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Accuracy Analysis of the Food Intake Variety Questionnaire (FIVeQ). Reproducibility Assessment among Older People

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Abstract: The study included 131 people aged 65 + (62 men and 69 women). Food intake variety questionnaire (FIVeQ) included questions about eating (yes/no) during last 7 days the named amounts of 65 subgroups of products. Interviews were made using the face-to-face situation, twice with a two-week interval (test and retest). For the further analysis products were aggregated into 9 main groups: cereal products, dairy products, meat products, vegetables, fruit, fats, sugar and sweets, beverages, spices. The questionnaires' accuracy measures were sensitivity index (%) and specificity index (%) and the test power. High reproducibility of the results obtained by the FIVeQ questionnaire was stated. It shows a good accuracy of the questionnaire as a tool for studying food intake variety and allows to recommend its usage among older people.

Key words: Food intake variety questionnaire, reproducibility, accuracy, test power

Introduction

Questionnaires for analyzing food intake are widely used in epidemiologic studies. They are measure tools that usually are elaborated for a specific project. Before applying a questionnaire in scientific studies it is necessary to check earlier its quality in a pilot study and examine its validity using the referential method in order to determine its accuracy and reliability (Jedrychowski, 1982). A good standard of proceeding is to check a new food questionnaire in a pilot study on the same or very similar sample to the one being in the question of the study, correct the questionnaire and retest it (Jedrychowski, 1982; Pisani *et al*., 1997). Next the questionnaire should be validated using the referential method (evaluation of the method's reliability), for example nutritional status evaluation method (validation) (Bathalon *et al*., 2000; Bohlscheid-Thomas *et al*., 1997; Jedrychowski, 1982; Johansson *et al*., 2002; Katsouyanni *et al*., 1997; Kroke *et al*., 1999; Lee *et al*., 2002; Ocke *et al*., 1997; Pisani *et al*., 1997; Shu *et al*., 2004; Yee *et al*., 2001) and/or food intake evaluation method (calibration) (Jedrychowski, 1982; Yee *et al*., 2001) and/or by repeating nutritional interview (results reproducibility evaluation) (Bohlscheid-Thomas *et al*., 1997; Boucher *et al*., 2006; Frankenfeld *et al*., 2003; Hu *et al*., 1999; Jedrychowski, 1982; Katsouyanni *et al*., 1997; Ozsoy *et al*., 2007; Wang *et al*., 2007). The obtained results referring to the pilot study, precise construction of the questionnaire and its modification and the applied validation method are popularized. In Poland only a few food questionnaires are checked and validated and results of such practices published (Czarnocinska and Wadolowska, 2006; Gawecki *et al*., 2002; Ilow *et al*., 2005; Szymelfejnik *et al*., 2006; Wadolowska, 2005). It creates a risk that the results of studies carried out using a not validated questionnaire have a unknown precision and may be questioned (Czarnocinska and Wadolowska, 2006; Wadolowska, 2005). That makes a food questionnaire's validation very important, especially that, as every research method, it should have a high reproducibility of results and be reliable, that is have a known validity and accuracy (Jedrychowski, 1982).

Test's validity describes the ability of the questionnaire to measure a precise feature in such a way that the value obtained in the measurement was correspondent with the real value (Jedrychowski, 1982). Validity measures are i.a. correlation coefficient and sensitivity and specificity indices. Reproducibility describes a degree in which the questionnaire applied to the same person, used by the same or other researcher, gives the same results (Jedrychowski, 1982).

Diet diversifying is an important feature of nutrition that favours an adequate intake many different nutrients and their proper balancing with the body needs. It is the dietary recommendation that appears the most often in proper nutrition rules and national dietary prevention recommendations in different countries and WHO (2003). The recommended diet diversification is particularly forwarded to older people (Roszkowski *et al*., 1995; Roszkowski, 2003). Taking into consideration proceeding of the aging processes, connected to changes in the alimentary canal, decrease in muscles vigour, inner organs working and physical activity, seniors have bigger problems in fulfilling body needs than younger people (Roszkowski, 2003). Often there are even more problems. For example because of lacks in dentition seniors avoid eating some products, especially hard and malleable foods. Those problems may deepen because of excessive usage of diuretic,

purging or neutralizing medicines or antibiotics (Roszkowski, 2003). A separate issue is the economic limitations of older people's households and many problems connected to foods, i.a. shopping and/or preparing dishes (Niedzwiedzka *et al.*, 2004; 2005a; 2005b). These and other factors significantly influence older people's nutrition manner and diversification of their daily diets and, as follows, diet-related diseases occurrence. Thus studying diet diversification is a frequent subject of studies on correlations between nutrition and diet-related diseases occurrence risk (Drewnowski and Specter, 2004; Elmadfa and Freisling, 2005; Gerhard *et al.*, 2004; Ledikwe *et al.*, 2004; Lichtenstein *et al.*, 2006; Matthiessen *et al.*, 2003; McCrory *et al.*, 1999; Norat and Riboli, 2003; Psaltopoulou *et al.*, 2004; Roberts *et al.*, 2005).

The aim of the work was the analysis of the validity of the created half-quantitive questionnaire of food intake diversification with acronym FIVeQ and testing its reproducibility among older people.

Materials and Methods

The study included 131 people (62 men and 69 women) aged above 65 years from people stating a so called basic sample. The basic sample was chosen by the quota method, granting that the total sample size amounts to 400 people, 50 persons each of 8 subgroups. The selection criteria of the basic sample were: sex, age (65-74 years old and 75+ years old) and family status (living alone and with other people). The basic study was carried out in five chosen provinces: Warminsko-Mazurskie, Slaskie, Mazowieckie, Podkarpackie and Wielkopolskie. During the recruitment we tried to reach older people with different education level, incomes, place of living etc., so as to have the studied sample similar to national differentiation. Finally the basic studies included 422 people. In the calibration study all people included in the basic studies and living in two provinces, Warminsko-Mazurskie and Slaskie (131 people) took part in the calibration study. Choosing sample for the basic study was realized according to the criteria of the project with the acronym SENIOR FOOD QOL (www.foodinlaterlife.org) and the calibration study was carried out within the status studies of the Department of Human Nutrition UWM in Olsztyn and the obtained financial aid from European Social Fund and national budged within the Integrated Operational Regional Development Program 2004-2006.

The created questionnaire of food intake variety with acronym FIVeQ (Food Intake Variety Questionnaire) consisted of two parts. The first part included questions about sex, age, place of living, total monthly income of the household and the average amount of money spent on food and beverages during a week. Second, the essential part of the FIVeQ questionnaire, concerned intake frequency (yes/no) during last 7 days of 65 subgroups of food products, being yet after thermal treatment (in the form "ready to eat"), in the amount usually bigger than 2 table spoons or 7 bread slices or 7 glasses (Appendix A). In this way information was gathered if a product was consumed in the amount bigger than insignificant. The division of products into 65 subgroups was created on the basis of their content and nutritive value (Kunachowicz *et al.*, 1998), our experience (Czarnocinska and Wadolowska, 2006; Szymelfejnik *et al.*, 2006; Wadolowska, 2005) and other authors results (Hu *et al.*, 1999; Lee *et al.*, 2002; Pisani *et al.*, 1997; Shu *et al.*, 2004) and erspecially studies of Horwath *et al.* (1999).

Before the basic research in the Warmia area, pilot studies were carried out twice with older people meeting the agreed criteria of the sample choosing (age, sex, family status). In the pilot study it was examined if the questions included in the FIVeQ questionnaire are understandable and properly formulated. After finishing the pilot studies the basic studies were carried out twice with a two-week break (test and retest) in the time from August till September 2005. The pilot and basic studies were carried out face-to-face. Public Opinion Research Center in Warsaw (CBOS) was responsible for collecting data. The CBOS pollsters were instructed by a person responsible for the study and all questions concerning the questionnaire were in detail described and explained. Each pollster, before starting an interview with a respondent, in detail described the aim of the study and ways of answering. Both studies (test and retest) among all subjects were carried by the same pollster.

For further analysis 65 subgroups were aggregated in 9 main groups: cereal products, dairy products, meat products, vegetables, fruit, fats, sugar and sweets, beverages, spices (Appendix A). During aggregating products we mainly took their content, origin and nutritive value into consideration (Kunachowicz *et al.*, 1998) and also features facilitating further separating of nutrition habit (Hu *et al.*, 1999).

The measures of questionnaire validity were indices of sensitivity (%) and specificity (%) (Jedrychowski, 1982) and the test power (in the range from 0 to 1) (Hall, 1983; Nelson *et al.*, 2004). Questionnaire's sensitivity describes its ability to proper classifying people answering yes-yes in both studies (test-retest) and determined the percentage of people (%) consuming specific groups and products. Questionnaire's specificity is its ability to reveal people answering no-no in both studies (test-retest) and describes the percentage of people (%) not consuming the mentioned groups of products. The test power was determined as a probability (in the range from 0 to 1) of taking the right decision connected to rejecting a false hypothesis and defining it as 1-β, where β is the probability of making a type II error. Accepting a true diagnostic hypothesis and

Appendix A. Applied products grouping

Food groups	Food subgroups	Food items	Amount of food items consumed during the last 7 days
1.Cereal products	Wholemeal cereal products	Wheat, rye, wholemeal bread, bread with grains, pumpernickel, grahams	7 slices of whole bread or roll
	Refined cereal products	White wheat bread, rye, wheat-rye, toast bread, normal rolls, butter rolls and bagels, French bagels, raised rolls	7 slices of whole bread or roll
	Large grains groats	Buckwheat groats, peeled barley, brown rice	2 table spoons
	Small grains groats	Manna, crushed barley	2 table spoons
	Ready-to-eat breakfast cereal products	Not cooked milk supplement, for example muesli, corn flakes	2 table spoons
	Potatoes, potato pancakes, French fries	Potatoes, potato pancakes, French fries	2 table spoons
2. Fruit	Stone	Apricots, avocado, cherries, nectarines, peaches, plums, wine grapes etc.	2 table spoons
	Kiwi and citrus	Kiwi, oranges, mandarins, citrons, grapefruit	2 table spoons
	Tropical fruit	Pineapples, melons, dactyls etc.	2 table spoons
	Berry fruit	Raspberries, blackberries, blueberries, strawberries, etc.	2 table spoons
	Bananas	Bananas	2 table spoons
	Apples and pears	Apples, pears	2 table spoons
	Dried fruit	Raisins, apricots, figs, apples, plums, etc..	2 table spoons
	Sweet fruit preserves	Stewed fruit, jam, plum jam, candied fruit, dactyls	2 table spoons
3.Vegetables	Flowers	Broccoli, brussels sprouts, fresh cabbage, cauliflower	2 table spoons
	Yellow-orange vegetables	Carrot, paprika	2 table spoons
	Leafy green vegetables	Different kinds of lettuce, pores, celery, spinach	2 table spoons
	Tomatoes	Tomatoes	2 table spoons
	Root and other vegetables	Red beets, parsnip, onion, garlic, celeriac, radish, turnip, mixed vegetables	2 table spoons
	Marrows	Fresh cucumber, eggplant, marrow, pumpkin, zucchini	2 table spoons
	Fresh and canned beans	Corn, green peas, French bean, green bean	2 table spoons
	Dry beans	Bean, lupine, pea, lentil, broad bean, soy	2 table spoons
	Sauerkraut and cucumber	Sauerkraut and cucumber	2 table spoons
	All other fermented products	Fermented rye soup, fermented beetroot soup etc.	2 table spoons
	All kinds of mushrooms	Champignons, dried, marinated and fried mushrooms etc.	2 table spoons
	Almonds, hazelnuts etc.	Almond, chestnut, cashew, coconut, hazelnut, pistachio, walnut, peanut, peanut butter, chocolate-nut cream	2 table spoons
	Pumpkin seed, sesame seed, sunflower seed	Pumpkin seed, sesame seed, sunflower seed	2 table spoons
	Olives	Olives	2 table spoons
4.Dairy products	Milk and dairy products	Milk, milk soup, milk drinks, yoghurt, kefir, buttermilk	7 glasses
	Cottage cheese	Different cottage cheese, natural and flavoured cheese, mozzarella	2 table spoons
	Cheese	Hard and processed cheese, spread cheese	2 table spoons
	Ice-creams and pudding	Ice-creams and pudding	2 table spoons
5.Meat products	Sausages	Different kinds of sausages, mingles meat sausages, frank-furters	Amount for 1 slice of bread, well covered
	Good quality cold meats	Poultry and pork-beef good quality cold meats	Amount for 1 slice of bread, well covered
	Organ meat and cold meat products	Liver, black pudding, brains, brawn, meat pies, bacon	2 table spoons
	Red meat	Pork, beef, veal, beef cold meat, for example beef ham	2 table spoons
	Poultry	Poultry meat from hens, chickens, ducks, turkey	2 table spoons
	Game	Quail, wild duck, rabbit	2 table spoons
	Lean fish	Pollock, cod, hake, carp to 1 kg etc.	2 table spoons
	Fatty fish	Tuna, salmon, sardines, herring, mackerel, smoked herring, big carp etc.	2 table spoons
	Mussels and oysters	Mussels, squids, oysters etc.	2 table spoons
	Shellfish	Lobsters, crabs, shrimps etc.	2 table spoons
	Hard roe	Caviar	2 table spoons
	All kinds of eggs	From hens, ducks, quails etc.	2 items
6.Fats	Oil	Oil	2 table spoons
	Butter	Butter	2 table spoons
	Margarine in cubes or cups	Margarine in cubes or cups (for spreading)	2 table spoons
	Cream	Cream	2 table spoons
	Other animal fats	Other animal fats, for example lard, fat	2 table spoons
	Mayonnaise and dressings	Mayonnaise and dressings (salad sauces)	2 table spoons
7.Sugar and sweets	Sugar, honey, fruit candies, hard caramels	Sugar, honey, fruit candies, hard caramels	2 table spoons
	Biscuits, cakes with cream, short,	Biscuits, cakes with cream, short, semi-short cakes,	2 table spoons

Appendix (A) continued

	semi-short cakes etc.	fruit, yeast, cheese cakes, donuts, poppy-seed cake	
	Different kinds of chocolate and chocolate sweets	Different kinds of chocolate and chocolate sweets	10 cubes of chocolate
	All kinds of salty snacks	Chips, salty crunchies, crackers, fingers etc.	2 table spoons
8.Beverages	Non-alcohol	Fizzy drinks such as coca-cola, fruit fizzy drinks, herbs and fruit infusions, fruit and herbs "teas"	7 glasses
	Tea	Black, green, red	7 glasses
	Coffee	Coffee	7 glasses
	Beer	Beer	7 glasses
	Wine	Wine, drinks	1 "wine" glass (100 ml)
	Vodka	Vodka and other strong alcohols	1 "vodka" glass (50 ml)
	Fruit juices	Apple, orange, grapefruit, currant, multifruit and other juices	7 glasses
	Vegetable and vegetable-fruit juices	Tomato, carrot and other juices	7 glasses
	Water	Water	7 glasses
9.Spices	Herbs and spices	Herbs and spices	2 table spoons
	Soya sauce	Soya sauce	2 table spoons

Table 1: Comparison of the test power values in sex and age groups

	In total N = 131		Men N = 62		Women N = 69		65-74 years old N = 68		75+ years old N = 63	
Food groups	x	95% CI	x	95% CI	x	95% CI	x	95% CI	x	95% CI
1.Cereal products	0.48	0.17 ÷ 0.79	0.45	0.08 ÷ 0.82	0.53	0.25 ÷ 0.81	0.58	0.30 ÷ 0.86	0.39	0.05 ÷ 0.74
2.Fruit	0.70	0.50 ÷ 0.90	0.68	0.43 ÷ 0.93	0.70	0.51 ÷ 0.89	0.72	0.53 ÷ 0.91	0.69	0.48 ÷ 0.89
3.Vegetables	0.70	0.58 ÷ 0.83	0.64	0.47 ÷ 0.81	0.75	0.64 ÷ 0.86	0.73	0.59 ÷ 0.87	0.68	0.55 ÷ 0.81
4.Dairy products	0.67	0.44 ÷ 0.89	0.70	0.58 ÷ 0.82	0.62	0.26 ÷ 0.97	0.66	0.42 ÷ 0.91	0.67	0.43 ÷ 0.90
5.Meat products	0.73	0.58 ÷ 0.87	0.68	0.51 ÷ 0.86	0.75	0.61 ÷ 0.90	0.76	0.63 ÷ 0.89	0.68	0.49 ÷ 0.86
6.Fats	0.64	0.46 ÷ 0.82	0.59	0.36 ÷ 0.82	0.71	0.57 ÷ 0.84	0.67	0.50 ÷ 0.84	0.61	0.38 ÷ 0.84
7.Sugar and sweets	0.61	0.35 ÷ 0.86	0.63	0.37 ÷ 0.89	0.58	0.33 ÷ 0.82	0.69	0.46 ÷ 0.91	0.52	0.15 ÷ 0.89
8.Beverages	0.73	0.54 ÷ 0.91	0.67	0.42 ÷ 0.92	0.74	0.57 ÷ 0.92	0.70	0.48 ÷ 0.93	0.75	0.60 ÷ 0.90
9.Spices	0.66	-3.47 ÷ 4.78	0.66	-3.47 ÷ 4.78	0.66	-3.47 ÷ 4.78	0.71	-2.79 ÷ 4.20	0.64	-3.75 ÷ 5.02

x-mean value; 95% CI-95% confidence interval

rejecting a false hypothesis is connected to taking a right decision based on an interview. However there was chance of making a type I error (α), that is the incorrect rejection of a true null hypothesis and there is the chance of making a type II error (β), that is the incorrect acceptance of a false null hypothesis. The greater the power in a study, the less likelihood of making a type II error (Jedrychowski, 1982; Nelson *et al.*, 2004).

Indices and the test power were determined for all 65 subgroups of products (Appendix B) and then for 9 main groups the mean values and 95% confidence interval were calculated (95% CI; Table 1-3). The statistical analysis was held using the computer programme STATISTICA PL v.7.1.

Results

The mean test power for the total sample amounted from 0.48 for cereal products to 0.73 for meat products and beverages (Table 1). The lowest mean values of the test power were stated for cereal products both for sex and age groups (from 0.45 to 0.58).

The mean sensitivity index amounted for the total sample from 55.3% for spices to 77.9% for fats, while the mean value of the specificity index from 47.8% for cereal products to 72.7% for meat products (Table 2-3). The lowest mean values of the specificity index in sex and age groups were for cereal products (from 39.4% to 57.8%) and the sensitivity index for spices (from 43.5% to 59.2%), excluding people aged 75+ years.

In the group analysis the low values of the test power of the cereal products (0.48) were influenced by the low test power value for small grains groats (0.19) and potatoes and/or potato pancakes and/or French fries (0.20; Table 1, Appendix B). At the same time in the cereal products group the highest test power was stated for ready-to-eat breakfast cereal products (0.88) and large grains groats (0.79). High mean test power for meat products (0.73) in the total sample was influenced by high test power for mussels and/or molluscs (1.00), shellfish (1.00), hard roe (0.99) and game (0.99), while in beverages group high value for beer (0.96), vodka (0.95) and wine (0.93). At the same time in the meat products group the lowest test power values were stated for poultry (0.46) and all kinds of eggs (0.47), while in beverages group for tea (0.29) and water (0.44).

In the group analysis low values of the sensitivity index for spices (55.3%) depended on low value of that index for Soya sauce (25.0%; Table 2, Appendix B). In the spice group high index was obtained for herbs and spices (85.5%). High mean sensitivity index in the total sample for fats (77.9%) was influenced by high values of that index for oil (94.4%) and butter (93.7%). At the same time in fats group the lowest sensitivity was stated for mayonnaise and/or dressings (57.1%).

In the group analysis low mean specificity index values for cereal products (47.8%), similarly like for the test power, were influenced by low values of that index for small grains groats (18.9%) and for potatoes and/or

Table 2: Comparison of the sensitivity index values (%) in sex and age groups

	In total N = 131		Men N = 62		Women N = 69		65-74 years old N = 68		75+ years old N = 63	
Food groups	x	95% CI	x	95% CI	x	95% CI	x	95% CI	x	95% CI
Cereal products	73.3	51.2÷95.3	78.0	62.2÷93.9	69.5	41.6÷97.5	69.2	41.3÷97.1	77.7	58.7÷96.7
Fruit	61.0	44.8÷77.1	64.9	50.0÷79.7	60.1	40.5÷79.8	52.2	26.7÷77.7	68.5	56.4÷80.7
Vegetables	63.6	49.1÷78.2	68.6	56.1÷81.0	59.4	41.4÷77.4	58.2	40.4÷76.1	70.4	58.8÷81.9
Dairy products	69.1	36.7÷101.5	63.4	25.2÷101.5	73.0	40.9÷105.0	68.1	37.4÷98.7	70.0	35.1÷105.0
Meat products	75.7	63.3÷88.1	76.8	65.6÷87.9	74.1	59.6÷88.7	75.5	63.5÷87.4	75.8	61.0÷90.6
Fats	77.9	61.1÷94.8	76.1	59.7÷92.5	79.3	61.7÷97.0	77.1	56.3÷97.8	79.2	65.8÷92.7
Sugar and sweets	68.8	30.9÷106.6	68.9	39.4÷98.3	69.3	25.2÷113.4	65.6	25.3÷106.0	72.0	30.6÷113.3
Beverages	65.5	49.2÷81.8	62.4	46.3÷78.6	72.6	52.9÷ 92.3	73.1	59.6÷86.6	58.4	37.0÷79.8
Spices	55.3	-329.1÷439.6	59.2	-269.9÷388.2	52.9	-364.6÷ 470.3	43.5	-508.6÷595.5	61.9	-215.8÷339.5

x-mean value; 95% CI-95% confidence interval

Table 3: Comparison of the specificity index values (%) in sex and age groups

	In total N = 131		Men N = 62		Women N = 69		65-74 years old N = 68		75+ years old N = 63	
Food groups	x	95% CI	x	95% CI	x	95% CI	x	95% CI	x	95% CI
Cereal products	47.8	16.4÷79.1	44.7	7.6÷81.9	53.0	24.6÷81.4	57.8	29.9÷85.8	39.4	4.9÷73.9
Fruit	70.1	50.4÷89.7	68.5	43.3÷93.6	70.0	51.3÷88.7	71.7	52.7÷90.6	68.4	47.8÷89.0
Vegetables	70.2	58.0÷82.5	64.2	47.5÷81.0	73.1	61.5÷84.6	70.7	56.5÷84.9	68.0	54.5÷81.4
Dairy products	66.6	44.4÷88.7	69.9	57.2÷82.5	61.5	25.8÷97.1	66.3	42.2÷90.4	66.6	43.4÷89.7
Meat products	72.7	58.3÷87.2	57.9	39.8÷76.1	67.3	52.3÷82.3	64.0	53.3÷74.7	61.2	41.3÷81.2
Fats	63.9	46.3÷81.4	58.6	935.6÷81.7	70.4	57.0÷83.8	67.1	50.3÷83.8	61.1	38.4÷83.7
Sugar and sweets	60.5	34.8÷86.1	63.2	36.9÷89.5	57.8	32.7÷82.9	68.6	45.9÷91.3	52.3	15.2÷89.3
Beverages	72.5	54.0÷91.1	67.0	41.7÷92.3	71.4	52.4÷90.3	70.2	48.1÷92.4	75.4	60.2÷90.6
Spices	65.9	-347.7÷479.4	65.8	-347.2÷478.8	65.9	-347.7÷479.4	70.7	-282.5÷423.9	63.5	-379.4÷506.3

x-mean value; 95% CI-95% confidence interval

potato pancakes and/or French fries (20.0%; Table 3, Appendix B). In the group of cereal products the highest values of that index were obtained for ready-to-eat breakfast cereal products (87.9%) and large grains groats (79.3%). High mean specificity for meat products (72.7%), similarly like in the case of the test power, was influenced by high values of that index for mussels and/or molluscs (100.0%), shellfish (100.0%), hard roe (99.2%) and game (99.2%). At the same time in that group of products the lowest specificity was stated for poultry (46.2%) and all kinds of eggs (46.7%).

For groups of products with the highest values of the test power, sensitivity and specificity indices, a narrow range of the confidence interval was stated (95% CI). In the group analysis the highest test power values and as well a narrow range of confidence interval were stated for meat products (0.73; 95% CI = 0.58÷0.87) and beverages (0.73; 95% CI = 0.54÷0.91; Table 1). Narrow range of the confidence interval and high value of the sensitivity index was stated for fats (77.9%; 95% CI = 61.1÷94.8%; Table 2) and narrow range of the confidence interval and high value of the specificity index for meat products (72.7%; 95% CI = 58.3÷87.2%; Table 3).

For the spices group a very wide range of the confidence interval was stated (95% CI). For example in the total sample 95% confidence interval for the test power amounted from -3.47 to 4.78, for the sensitivity index from -329.1% to 439.6%, while for the specificity index from -347.7% to 479.4% (Table 1-3).

Discussion

The created FIVeQ questionnaire turned out to be a good measure tool to determining groups of products both consumed and not consumed by older people. On the basis of the high values of the specificity index ($\geq$ 80%) we showed products subgroups that were not consumed by the respondents or consumed very rarely (>once a week). They included: ready-to-eat breakfast cereal products; tropical fruit, dried fruit, bananas, berries; olives, almonds and/or hazelnuts etc., pumpkin and/or sesame and/or sunflower seeds, all kinds of mushrooms, dry beans; ice-creams and/or pudding; mussels and/or molluscs, shellfish, hard roe, game, fatty fish; all kinds of salty snacks; beer, vodka, wine, vegetable juices and/or vegetable-fruit juices and Soya sauce. One of the reasons for such a low intake of the mentioned products could be their quite high price and/or small knowledge of (Gronowska-Segner, 2002; Gutkowska, 2002; Niedzwiedzka *et al.*, 2005a,b). At the same time the highest values of the sensitivity index ($\geq$ 80%) in the group analysis enabled for showing subgroups of products often consumed by seniors, stating the base of their diets. That were: potatoes and/or potato pancakes and/or French fries, refined cereal products, small grains groats; apples and/or pears; tomatoes, root vegetables and/or other vegetables, yellow-orange vegetables, flowers; milk and/or dairy products, cottage cheese; poultry, all kinds of eggs, good quality cold meats, sausages; oil, butter, cream; sugar and/or honey and/or fruit candies and/or

Appendix B. Detailed comparison of the test power, the specificity (%) and the sensitivity index values (%) in age and sex groups

		Test power					Sensitivity index (%)					Specificity index (%)				
Food groups	Food subgroups	O	M	K	65-74	75+	O	M	K	65-74	75+	O	M	K	65-74	75+
1.Cereal products	Wholemeal cereal products	0.49	0.62	0.35	0.61	0.33	77.8	85.4	71.4	84.4	71.1	48.8	61.9	35.0	60.9	33.3
	Refined cereal products	0.32	0.23	0.44	0.31	0.33	85.3	79.6	90.0	83.6	87.0	31.8	23.1	44.4	30.8	33.3
	Large grains groats	0.79	0.78	0.80	0.84	0.74	49.0	66.7	35.7	29.2	68.0	79.3	78.0	80.5	84.1	73.7
	Small grains groats	0.19	0.19	0.19	0.29	0.13	84.0	85.4	83.0	79.6	90.0	18.9	19.0	18.8	28.6	13.0
	Ready-to-eat breakfast cereal products	0.88	0.86	0.89	0.93	0.83	45.8	54.5	38.5	42.9	50.0	87.9	86.3	89.3	92.6	83.0
	Potatoes, potato pancakes,French fries	0.20	0.00	0.50	0.50	0.00	97.6	96.6	98.5	95.5	100.0	20.0	0.0	50.0	50.0	0.0
2.Fruit	Stone	0.59	0.55	0.63	0.54	0.64	72.9	70.0	75.6	75.0	70.7	58.7	54.5	62.5	54.2	63.6
	Kiwi and citrus	0.74	0.72	0.75	0.76	0.71	67.8	65.4	69.7	66.7	69.0	73.6	72.2	75.0	76.3	70.6
	Tropical fruit	0.94	0.93	0.95	0.97	0.92	33.3	50.0	25.0	0.0	66.7	94.4	93.3	95.4	96.9	91.7
	Berry fruit	0.80	0.80	0.80	0.85	0.74	41.5	33.3	50.0	42.9	40.0	80.0	80.5	79.6	85.1	74.4
	Bananas	0.82	0.82	0.82	0.84	0.79	66.7	61.1	70.0	60.9	72.0	81.9	81.8	82.1	84.4	78.9
	Apples and pears	0.20	0.00	0.27	0.29	0.13	89.7	91.4	87.9	90.2	89.1	20.0	0.0	27.3	28.6	12.5
	Dried fruit	0.89	0.89	0.88	0.89	0.89	43.8	80.0	27.3	16.7	60.0	88.7	89.5	87.9	88.7	88.7
	Sweet fruit preserves	0.63	0.76	0.50	0.59	0.67	72.0	67.6	75.6	65.2	80.6	63.3	76.0	50.0	59.1	66.7
3.Vegetables	Flowers	0.50	0.38	0.58	0.47	0.60	80.2	79.6	80.7	86.8	74.1	50.0	37.5	58.3	46.7	60.0
	Yellow-orange vegetables	0.67	0.50	1.00	1.00	0.50	95.3	96.7	94.1	94.0	96.7	66.7	50.0	*	*	50.0
	Leafy green vegetables	0.71	0.83	0.61	0.65	0.78	74.4	68.2	80.4	71.1	77.8	70.7	83.3	60.9	65.2	77.8
	Tomatoes	0.50	0.25	0.50	0.50	0.25	98.4	98.3	98.5	95.5	98.3	50.0	25.0	50.0	50.0	25.0
	Root and other vegetables	0.17	0.00	0.29	0.14	0.20	95.8	94.7	96.8	96.7	94.8	16.7	0.0	28.6	14.3	20.0
	Marrows	0.64	0.50	0.75	0.70	0.61	60.2	54.0	66.0	53.4	68.9	64.3	50.0	75.0	70.0	61.1
	Fresh and canned beans	0.77	0.73	0.82	0.81	0.73	53.8	66.7	45.2	50.0	57.7	77.2	73.2	81.6	81.0	73.0
	Dry beans	0.82	0.80	0.83	0.81	0.83	29.6	33.3	26.7	18.8	45.5	81.7	80.0	83.3	80.8	82.7
	Sauerkraut and cucumber	0.64	0.52	0.75	0.59	0.68	73.8	79.5	68.9	65.2	84.2	63.8	52.2	75.0	59.1	68.0
	All other fermented products	0.79	0.84	0.75	0.88	0.71	75.6	75.7	75.6	76.7	74.3	79.2	84.0	75.0	88.0	71.4
	All kinds of mushrooms	0.83	0.84	0.82	0.81	0.85	45.5	52.0	40.0	46.2	44.8	82.9	83.8	82.1	81.0	85.3
	Almonds, hazelnuts etc.	0.93	0.91	0.95	0.93	0.93	54.5	77.8	38.5	38.5	77.8	92.7	90.6	94.6	92.7	92.6
	Pumpkin seed, sesame seed, sunflower seed	0.90	0.91	0.88	0.92	0.88	28.6	50.0	20.0	22.2	40.0	89.7	91.4	88.1	91.5	87.9
	Olives	0.98	0.98	0.97	0.98	0.97	25.0	33.3	0.0	0.0	50.0	97.6	98.3	97.1	98.5	96.7
4.Dairy products	Milk and dairy products	0.55	0.65	0.48	0.52	0.59	87.1	80.0	93.8	87.2	87.0	55.3	64.7	47.6	52.4	58.8
	Cottage cheese	0.54	0.63	0.38	0.56	0.50	83.2	80.4	85.2	76.9	89.1	54.2	62.5	37.5	56.3	50.0
	Cheese	0.75	0.72	0.77	0.71	0.80	63.2	63.6	62.8	65.9	60.5	75.0	72.2	76.9	70.8	80.0
	Ice-creams and pudding	0.82	0.80	0.84	0.86	0.78	42.9	29.4	50.0	42.3	43.5	81.7	80.0	83.8	85.7	77.5
5.Meat products	Sausages	0.50	0.22	0.63	0.56	0.42	82.5	83.0	82.0	86.5	78.4	50.0	22.2	63.2	56.3	41.7
	Good quality cold meats	0.60	0.53	0.65	0.75	0.42	83.0	84.4	81.4	77.3	88.6	60.5	52.9	65.4	75.0	42.1
	Organ meat and cold meat products	0.65	0.57	0.69	0.55	0.79	68.9	73.2	63.6	57.1	79.5	64.9	57.1	69.4	54.5	79.2
	Red meat	0.50	0.33	0.63	0.58	0.39	70.1	65.8	74.4	70.3	70.0	50.0	33.3	63.3	58.1	39.1
	Poultry	0.46	0.43	0.50	0.56	0.25	95.8	94.5	96.8	94.9	96.6	46.2	42.9	50.0	55.6	25.0
	Game	0.99	1.00	0.99	1.00	0.98	*	*	*	*	*	99.2	*	98.6	*	98.4
	Lean fish	0.70	0.67	0.72	0.67	0.73	59.6	62.1	56.5	61.5	57.7	69.6	66.7	71.7	66.7	73.0
	Fatty fish	0.86	0.81	0.91	0.90	0.82	54.3	60.0	46.7	64.7	44.4	86.5	81.0	90.7	90.2	82.2
	Mussels and oysters	1.00	1.00	1.00	1.00	1.00	*	*	*	*	*	100.0	*	*	*	*
	Shellfish	1.00	1.00	1.00	1.00	1.00	*	*	*	*	*	100.0	*	*	*	*
	Hard roe	0.99	0.98	1.00	1.00	0.98	*	*	*	*	*	99.2	98.4	*	*	98.4
	All kinds of eggs	0.47	0.67	0.33	0.56	0.33	91.4	91.1	91.7	91.5	91.2	46.7	66.7	33.3	55.6	33.3
6.Fats	Oil	0.43	0.25	0.67	0.40	0.50	94.4	91.4	97.0	96.8	91.8	42.9	25.0	66.7	40.0	50.0
	Butter	0.45	0.40	0.50	0.58	0.25	93.7	90.4	96.6	96.4	90.9	45.0	40.0	50.0	58.3	25.0
	Margarine in cubes or cups	0.75	0.70	0.81	0.70	0.81	73.6	74.4	72.9	77.8	69.0	75.0	69.6	81.0	69.6	81.0
	Cream	0.62	0.60	0.64	0.71	0.57	86.4	84.6	87.9	83.6	89.8	61.9	60.0	63.6	71.4	57.1
	Other animal fats	0.79	0.81	0.77	0.79	0.78	62.3	62.9	61.5	60.0	65.4	78.6	81.5	76.7	78.8	78.4
	Mayonnaise and dressings	0.80	0.76	0.84	0.84	0.75	57.1	52.9	60.0	47.8	68.4	79.8	75.6	84.1	84.4	75.0
7.Sugar and Sweets	Sugar. honey. fruit candies. hard caramels	0.48	0.50	0.47	0.73	0.25	88.9	83.3	94.4	89.5	88.2	47.8	50.0	46.7	72.7	25.0
	Biscuits. cakes with cream. short. semi-short cakes etc.	0.47	0.50	0.43	0.50	0.42	85.9	84.1	87.3	85.4	86.3	46.9	50.0	42.9	50.0	41.7
	Different kinds of chocolate and chocolate sweets	0.67	0.68	0.65	0.68	0.66	62.3	62.5	62.1	46.4	80.0	66.7	68.4	65.0	67.5	65.8
	All kinds of salty snacks	0.80	0.84	0.76	0.84	0.76	37.9	45.5	33.3	41.2	33.3	80.4	84.3	76.5	84.3	76.5
8.Beverages	Non-alcohol	0.61	0.67	0.56	0.65	0.57	66.1	48.3	81.8	61.8	71.4	60.9	66.7	55.6	64.7	57.1

Appendix (B) continued

	Tea	0.29	0.00	0.31	0.13	0.50	95.7	93.4	98.2	95.0	96.5	28.6	0.0	30.8	12.5	50.0
	Coffee	0.72	0.77	0.68	0.61	0.82	90.6	88.9	92.9	97.1	82.8	71.6	76.9	68.3	60.6	82.4
	Beer	0.96	0.91	1.00	0.95	0.98	58.8	53.3	100.0	80.0	28.6	96.5	91.5	*	94.8	98.2
	Wine	0.93	0.94	0.92	0.92	0.94	46.7	50.0	40.0	66.7	33.3	93.1	94.2	92.2	91.9	94.4
	Vodka	0.95	0.89	0.98	0.96	0.93	60.0	56.0	70.0	66.7	55.0	94.8	89.2	98.3	96.2	93.0
	Fruit juices	0.73	0.71	0.74	0.80	0.65	52.2	54.2	50.0	47.8	56.5	72.9	71.1	74.5	80.0	65.0
	Vegetable and vegetable-fruit juices	0.90	0.89	0.91	0.92	0.88	33.3	33.3	33.3	55.6	16.7	90.0	88.7	91.2	91.5	88.2
	Water	0.44	0.25	0.60	0.40	0.50	86.1	84.5	87.5	87.3	84.7	44.4	25.0	60.0	40.0	50.0
9.Spices	Herbs and spices	0.33	0.33	0.33	0.43	0.29	85.5	85.1	85.7	86.9	83.7	33.3	33.3	33.3	42.9	28.6
	Soya sauce	0.98	0.98	0.98	0.98	0.98	25.0	33.3	20.0	0.0	40.0	98.4	98.3	98.4	98.5	98.3

*no possible statistical analysis; O-total sample; M-men; K-women; 65-74-people aged 65-74 years; 75+-people aged 75 years and more

hard caramel, biscuits and/or cakes with cream and/or short and/or semi-short etc.; tea, coffee, water; herbs and spices. Those were products traditionally consumed by Polish and in reasonable price (Gutkowska, 2002; Laskowski, 2005; Slowinska and Wadolowska, 2000; Wierzbicka *et al*., 1997).

The carried out evaluation of the FIVeQ questionnaire showed that it can be recommended as an accurate and reliable measure tool in epidemiologic studies among older people. For the majority of products (about 2/3 items) we obtained good results reproducibility (test and retest). High test power values (over 0.8) were stated for 31% subgroups of products, while moderately high test power (from 0.6 to 0.8) for 35% items. Similarly for the sensitivity and specificity indices their high values (over 80%) were revealed for 38% and 32% subgroups of products, respectively and moderately high sensitivity and specificity (from 60% to 80%) for 28% and 34% items, respectively.

References show that in order to examine questionnaire's reproducibility it is necessary to make an interview twice with the same person, the same pollster and to compare obtained results of test and retest (Bohlscheid-Thomas *et al*., 1997; Boucher *et al*., 2006; Frankenfeld *et al*., 2003; Hu *et al*., 1999; Jedrychowski, 1982; Katsouyanni *et al*., 1997; Ozsoy *et al*., 2007; Wang *et al*., 2007). The time gap between two interview should be respectively short, so that the change in nutrition habit is minimal, but on the other hand long enough, in order not to have the respondent remember his answers. The reason for small reproducibility of results may be: (i) respondent (not meeting the recruitment requirements, not stable emotionally, etc.) (ii) non-adequate questionnaire (not understandable and long questions, lack of explanations, etc.) (iii) pollster (his attitude, behaviour, expectations concerning answers, age, sex, intellectual level, etc.) (Jedrychowski, 1982). During carrying out the study we made an effort to eliminate outer reasons interfering with the interview results, i.e. connected to respondent, pollster and questionnaire. Thus it should be expected that the stated for some products smaller results reproducibility had different reasons.

During the second food interview (retest) it is assumed that people's nutrition did not change and the results are to be repeated. However that assumption is not always true. The first interview may change nutritional behaviour of respondents, for example encourage them to eat products earlier not known. Another reason may be individual changeability of nutrition, so called day-to-day, which especially concerns products consumed rarely (Gibson, 1990; Wadolowska *et al*., 2004). For those reasons in the retest results may be reliable, but different than those obtained in test (Gibson, 1990). In this way the calibration method shown small results reproducibility, but it is not a proper conclusion with reference to nutritional behaviour. Unfortunately, each calibration proceeding is burdened by some error and real precision may never be determined, as repeating the nutritional observation of people is impossible (Block, 1982 according to Gibson, 1990; Wadolowska *et al*., 2004). Repeating a nutritional interview gives new information on consumption in next day or week, since day-to-day changeability (of one person) is stated by short-term consumption of different products by the same person (Gibson, 1990). This conviction does not entitle to absolute ceasing working on evaluation of food questionnaire's accuracy, but forces a critical approach and indicates on purposefulness of regular improving food intake evaluation methods (Wadolowska *et al*., 2004).

An important conclusion arising from the study is fact that sex and age of older respondents (65-74 or 75+ years old) did not influence significantly the sensitivity and accuracy indices and the test power values. It enables to acknowledge the FIVeQ questionnaire as a tool properly classifying the examined older people regardless of their sex and age. The advantage of the questionnaire is its simple construction and the ability to give dichotomic answers (yes/no). Thus the questionnaire, after a short description of the study's aim and essence, may be filled during an interview by a pollster or individually by older people and probably by younger adults.

The results obtained for meat products, beverages and fats should be especially considered as they had the

highest mean test power and the sensitivity and specificity indices and at the same time narrow ranges of the confidence interval for those groups of products. It shows that products were aggregated into groups properly and that questionnaire had similar high accuracy for assortment subgroups constituting main groups. On the other hand spices group were found to have a very wide range of the confidence interval. Thus in the future it can be predicted that spices group and its assortment subgroups will be excluded from the studies on seniors nutrition differentiation.

The noted high values of the sensitivity indices indicate on a good ability of the questionnaire to proper classifying the examined to a group of people consuming specified products, while high values of the specificity indices indicate on a good ability of the questionnaire to proper classifying the examined to a group of people not consuming specified products. That questionnaire's feature is extremely useful in epidemiologic studies because of possible detecting by the FIVeQ questionnaire both negative and positive features of people's nutrition. It means that the created questionnaire may be applied in studying relations between consuming by seniors different foods and diet-related diseases occurrence. Nutritional conditionings of diseases, i.a. obesity, cardiovascular disease, cancer, hypertension, diabetes, are often analyzed with regards to eating or not pro-healthy or unhealthy and in the context of diet diversity (Drewnowski and Specter, 2004; Elmadfa and Freisling, 2005; Lichtenstein *et al*., 2006; McCrory *et al*., 1999; Norat and Riboli, 2003; Psaltopoulou *et al*., 2004). Realization of such studies needs applying proper research tools: sensitive and accurate and at the same time simple. The carried out analysis gives the basis for stating that the FIVeQ questionnaire meets these requirements.

Conclusion: High values of the sensitivity, specificity and test power indices were stated for the food intake variety questionnaire FIVeQ and proper classification of the subjects to the group of people eating or not specific products, regardless of their sex and age. That questionnaire's feature is extremely useful in epidemiologic studies because of possible detecting by the FIVeQ questionnaire both negative and positive features of people's nutrition. The obtained results prove good accuracy of the FIVeQ questionnaire as a tool for studying food intake variety and enable us to recommend its applying among older people.

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