

Developing Well-Being Indicators and Measurement Methods as Illustrated by Projects Aimed at Preventing Obesity in Children

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Abstract—Consumption of vegetables by school children and adolescents is essential for their normal growth, development and health, but a significant minority of the world's population consumes the right amount of these products. The aim of the study was to evaluate the preferences and frequency of consumption of vegetables by school children and adolescents. It has been assumed that effectively implemented nutrition education programs should have an impact on increasing the frequency of vegetable consumption among the recipients. The study covered 514 students of five schools in the Opole Voivodeship aged 9 years to 22 years. The research tool was an author's questionnaire, which consisted of closed questions on the frequency of vegetable consumption and the use of 10 ways to treat them. Preferences and frequencies are shown in percentages, while correlations were estimated on the basis of Cramer's V and gamma coefficients. In each of the examined age groups, the relationship between sex and vegetable consumption (the Cramer's V coefficient value was 0.06 to 0.38) was determined and the various methods of culinary processing were used (V Craméra was 0.08 to 0.34). For both sexes, the relationship between age and frequency of vegetable consumption was shown (gamma values ranged from ~ 0.00 to 0.39) and different cooking methods (gamma values were 0.01 to 0.22). The most important determinant of nutritional choices is the taste and availability of products. The fact that they have a positive effect on their health is only in third position. As has been shown, obesity prevention programs can not only address nutrition education but also teach about new flavors and increase the availability of healthy foods. In addition, the frequency of vegetable consumption can be a good indicator reflecting the healthy behaviors of children and adolescents.

Keywords—Children and adolescents, frequency, welfare rate, vegetables.

I. INTRODUCTION

PROPER nutrition, crucial to human well-being, is particularly important for children due to their developmental needs [1], [2]. Wrong diet choices and nutrition mistakes that children acquire lead to undernourishment, and are bound to result in future complications and health risks associated with nutrition-related diseases. A large majority of obesity prevention programs are aimed at promoting healthy diet choices in this group, with special emphasis on adequate vegetable and fruit (VF) intake in daily diet. School age is the critical period for shaping a healthy lifestyle, including healthy diet choices [3].

In Poland, the arrangements concerning school meal planning and involvement of schools in preventing diet-related

health issues are far from satisfactory. In 1992, the Health-Promoting Schools program was launched as a WHO initiative, originally designed as a 3-year project. In 2006, a network of health-promoting schools was established throughout all Polish voivodeships (administrative units in Poland). A study by Woynarowska compared i.e. the availability of given foods and drinks at "health-promoting" schools and schools without such an agenda [3]; 75.7% of health-promoting schools, compared with 67.3% of schools from the control group offered 100% vegetable or fruit juices. As little as 18.9% of health-promoting schools, compared with 12.1% of "control" schools, served vegetables to their students. Unfortunately, in nearly 75% of schools, students had access to various candy and sweet products, which were even more readily available in schools supposedly promoting a healthy lifestyle. Only 48% of health-promoting schools and 21.3% of control-group schools had a written contract obligating them to provide students with daily healthy meals, and as little as 11.5% of health-promoting schools and 4.5% of control-group schools were obligated in writing to supply vegetables and fruits with school lunches. Results of various studies show nutrition arrangements in schools to be unsatisfactory; hence, the dire need for further measures aimed at inspiring healthier diet choices in children and adolescents.

Since the school year 2009/2010, the European Union School Fruit Scheme, geared towards increasing daily VF intake in students and educating them about the rudiments of healthy eating, has been in operation [4]. The initiative is dedicated to elementary school students from grades 1 through 3 (children aged 7-9 years old in Poland). Students receive fruit juices and fresh vegetables or fruits 2-3 times a week. The products must be free from any fats, salt, sugar and other sweetening additives. Wolnicka et al. surveyed grade 3 students from schools covered by the School Fruit Scheme and from control-group schools, and found vegetable intake in schools participating in the program to be significantly higher than that in schools from the latter group (both on school days and at weekends) [5].

In 2009-2010, approximately 1-in-5 children in the USA met the obesity criteria. For the past 10 years, school policies aimed at increasing physical activity among students and promoting a healthy diet have been used to fight the epidemics. According to Nanney et al., less than 40% of high school students were eligible for reduced-price or free lunches under the National School Lunch Program [6]. In 2002-2006, a slight increase in daily vegetable and fruit intake (by a mere

0.07 portion) was seen, accompanied by a slight increase in physical activity, whereas no significant changes in students' nutritional health were noted. Changes in school environments lead, therefore, to a slight improvement of kids' eating patterns, yet adequate actions in other areas of life are necessary to achieve better effects.

Fruits and vegetables have a beneficial impact on children's and adolescents' health, however motivating young people to include them in their diet on a regular basis is a major challenge we are continuously faced with [7]. The Go Wild with Fruits & Veggies! (GWWFV) classroom curriculum was created for elementary school, grade 3 through to grade 5, to motivate children to consume FV by integrating a different wild animal character into seven interactive lessons. The program also included additional activities for school food service personnel, teachers and parents to ensure the best possible setting to facilitate nutritional behavior change.

Veggiecation! is an innovative American nutrition education program geared towards empowering kids to change their eating habits, introducing them to new vegetables with the support of educators and nutrition specialists. Activities include hanging up vegetable-of-the-month posters in schools, nutrition education in classes, and meals featuring the vegetable in school cafeterias.

Increased FV intake is one of the essential objectives of the American National School Lunch Program [8]. Since 2012, the US Department of Agriculture (USDA) has obliged students to select a vegetable or fruit component as part of the reimbursable lunch at school.

Another American initiative developed to increase VF intake was the Cooking with Kids (CWK) program aimed at exposing elementary school students to fresh produce through 2-hour cooking classes raising multicultural awareness and 1-hour classes dedicated to tasting a variety of vegetables and fruits [9].

The promotion of vegetables and fruit intake is a crucial measure aimed at improving daily diet quality and reducing the prevalence of overweight and obesity in children and adolescents [10].

In 2015, the prevalence of pediatric overweight in Italy was 22.9% and pediatric obesity – 11.1% [11]. Children's vegetable intake is considerably lower than recommended, whilst consumption of high-calorie foods combined with low physical activity lead to increasing body weight. To counteract overweight and obesity, and increase vegetable intake in Italian children, the Food Dudes (FD) Healthy Eating Program was introduced. The program involved evaluation of snacks prepared by parents for the school lunch break and the provision of vegetable and fruit portions that students could eat at their discretion.

In 2015, the Joint Action on Nutrition and Physical Activity (JANPA) was launched, a collaborative effort addressing nutrition awareness and physical activity across Europe. The primary objective of this project is to stop the rise of overweight and obesity in children and adolescents in EU member states by 2020. It focuses on specific outcomes that strongly contribute to the nutritional and physical activity

policies dedicated to families with children and adolescents. Twenty six countries participated in the project, including 25/28 UE member states and Norway. The participating countries and organizations share information, opinions and practices, ensuring broad and comprehensive involvement. Identifying and selecting best practices allows to estimate the economic burden of overweight and obesity, and promote better conditions for child care in the family, kindergarten (preschool) and school setting. Bytom Public Health Department of the Medical University of Silesia in Katowice is a collaborating partner to the program, involved in three out of six delineated areas [12].

Promoting healthy eating habits and physical activity begins in early childhood. Implementing policies and taking adequate measures requires a multi-sector approach, including better-coordinated government-level actions involving the public, employment, education, agriculture, transport and private sector. As nutrition and physical activity are inevitably linked to social conditions, reduction of social inequalities is considered as the project's key objective [12].

Both civic and political mobilization are necessary to facilitate joint efforts on all levels, aimed at improving the quality of nutrition health and physical activity among children in Europe. Particularly, partnerships among public health experts, regional and local authorities, education institutions, communities, universities, representatives of food industry, and as well, sector organizations are crucial to address the problem [12].

All the above considered, it is important to determine the effectiveness of promoting vegetable consumption as the basis of rational nutrition and good health contributing to overall well-being. According to the ISO definition, health indicators are the key dimensions and sub-dimensions that are required to describe the health of the population, and the performance of a health care system [13]. Health indicators are operative in health policymaking, monitoring development and meeting set objectives [13]. They play an informative, diagnostic, planning, comparative, prognostic, monitoring and evaluative role. Most commonly, they are presented as numbers. This definition highlights the informative character of the indicators and their sensitivity to change in time. Moreover, health indicators help to determine the health of a given population or individual, foresee health risks, and compare population groups between different countries [14]. They are also associated with health programs and policies [13], helping to assess the impact of health-oriented programs while they are still operating, as well as summarize their final outcomes, and thus, determine their effectiveness.

Vegetable intake in children and adolescents translates into the group's nutrition. Evaluating children's diet is of utmost importance in the context of the prevalence of diet-related diseases [15]. Nutritional disorders are on the rise in children, adolescents and adults alike, with studies showing e.g. approximately 70% of the Polish population to be affected. An adequate nutritional status is particularly important at developmental age due to the ongoing growth and formation of new tissues, and it is directly associated with an

individual's diet [16].

II. OBJECTIVE OF THE STUDY

This study was aimed at evaluating the vegetable intake and the choice of cooking methods in children and adolescents of school age. The majority of programs dedicated to children are focused on encouraging young people to eat proper amounts of vegetables and fruits, and empowering them to make independent healthy diet choices, hence, the importance of determining vegetable intake and preferences regarding vegetable cooking methods for the implementation and evaluation of preventive programs.

III. MATERIAL AND METHOD

The study was conducted in January/February 2016. It covered 514 students from five schools, aged 9-22 years old, including 103 students from elementary school grades 4 through 6 (10-12 year-olds), 101 middle (junior high) school students (gimnazjum in Poland), and 310 senior high school students, including 104 liceum (academic profile high school in Poland) students, 106 technikum (technical profile high school) students, and 100 vocational profile high school students.

As the research tool, we used our own survey, composed of closed-ended questions on the intake of 21 vegetables, such as cabbage, Brussels sprouts, turnip cabbage, cauliflower, broccoli, bell pepper, carrot, pumpkin, spinach, lettuce, string beans, green peas, beetroot, leek, parsley root, celeriac, cucumber, radish, zucchini and corn, and questions concerning personal preferences and frequency of using 10 methods of cooking vegetables, including boiling, steaming, frying, roasting, sautéing, puréeing, barbecuing, as well as use of frozen vegetables, concentrates, juices and fresh vegetables.

To identify the factors influencing the choice of vegetables and given cooking methods, a 5-item scale was used, where the respondents were asked to give answers such as "like a lot", "like", "don't care", "don't like", "hate", and, additionally – "never eat" (scale from positive to negative). Vegetable intake and the frequency of applying given culinary methods were evaluated with a 9-item scale featuring answers such as "several times a day", "6-7 times a week", "4-5 times a week", "1-3 times a week", "3 times a month", "2 times a month", "once a month", "occasionally" and "never".

The results were analyzed with Microsoft Excel, and statistical analyses were performed with Statistica 12 software. To evaluate the relationships between the respondents' sex and age and their vegetable and cooking method preferences, Cramer's V was computed. The correlation between the respondents' sex and age and vegetable intake and choice of given culinary methods was assessed using Goodman and Kruskal's gamma (G). The results were interpreted assuming the following association strength levels: ≤ 0.2 – poor, ≤ 0.4 – slight, ≤ 0.7 – moderate, ≤ 0.9 – high, > 0.9 – very high.

IV. RESULTS

The obtained results have shown a poor association between

the respondents' age and vegetable intake.

TABLE I
 THE CORRELATION BETWEEN THE RESPONDENTS' AGE AND VEGETABLE INTAKE (GOODMAN AND KRUSKAL'S GAMMA (G))

Intake of given vegetables	Boys	Girls
cabbage	0.04	0.13
Brussels sprouts	0.39	0.19
turnip cabbage	0.21	0.07
cauliflower	0.17	~ 0.00
broccoli	~ 0.00	-0.01
tomatoes	0.03	0.03
bell pepper	0.21	0.26
carrots	-0.16	0.02
pumpkin	0.30	0.06
spinach	0.16	0.09
lettuce	0.06	0.11
string beans	0.07	0.13
green peas	0.02	0.06
beetroots	-0.02	0.07
leech	0.09	0.22
parsley root	0.04	0.24
celeriac	0.28	0.24
cucumbers	-0.21	-0.06
radishes	0.1	0.10
zucchini	0.26	0.25
corn	0.08	-0.05

A similar slight association was demonstrated between the respondents' sex and their choice of given methods of cooking vegetables.

TABLE II
 THE CORRELATION BETWEEN THE RESPONDENTS' SEX AND THE FREQUENCY OF USE OF GIVEN METHODS OF COOKING VEGETABLES (GOODMAN AND KRUSKAL'S GAMMA (G))

Frequency of use of given cooking methods	Boys	Girls
boiling	-0.01	-0.04
steaming	0.05	-0.04
frying	0.02	0.10
roasting	0.04	0.03
sautéing	0.22	0.13
puréeing	0.07	0.13
barbecuing	-0.02	0.04
frozen vegetables	0.11	0.11
juices and concentrates	-0.03	-0.07
raw	-0.02	-0.05

The respondents indicated taste as the main factor determining how often they ate a given vegetable, with approx. 70% of the respondents in each of the analyzed groups selecting this answer. Among boys aged 9-12 years old, as many as 87.5% of the participants indicated taste as the decisive factor. The students pointed to availability as another important decision factor. Approximately 40% of the respondents of both sexes also indicated the effect that vegetables have on our health to be important, while 20-30% of students listed smell as an important factor. For 22.5% of boys and 31% of girls, parents were operative for the frequency of eating a given vegetable.

TABLE III
 THE DECISIVE FACTORS BEHIND THE INTAKE OF A GIVEN VEGETABLE ACCORDING TO THE RESPONDENTS' AGE AND SEX (GOODMAN AND KRUSKAL'S GAMMA (G))

Factor	9-12 years old		over 12 years old - 16 years old		over 16 years old	
	Boys	Girls	Boys	Girls	Boys	Girls
taste	87.5%	77.8%	75.3%	69.7%	76.6%	67.8%
availability	32.5%	20.0%	33.3%	42.6%	20.7%	46.1%
effect on health	42.5%	48.9%	27.2%	31.1%	29.7%	29.6%
smell	37.5%	35.6%	28.4%	22.1%	25.2%	22.6%
appearance	25.0%	33.3%	24.7%	33.6%	16.2%	25.2%
nutritional value	17.5%	28.9%	19.8%	23.0%	21.6%	22.6%
parents	22.5%	31.1%	24.7%	25.4%	9.0%	14.8%
price	12.5%	6.7%	14.8%	17.2%	12.6%	15.7%
appetite	-	4.4%	3.7%	1.6%	0.9%	-
availability in school store	-	-	2.5%	1.6%	-	0.9%
dietary habits	2.5%	-	1.2%	-	-	-
want to maintain a slender figure	-	-	-	0.8%	-	-
being vegan	-	-	-	-	-	0.9%
being vegetarian	-	-	-	0.8%	-	-
prefer other products	2.5%	-	-	-	-	-

V. DISCUSSION

A low association strength was found between the respondents' sex and the preference for boiling, steaming, frying, roasting, barbecuing, pureeing, using frozen vegetables and raw vegetables in the group of children aged 9-12 years, and for boiling, steaming, roasting, using frozen vegetables and raw vegetables in the group of children aged over 12 years old to 16 years old. Thereby, gender had little effect on the preference for using a given method of cooking or preparing vegetables.

Other authors have shown gender to have an impact on vegetable intake. Vereecken et al. [17] studied children aged 11 years, 13 years, and 15 years old in 33 countries, and found that in all of the countries covered by the study girls ate more VF than boys. According to Al Ani et al. [18], more girls than boys aged 13- 15 years old from 11 countries ate vegetables at least 5 times a day.

According to a study by A-Hazzaa et al. [19], in turn, Saudi Arabian boys aged 14 to 19 years old ate vegetables more often than girls. 23.3% of boys and 22.3% of girls covered by the study declared daily vegetable consumption. Zhang et al. [20] studied Chinese children aged 12-17 years old, and found that boys ate more vegetables than girls. According to Wolnicka et al. [21], boys aged 9 years old ate on average 164 g of vegetables, whereas girls – 155 g.

Taste was identified as the main factor determining vegetable intake among the respondents of both sexes across all age groups.

Another important factor determined in studies by other authors was the availability of given vegetables. Studies by Terry-McElrath et al. [22] and Gosliner [23] found that increased vegetable exposure at schools (e.g. by introducing salad bars) was associated with a rise in regular and daily vegetable consumption by American students. According to Attorp et al., [24], VF intake in Canadian children was correlated with the availability of given products. A slight, statistically significant correlation between vegetable exposure

and vegetable intake in children was also demonstrated by Wolnicka et al. [25]. Trofholz et al. [26] studied American children aged 6-12 years old and their families, and found that the availability of vegetables at home was significantly associated with their inclusion in family dinner meals and thus with a child's daily intake of those same foods.

Analyzing results of 15 studies, Cook et al. [27] found that seven of them confirmed the association between vegetable exposure at home and child vegetable intake. According to Lehto et al. [28], availability of vegetables was one of the factors most strongly associated with consumption of these foods by 11 year-olds from 10 different European countries. Korinek et al. [29] studied American students aged 8-11 years old, and found that consumption of fruits and vegetables at school increased with their increased availability at home. According to Wolnicka et al. [30], availability of vegetables at home had a significant effect on average consumption of these products by children. Harris et al. [31], in turn, found vegetable intake in African American children not to be associated with availability.

Vegetable intake was also heavily influenced by children's parents, especially according to children from the two younger age groups, i.e. 9-12 year-olds and children over 12 years to 16 years old. Parents' influence on vegetable intake was demonstrated by Wolnicka et al. [25], who studied children aged 9 years old. The researchers found a slight, statistically significant correlation between vegetable intake in children and in parents and parents' efforts at convincing their children to eat vegetables. Also Bjelland et al. [32] showed a statistically significant association between vegetable intake in Norwegian children aged 11 years old and their parents' vegetable intake. Harris et al. [31] found that fresh and frozen vegetable intake in African American children aged 3 years to 13 years old was positively correlated with vegetable intake in their fathers. Tada et al. [33] in their study of Japanese children aged 10-12 years old showed a positive association between vegetable intake in mothers and in their children.

Trofholtz et al. [26] found a significant association between parents' consumption of vegetables and their inclusion in family dinner meals (and thus children's intake of those foods).

Price was also an important factor determining vegetable intake. According to Terry-McElrath et al. [22], children from high-income families ate more green vegetables than their peers from families from the average- or low-income setting. Attorp et al. [24] studied Canadian students aged 10-12 years old and their families, and found a slight, statistically significant correlation between a given family's level of affluence assessed according to the Family Affluence Scale and VF intake in children. Wolnicka et al, [30], in turn, studied 9 year-olds, and found that parents' income had no significant impact on vegetable intake.

Vegetable intake in a large majority of children and adolescents worldwide continues to be lower than recommended by WHO, as evidenced by studies by numerous authors [18]-[33]. Adequate vegetable intake would definitely help to fight the overweight and obesity epidemics in this age group, whilst also significantly reducing the risk for many diseases both in childhood/adolescence and adulthood. Hence, it is necessary to identify the factors affecting vegetable intake in children and adolescents, and continue efforts to increase it by implementing well-designed initiatives supported by a sufficient body of research.

VI. CONCLUSIONS

- Vegetable intake may be a good indicator of health behavior in children and adolescents affecting their overall well-being.
- Children and adolescents choose which vegetables to eat based on a vegetable's subjective sensory appeal, availability, and knowledge about its impact on health.
- Pediatric obesity prevention programs should extend beyond promoting vegetable consumption in this group. It is necessary to consider also the various factors determining the selection of vegetables in children's daily diet. Exposure to new flavors and culinary methods should therefore be an integral part of the implemented initiatives.

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