). Because cell wall polysaccharides are the principal dietary fibre constituents, fruits and vegetables are important sources of DF. The fibre obtained from fruit sources usually has better functional quality than that obtained from cereals, due to a higher concentration of bioactive compounds, such as phenolic compounds (Beres et al., 2016). Whole grain based diets are also rich in DF so that a systematic consumption of whole grain foods instead of refined cereals is recommended (Hollmann et al., 2013). Legumes are as well a rich source of DF and provide a good source of energy from starch, besides proteins. The beneficial effects of legumes have been demonstrated to improve in fasting blood glucose concentration, being these hypoglycaemic effects of legumes attributed to their high concentration in DF (Aldwairji et al., 2014; Sievenpiper et al., 2009; Trinidad et al., 2010).

It is a recommendation of the Food and Agriculture Organization of the United Nations (FAO) that the energy provided by the fermentation of DF should be accounted when calculating the total energy value of foods, representing approximately 8 kJ/g. This value comes from the fact that about 70% of DF is fermented in the colon so that a portion of the energy resulting from this process is lost in the form of gas as well as in the faeces. However, most part of the short-chain fatty acids produced during the fermentation process is absorbed in the colon and metabolized by human tissues, and therefore

accounting for the accounted 70%. The European Union established back in 2008 that DF must be included in the calculation of food total energy value for nutritional labelling (Menezes et al., 2016).

DF is a valuable food component, with important physiological effects accounting for a number of potential health benefits, including: maintaining gut function (improvement of gastrointestinal motility through volume increase, nutrient digestion and absorption, interaction with gut microbiota); reducing cholesterol absorption, acting as a prebiotic and supporting the production of short-chain fatty acids. Also beneficial effects of DF have been demonstrated in regards to weight control, cholesterol and blood glycemic reductions, cardiovascular diseases or gastrointestinal types of cancer. However, the extension of these effects depends on the composition and physico-chemical properties of the DF (Fabek and Goff, 2015; Montoya et al., 2016; Moyano et al., 2016; Schroeder et al., 2013; Tabernero et al., 2011).

The consumption of meals rich in DF, particularly soluble viscous fibres has proven to induce long lasting perceptions of post-prandial fullness, an effect known as satiety (Yong et al., 2016). Hence, both fermentability and viscosity of DF interact in complex ways to influence the concentration of plasma hormones associated with satiety and adiposity. Schroeder et al. (2013) suggest that highly viscous, non-fermentable fibres may limit the weight gain and therefore reduce adiposity. Thjey also suggest that the non-fermentable fibres, independently of viscosity, may promote meal termination. Furthermore, DF may have potential in preventing obesity-related inflammation and associated diseases (Al-Lahham et al., 2012).

Countless prospective epidemiological studies have devoted to study the influence of dietary habits as well as environmental and lifestyle factors on the incidence of cancer and other chronic diseases. These have demonstrated an inverse association between and adequate daily DF consumption and colon cancer risk as well as with the incidence of cardiovascular diseases (Hollmann et al., 2013; Kim and Je, 2016). Soluble DF thickens when in contact with digestive secretions, thus increasing viscosity, being through this mechanism that they could have a protective role in diabetes, through glycemic control. However, further studies are still recomended (Fabek and Goff, 2015; Hopping et al., 2010)

The objective of this work was to evaluate the level of knowledge about DF on a sample population original from Portugal. Factors like age, gender, level of education or living environment were considered when assessing their effect on the knowledge about dietary fibre.

2. MATERIAL AND METHODS

2.1. Data collection

The data was obtained through a survey by means of a questionnaire, distributed through the internet and answered voluntarily with informed consent of the participants.

The first part of the questionnaire aimed at gathering the socio-demographic characteristics like age, gender, level of education and living environment. Another section of the questionnaire addressed aspects related to general knowledge about dietary fibre, for which the respondents were asked a set of questions to answer on a 5-point Likert agreement-scale ranging from 1 (totally disagree) to 5 (totally agree). The statements included were: “Only vegetable foods have fibre”, “Foods of animal origin such as meat, eggs and dairy products naturally do not contain fibres”, “The average adult should eat 25g of fibre per day”, “Whole foods (pasta, rice, bread, cereal ....) have less fibre than non-whole foods”, “The unpeeled fruits have less fibre than peeled ones” and “Dietary fibres are classified into soluble and insoluble”.

2.2. Statistical analysis

For the analysis of the data the software SPSS, from IBM Inc. (version 22) was used and several basic descriptive statistics tools were used. Also the crosstabs and the chi square test were used to assess the

relations between some of the variables under study. For all data analysis the level of significance considered was 5%.

2.3. Sample characterization

This study was undertaken during the years 2015 in Portugal. The total number of participants was 382, from which 62.0% were female and 38.0% were male. The average age of the participants was 37.8±10.6 years, ranging from 19 to 65 years, being the average age of the male participants (40.0±10.5 years) higher than that of the female (36.4±10.5 years). The enquired were all adults, given the age interval between 19 and 65 years, thus not including elderly people. Still, the variable age was classified into categories according to: • young adults, from 19 to 30 years, accounting for 26.7%; • average adults, from 31 to 50 years, representing 58.9%; • senior adults, from 51 to 65 years, corresponding to 14.4%.

The majority of the participants had a high level of education (82.0% with a university degree), while 18.0% had competed secondary school. Most of the participants lived in an urban environment (80.4%), while 19.6% lived in rural areas.

3. RESULTS AND DISCUSSION

DF comes from plant foods, and includes the cell wall polysaccharides (cellulose, hemicelluloses and pectins) together with other non-polysaccharide components originating from the secondary cell walls (lignin, cutin, waxes and suberin) (Chylińska et al., 2016). Therefore, the statement "Only vegetable foods have fibre" (Table 1) is true and so is the statement "Foods of animal origin … do not contain fibre" (Table 2). The results presented in Table 1 reveal that considering the whole sample, the mean attributed to the statement analysed was 3.02±1.37, corresponding to a very low level of agreement (score: 1= totally disagree to 5=totally agree). This shows that the majority of the participants in the survey are still not aware of the origin of DF.

Table 1. Results for the knowledge about the plant origin of DF.

Statement evaluated:

"Only vegetable foods have fibre"

(scale from 1 = totally disagree to 5 = totally agree)

Variable		**Mean ± St. Dev.**	χ^2	***p-value***	***Cramer´s V***
Age	Young adults (19 to 30)	2.66 ± 1.30	*12.052*	*0.149*	*0.126*
	Average adults (31 to 50)	3.19 ± 1.36			
	Senior adults (51-65)	3.04 ± 1.39			
Gender	Female	2.99 ± 1.40	*8.119*	*0.087*	*0.148*
	Male	3.08 ± 1.31			
Level of Education	Secondary school	2.67 ± 1.08	*24.704*	*0.002*	*0.181*
	University degree	3.10 ± 1.41			
Living Environment	Rural	2.86 ± 1.28	*3.329*	*0.504*	*0.094*
	Urban	3.06 ± 1.38			
	Total	**3.02 ± 1.37**			

Regarding the age groups (Table 1), no statistical significant differences were observed (p=0.149), although the means score obtained for the young adults was slightly lower (2.66±1.30). Also the variable gender did not significantly relate to the level of agreement with the statement about the plant origin of DF (p=0.087), being the mean scores very similar for women and men. Also for the living environment the differences were not statistically significant (p=0.504), although the mean score was a little lower for people living in rural areas (2.86±1.28). However, the level of education was found significantly related to the level of agreement with the statement (p=0.002), so that people with higher level of education (university degree) showed higher agreement (mean score = 3.10±1.41), thus indicating that higher instruction is associated with higher knowledge about the origin of DF.

In Table 2 are shown the results obtained for the statement about DF not being naturally present in foods from animal origin. The results obtained for the overall mean score were 3.27±1.27, being relatively similar to those described earlier for the plant origin of DF, since these two statements are strongly related to each other. Again, the agreement with the statement is low demonstrating that not much reliable information was present when answering this question.

For most grouping variables evaluated in Table 2 (age, gender or living environment) no statistically significant differences were encountered (p=0.075, p=0.337 and p=0.540, respectively), similarly to what was verified for the statement in Table 1. However, the level of education proved to have influence on the level of agreement with the statement (p=0.04), thus confirming what was observed for the previous statement, i.e., that higher education is associated with higher knowledge about DF (mean score = 3.37±1.27).

Table 2. Results for the knowledge about animal foods not containing DF.

Statement evaluated:

"Foods of animal origin such as meat, eggs and dairy products naturally do not contain fibres"

(scale from 1 = totally disagree to 5 = totally agree)

Variable		**Mean ± St. Dev.**	χ^2	***p-value***	***Cramer´s V***
Age	Young adults (19 to 30)	2.93 ± 1.24	*14.272*	*0.075*	*0.137*
	Average adults (31 to 50)	3.45 ± 1.24			
	Senior adults (51-65)	2.88 ± 1.34			
Gender	Female	3.20 ± 1.31	*4.545*	*0.337*	*0.110*
	Male	3.41 ± 1.20			
Level of Education	Secondary school	2.88 ± 1.19	*15.881*	*0.044*	*0.146*
	University degree	3.37 ± 1.27			
Living Environment	Rural	3.10 ± 1.23	*3.108*	*0.540*	*0.091*
	Urban	3.33 ± 1.28			
	Total	**3.27 ± 1.27**			

The recommended daily ingestion for an adult is at least 25 g DF/day, according to a joint commission of the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO). The American Dietetic Association (ADA) makes a similar recommendation, corresponding to ingestion between 20 and 35 g/day for adults. However these recommendations may differ from agency to agency, and they must be corrected for children, according depending on age (Marques, 2007). The results in Table 3 refer to the recommendations for ingestion of DF by adults,

and they show that the participants were just slightly informed about this fact (mean score of 3.37±0.79).

For this variable (Table 3), no statistical significant differences were encountered between age groups (p=0.101), nor between genders (p=0.430), not even between levels of education (p=0.442) and finally not between living environments (p=0.604). These results revealed that nor even the more educated people were more aware of the recommended DF ingestion, which alerts to the necessity in reinforcing the education of the population about what amounts of cereals, fruits or vegetables they should eat on the regular diet.

Table 3. Results for the knowledge about the recommended ingestion of DF.

Statement evaluated:

"The average adult should eat 25g of fibre per day"

(scale from 1 = totally disagree to 5 = totally agree)

Variable		**Mean ± St. Dev.**	χ^2	***p-value***	***Cramer´s V***
Age	Young adults (19 to 30)	3.34 ± 0.81	*13.316*	*0.101*	*0.133*
	Average adults (31 to 50)	3.35 ± 0.77			
	Senior adults (51-65)	3.53 ± 0.82			
Gender	Female	3.43 ± 0.78	*3.823*	*0.430*	*0.102*
	Male	3.29 ± 0.80			
Level of Education	Secondary school	3.27 ± 0.73	*7.912*	*0.442*	*0.103*
	University degree	3.40 ± 0.80			
Living Environment	Rural	3.38 ± 0.83	*2.729*	*0.604*	*0.086*
	Urban	3.37 ± 0.78			
	Total	**3.37 ± 0.79**			

Non-starch polysaccharides comprise an important fraction of DF being present in cereal endosperm cell walls, the aleurone layer, the bran and the husk (Comino et al., 2016). Because of this, whole foods like whole cereals are naturally richer in DF when compared to the refined grain products. The refined cereals natural composition has been significantly altered as a consequence of the mechanical removal of the bran and germ, therefore diminishing the nutritional value and the amount of DF (Delcour and Poutanen, 2013). In view of this fact, the statement "Whole food have less fibre than non-whole foods" is false, and therefore a higher degree of knowledge corresponds to the lowest score (disagreement). The global mean score was 1.96±1.11 (Table 4), being slightly under 2, thus indicating that the respondents in general disagreed with the false statement, revealing some knowledge about the fact.

For this case (Table 4), again only the level of education showed significant differences (p=0.004), with the higher level of education corresponding to a higher degree of knowledge (lower mean score: 1.89±1.11). The differences among age groups, genders or living environments were once more not statistically significant (p=0.456, p=0.255 and p=0.295, respectively).

Table 4. Results for the knowledge about DF content in whole foods.

Statement evaluated:

"Whole foods have less fibre than non-whole foods"

(scale from 1 = totally disagree to 5 = totally agree)

Variable		**Mean ± St. Dev.**	χ^2	***p-value***	***Cramer´s V***
Age	Young adults (19 to 30)	1.98 ± 1.02	*7.772*	*0.456*	*0.101*
	Average adults (31 to 50)	1.99 ± 1.16			
	Senior adults (51-65)	1.83 ± 1.14			
Gender	Female	1.89 ± 1.05	*5.334*	*0.255*	*0.120*
	Male	2.09 ± 1.21			
Level of Education	Secondary school	2.31 ± 1.12	*22.871*	*0.004*	*0.175*
	University degree	1.89 ± 1.11			
Living Environment	Rural	1.99 ± 1.01	*4.923*	*0.295*	*0.115*
	Urban	1.96 ± 1.15			
	Total	**1.96 ± 1.11**			

In fruits or some vegetables, the peels are particularly rich in DF as compared to the inner part, because the peel serves as a protective cover aimed at defending the fruit from external stresses (Ajila and Rao, 2013). Therefore, the whole fruits have more fibre when compared to those where the peel has been removed. In this way, the statement evaluated in Table 5 is false, and again the highest score indicates a lowest degree of knowledge. Globally the mean score obtained was 1.83±1.01, which corresponds to a disagreement with the false statement, and hence a positive level of knowledge.

Regarding the differences between the grouping variables, statistically significant differences were encountered between age groups (p=0.027), and again the young adults were those revealing the lowest knowledge (higher mean score: 2.04±1.08) (Table 5). The differences between genders, levels of education or living environment were not statistically significant (p=0.140, p=0.079 and p=0.200, respectively).

Table 5. Results for the knowledge about the DF content in fruit peels.

Statement evaluated:

"The unpeeled fruits have less fibre than peeled ones"

(scale from 1 = totally disagree to 5 = totally agree)

Variable		**Mean ± St. Dev.**	χ^2	***p-value***	***Cramer´s V***
Age	Young adults (19 to 30)	2.04 ± 1.08	*17.270*	*0.027*	*0.152*
	Average adults (31 to 50)	1.77 ± 0.96			
	Senior adults (51-65)	1.68 ± 1.05			
Gender	Female	1.76 ± 1.00	*6.925*	*0.140*	*0.137*
	Male	1.94 ± 1.03			
Level of	Secondary school	1.97 ± 0.88	*14.090*	*0.079*	*0.138*

Education	University degree	1.80 ± 1.04			
Living Environment	Rural	2.00 ± 1.07	*5.983*	*0.200*	*0.127*
	Urban	1.79 ± 1.00			
	Total	**1.83 ± 1.01**			

Depending on the solubility in water, DF can be classified into soluble or insoluble, having different physical properties and consequently different physiological effects (Sumczynski et al., 2015). While the insoluble part is linked to the water absorption and, consequently, intestinal regulation; the soluble fraction is associated with the reduction of serum cholesterol as well as the diminishing of glucose absorption by the small intestine. In this way, both types of DF impart different and complementary health benefits when ingested. The recommended ratios between insoluble and soluble DF range from 70:30 to 50:50, to provide the body with the desired effects (Ajila and Rao, 2013). The results in Table 6 demonstrate that the participants in the study are relatively informed about the soluble or insoluble classification of DF, considering that the mean score is higher than 3 (3.69±1.06) thus indicating agreement with the statement.

The results in Table 6 further reveal that women showed a statistically significant higher knowledge about this fact than men (mean scores of 3.78±1.11 and 3.54±0.96, respectively and p-value equal to 0.016). Also the differences between participants with different levels of education were statistically significant (p=0.021), so that for people with higher education was obtained a higher mean score (3.77±1.07). Regarding the age or lining environment, the differences observed were not statistically significant (p=0.593 and p=0.186, respectively).

To assess the global level of knowledge a new variable was created as the average value considering all the six statements, but after reversing the scores for the two statements that were false. Consequently, the new variable would be on the same scale from 1, corresponding to the lowest degree of knowledge, to 5, corresponding to the highest degree of knowledge. The obtained results (shown in Table 7) revealed that the global knowledge varied from a minimum value of 2.0 to a maximum of 5.0, with a mean score of 3.59±0.64.

Table 7 presents the results for this variable, considering the differences between age groups, genders, levels of education or living environments. The variable age was found related to the global level of knowledge, with statistically significant differences between the age groups considered (p=0.030). As expected, in view of previously observed results, the young adults demonstrated a lower global level of knowledge (mean score: 3.43±0.62) when compared to other age groups. In all other cases the differences were not statistically significant (p=0.469 for gender, p=0.089 for level of education and p=0.673 for living environment). Although the level of education showed differences in some of the statements evaluated, in relation to the global level of knowledge that was not verified, however, it could be pointed that if a level of significance of 10% would be considered then this variable would be significant.

Table 6. Results for the knowledge about the soluble or insoluble nature ofDF.

Statement evaluated:

"Dietary fibres are classified into soluble and insoluble"

(scale from 1 = totally disagree to 5 = totally agree)

Variable		**Mean ± St. Dev.**	χ^2	***p-value***	***Cramer´s V***
Age	Young adults (19 to 30)	3.76 ± 1.02	*6.487*	*0.593*	*0.093*
	Average adults (31 to 50)	3.69 ± 1.07			

	Senior adults (51-65)	3.52 ± 1.11			
Gender	Female	3.78 ± 1.11	*12.149*	*0.016*	*0.181*
	Male	3.54 ± 0.96			
Level of Education	Secondary school	3.34 ± 0.95	*18.075*	*0.021*	*0.156*
	University degree	3.77 ± 1.07			
Living Environment	Rural	3.82 ± 0.90	*6.185*	*0.186*	*0.129*
	Urban	3.65 ± 1.10			
	Total	**3.69 ± 1.06**			

Table 7. Measurement of the global level of knowledge about DF.

Global level of knowledge about DF
(scale from 1 = low level of knowledge to 5 = high level of knowledge)

Variable		**Mean ± St. Dev.**	χ^2	***p-value***	***Cramer´s V***
Age	Young adults (19 to 30)	3.43 ± 0.62	*48.629*	*0.030*	*0.256*
	Average adults (31 to 50)	3.66 ± 0.65			
	Senior adults (51-65)	3.65 ± 0.60			
Gender	Female	3.62 ± 0.68	*15.769*	*0.469*	*0.208*
	Male	3.55 ± 0.60			
Level of Education	Secondary school	3.31 ± 0.57	*43.201*	*0.089*	*0.243*
	University degree	3.66 ± 0.64			
Living Environment	Rural	3.53 ± 0.63	*12.999*	*0.673*	*0.189*
	Urban	3.61 ± 0.64			
	Total	**3.59 ± 0.64**			

4. CONCLUSIONS

The present work allowed drawing some conclusions about the knowledge regarding DF. The participants revealed on average a positive global level of knowledge, although still not high as desirable, which alerts to the necessity of developing new strategies to better inform the population about DF as well as its role in human health. The results further revealed differences between age groups (with younger people showing lower knowledge), genders (men revealing lower knowledge) and levels of education (lower education associated with lower knowledge). The living environments did not reveal significant differences for any of the aspects evaluated. Hence, the highest global level of knowledge about DF was found on women, aged between 31 and 50 years, with university degree and living in urban areas.

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