The Effect of Hidden Sugar Guidance Program on Young and Older Adults' Knowledge and Consumption Pattern

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Abstract

Background: Consumption of unnecessary hidden sugars is an important public health concern because it may lead to various health problems. A multi-pronged approach has to be taken to addressing the issue of "hidden" sugars in processed food. **The aim** of this study is to determine the effect of a hidden sugar guidance program on the young and older adults' knowledge and consumption pattern. **Design:** The study followed a quasi-experimental research design (one group pre-test post-test) **Setting**: two settings were used to carry out the study; El Waffa club for the older adults, and two faculties at Alexandria University for young adults namely; Faculty of Art and Faculty of Science. **Subjects:** a convenience sampling technique was used to select the study subjects; they included two groups; young adult undergraduate students, and older adults aged 60 years or more. **Results:** There was an improvement in the total score of knowledge regarding hidden sugar of the young and older adults after the implementation of the program with a statistically significant difference (P = 0.0001). There was also an improvement in the total score of the consumption pattern of the hidden sugar of the young and older adults after the implementation of the program with a statistically significant difference (P = 0.001). **Conclusion:** The hidden sugar guidance program had a significant effect on the young and older adults' knowledge and consumption pattern of hidden sugar. **Recommendations**: Community based awareness programs should be developed and implemented to inform the public about the risks of overconsumption of hidden sugars, raise awareness, and support both young and older adults to change their eating behaviors.
Keywords: Hidden sugar, guidance program, knowledge, consumption pattern, young & older adults

Introduction

The provision of healthy and safe food is vital for human health. Higher consumption of unnecessary addition of free sugars in foodstuffs is an important public health concern and global issue (Haque et. al. 2020 and Amoutzopoulos et al. 2020). Excessive consumption of dietary sugars leads to various long- and short-term health issues and raising costs for individuals and governments (Hagmann et al. 2018 and Haque et al. 2020). The consumption of sugar remains high worldwide, despite health warnings (Anderson et al. 2020). Free sugar consumption varies according to the country, settings, and age. Fore example, sugar intake represents in an adult 7- 8% of total energy intake in Norway or Hungary, 12% in Sweden, Slovenia or Denmark, 16-17 % in the United Kingdom or Spain, and around 25% in Portugal. Rural South African communities show 7.5%, but in urban communities, it is around 10% (WHO report 2003), and United States citizen consumed around 18% (Johnson et al, 2009).

Recent years have witnessed the progressive changes of the traditional Egyptian diet and the introduction of new foods and eating habits such as excessive consumption of unhealthy foods namely fast food (Wassef 2004). College students in Alexandria are prone to unhealthy eating habits and food during their college years which might affect their wellbeing. Many studies revealed that both adolescents and young adults are likely to exceed the recommended sugar intake (Prada et al. 2020, Mumena et al. 2020, Tayel et al. 2017, and Genena et al. 2017). It was found that the consumption of added sugars mainly presents in the processed foods of older adults' diet was concomitant with frailty (Laclaustra et al. 2018). However, with changed dietary patterns, people are now consuming more foods high in energy; fats, free sugar, and salt/sodium, and many people do not eat enough fruits, vegetables, and other dietary fiber such as whole grains (WHO Fact Sheet, 2020).

There are different and inconsistent definitions of what constitutes added and free sugars that are used by international and national organizations which present important considerations for public health monitoring and surveillance programs and comparison across countries over time (Hess et al., 2012). According to the European Food Safety Authority (EFSA 2012), Added sugars include sucrose, fructose, glucose, starch hydrolysates (glucose syrup, high-fructose syrup), and other isolated sugar preparations which are added during food preparation and manufacturing.

The WHO proposes more global definition, which refers to that the free sugar, includes all sugars that are added during food manufacturing and preparation as well as sugars that are naturally present in honey, syrup, fruits juices and fruit concentrates (WHO 2015a).

Hidden sugar is known as the simple sugars present in food that user is not aware of their existence. Much of the sugars consumed today are "hidden" in processed foods that are not usually realized as sweets (WHO 2015b). Although public understanding of the short and long-term adverse effects of sugars (both overt and hidden) remains poor, sugar is considered the main determinant of poor health. The amount of sugar intake has tripled because of the promotion of fast (junk) food, processed food, and sugar-sweetened beverages (SSBs) (Mustapha 2019). Therefore, if hidden sugar is consumed in large quantities, it will cause harmful health effects (Yeung et al. 2015 and Farokh-Gisour et al., 2017).

Sugar has many properties of a drug, and multiple studies have reported that people could become addicted to sugar in a similar way as becoming addicted to cocaine, nicotine, tobacco, or caffeine (Avena et al., 2007, Ahmed et al., 2013 and American Psychiatric Association, 2019). Hidden sugar could lead to dependence and withdrawal signs and symptoms if stopped suddenly (Mysels et al., 2010, and Avena et al., 2007). One study has reported a feeling of withdrawal signs and symptoms among young people when stopped consumption of SSBs for 3 days, they developed a strong desire for SSBs, complained of headaches, reported a reduction in inspiration, happiness, and satisfaction, a failure to concentrate and a lack of overall well-being. The impact of addictive properties of hidden sugar in processed foods and SSBs on consumers' health is not directly understood or addressed by them (Falbe et al., 2019).

The dietary pattern and attitude of individuals towards the consumption of hidden sugar are proposed to be linked with several factors such as social and economic factors. These factors include income, food prices, (which will affect the availability and affordability of healthy foods), individual preference, beliefs, cultures, and traditions. Additionally, the limited knowledge of what added or hidden sugar is, and its health consequences may result in excessive intake of added sugar (Mumena et al., 2020). Therefore, promoting a healthy food environment-including a food system that promotes balanced and healthy diet- requires the involvement of multiple sectors, stakeholders, governments, public and private sectors (WHO 2020).

Because of the excessive intake of added/hidden sugar all over the world, the World Health Organization (WHO) has established a maximum limit of added sugar intake in an attempt to reduce the intake at a global scale. It recommends limiting the daily intake of added sugar to less than 10% of total energy, highlighting that a further reduction to less than 5 % of total energy intake equals to 6 teaspoon /25 grams per day, would improve the health status (WHO 2015b).

Free sugars or added sugars are different from intrinsic sugars found in whole fresh fruits and vegetables. As no reported evidence links the consumption of intrinsic sugars present in whole fresh fruits and vegetables, it was not statistically associated with worse outcomes (WHO 2015c and Laclaustra et al. 2018).

Health messages about what food and drinks containing sugars are safe for health still cause some confusion among professionals and the public. Community health nurses and the gerontological nurse has a great role in the preparation and the application of public health strategies and guidance, including health education and promotion that have been employed to address the issues raised by the addition of sugar and other products to foods and beverages. A multi-pronged approach has to be taken to addressing the issue of "hidden" sugars in processed food and SSBs (Haque et al., 2020).

Significance of the study:

Studies have shown that free sugar is an important risk factor for the occurrence of non-communicable diseases. A high sugar diet means excessive calorie intake (DiNicolantonio et al., 2016, Rippe et al. 2017, and Vos et al., 2017). Free sugars contain extra calories with no nutritional benefits known as "empty calories". Unfortunately, people consuming these types of food do not eat less food to balance this high caloric content (Mari 2017). A high sugar diet not only increases the risk of obesity, diabetes, dental caries, but also may cause metabolic changes such as lipid derangements, coronary heart disease, and other vascular diseases (DiNicolantonio et al., 2016, Rippe et al. 2017, Vos et al., 2017, Abbas et al. 2019, and Johnson et al., 2009). Furthermore, it would make individual suffer from cognitive deficits and neurological impairment underlying the development of neurodegenerative diseases such as senile dementia (Alzheimer's Disease) (Stephan et al. 2010). Moreover, a high sugar intake increases the risk of cancer, oxidative stress, and

inflammation (Jacques et al. 2019). One study found that in both sexes the consumption of SSBs was strongly correlated with reduced fertility (Hatch et al., 2018). SSBs consumption is associated with a higher mortality rate (Anderson et al., 2020).

Hidden sugars food pose a major health risk that must be avoided, in a similar way to what is already known about hidden fats (Mari 2017). This shows the need for more education about the hidden sugar and harmful effects of sugar on health (Farokh-Gisour et al., 2017). Effective interventions aiming to improve young and older adults eating behaviors and dietary habits should be provided by the community health nurse and gerontological nurse (Genena et al., 2017 and WHO Healthy Diet 2020).

Aim of the study:
To determine the effect of a hidden sugar guidance program on the young and older adults' knowledge and consumption pattern

Operational definition of consumption pattern: consumption patterns in this study mean that the process by which people purchase and consume hidden sugar to satisfy their needs.

Research Hypothesis:
1- Young and older adults who attend the hidden sugar guidance program exhibit higher level of total knowledge score than before it.
2- Young and older adults who attend the hidden sugar guidance program exhibit lower level of total hidden sugar consumption pattern than before it.

Materials and Method
Materials
Design:
The study followed a quasi-experimental research design (one group pre-test post-test)
Setting:
The study was carried out in two settings:
1- El Waffa club for older adults which is affiliated to the Ministry of Social Solidarity, Alexandria, Egypt. El Waffa club is the biggest club for community-dwelling older adults with higher registration and attendance rate. It is easily accessible for older adults and characterized by multiple social and recreational activities.
2- Two faculties at Alexandria University, one faculty from the theoretical faculties (Faculty of Art), and one from the practical faculties (Faculty of Science) were selected.

Subjects:
The study subjects were selected by a convenience sampling technique from the previously mentioned settings and fulfill the following inclusion criteria; agreed to participate in the study, free from any medical conditions that interfere with their dietary intake such as Diabetes Mellitus and cardiovascular diseases, and able to read and write for older adults. They were divided into two groups:
1- Young adults, they were undergraduate students from all grads of Faculty of Art and Faculty of Science, Alexandria, Egypt. Their age ranges between 18 to 24 years.
2-   Older adults aged 60 years or more.

Sample size:
The sample size of the participants required can be calculated according to the following formula.

$$n= \frac{t^2 \times p(1-p)}{m^2}$$

n = required sample size
t = confidence level at 95% (standard value of 1.96)
p = estimated measurements
m = margin of error at 5% (standard value of 0.05)
Calculation of sample size (N):

$$n= \frac{1.96^2 \times 0.085(1-0.085)}{0.05^2}$$

$$n = \frac{3.8416 \times 0.0777}{0.0025}$$

$$n = \frac{0.2987}{.0025}$$

$$n = 120$$

The sample size must be at least 120 subjects in this study, 60 in each group.
Tools:
Four tools were used to collect the necessary data:
Tool (I): Young and Older Adults' Sociodemographic Characteristics, Health Profile, and Lifestyle Structured Questionnaire Sheet:
It was developed by the researchers after reviewing the related literature (Mumea et al. 2020, Prada et al. 2020, Laclaustra et al. 2018, and Murad 2017), and it includes three parts;
•   **Part 1**: it includes data about sociodemographic characteristics such as: age, sex, level of education for older adults and grade for young adults, marital

status, living arrangement, monthly income, and working status if present.

- **Part 2:** it includes data about the health profile of the subjects such as current health status, medications taken, random blood glucose levels and anthropometric measurements such as height and weight to calculate BMI. **BMI** was classified based on the **WHO** classification into four categories: underweight ($\leq$ 18.5 kg/m^2), healthy weight (18.5 and 24.9 kg/m^2), overweight (25.0 and 29.9 kg/m^2), and obese ($\geq$ 30 kg/m^2) WHO. BMI. 2018).
- **Part 3:** it includes questions related to subjects' lifestyle such as: practicing exercises, and smoking habits.

Tool (II): Young and Older Adults' Hidden Sugar Knowledge Structured Questionnaire Sheet:

It was developed by the researchers after reviewing the related literature (Mumena et al. 2020, Prada et al. 2020, Laclaustra et al. 2018, Tang et al. 2020, Tierney et al. 2017, and Parmenter et al. 1999), it includes questions related to the subjects' knowledge about hidden sugar such as the definition of hidden sugar, sources, dietary recommendation, sugar disease relationship, health effect of hidden sugar, the addictive effect of sugar, withdrawal symptoms, and receiving any nutrition class. The total score for each right answer marks as (1) and wrong answer marks as (0), then sum the total score of knowledge ranged from 0-10, for each subject the category of a score was calculated as follows; if the total score is less than 33.3% it would be poor knowledge, from 33.3-66.6 would be fair, more than 66.6% would be good level of knowledge.

Tool (III): Young and Older Adults' Hidden Sugar Consumption Pattern Structured Questionnaire Sheet:

It includes three parts;

- **Part 1: Semi-Quantitative Food Frequency Questionnaire (SQFFQ):**

This is a type of dietary assessment instrument and it was developed by Teufl, 2013. This assessment includes 33 items, open-ended, self-administered, semi-quantitative food frequency questionnaire designed to measure usual sugar intake over the past month. It is a reliable tool at 0.77. There has been a section asking about the foods in the questionnaire included beverages such as juice, fruit drinks, soft drinks and flavored milk; there was another section asking about the amount of sugar added to tea or coffee as well as questions on baked goods, cereals, sugar added to cereals and other sweet foods intake. The questions were split into two parts: the first

part required the participants to specify how often they ate a specific food over the past month and the second quantified the amount eaten each time in 'natural' units such as 'one piece' of fruit. The **Food Frequency Questionnaire** included photographs of beverage size, thickness of spread on bread, muffin size and the size of heaped teaspoons to aid quantifying by participants. The score of each item for this questionnaire was calculated as follows; the highest consumption score takes 0 and the lowest consumption score take 3. So, the total score ranged from 0-93 points, for each subject the category score was calculated. If the total score was less than 33.3%, it is considered a high consumption score, from 33.3-66.6 moderate consumption score more than 66.6% considered lower consumption score of usual sugar intake.

Part 2 and part 3 were developed by the researchers after reviewing the related literature (Mumea et al. 2020, Prada et al. 2020, Laclaustra et al. 2018, and Murad 2017).

- **Part 2:** it includes data about both dietary habits, and behaviors such as: main food shopper, cooker, interest in food, the daily intake of vegetables and fruits, the healthfulness of dietary habits, reading labels, their efforts to decrease sugar intake and how, and sugar consciousness.
- **Part 3:** it includes data about factors influencing the consumption pattern of sugar such as appetite, mood and/or stress, cost, access time and/or cooking skills, family and/or peers.

Tool (IV): Measurements' scales for weight, height, and random glucose blood level:

It includes adults' weighing scale, measuring tape for height, and Glucochech apparatus.

Method:

Validity and reliability of the tools:

- Tools I, II, part 2 and part3 of tool III were developed by the researchers after reviewing the related literature, translated into Arabic, reviewed by a jury committee from the related specialties such as Gerontological Nursing and Community Health Nursing. Tools II and part I of tool III were tested for their reliability using Cronbach's alpha. It was 0.785 and 0.801 respectively.

Field Work:

- An official letter was obtained from the Faculty of Nursing, Alexandria University forwarded to the concerned authorities to take their permission to carry out the study, as follows;

1- The main campus of colleges for theoretical and practical faculties of the Alexandria University.
2- The Ministry of Social Solidarity and the director of El Waffa elder's club in Alexandria.

The permission was obtained after explaining the purpose of the study, the time, and date of the data collection.

- The two faculties at Alexandria University were selected randomly from all the faculties of Alexandria.
- A pilot study was done to explore the applicability and clarity of the tools on 20 young and older adults. Required modifications were done accordingly. The sample of the pilot study was excluded from the study.
- Data collection took four months, started in September 2019 till the end of the year.

Procedure of data collection:
- The questionnaire was disseminated to the study subjects (young and older adults) who fulfill the inclusion criteria of the study, after obtaining their oral consent to participate in the study.

The hidden sugar guidance program was carried out through the following phases (The preparation phase, The implementation phase, and The evaluation phase).

I- Preparation phase:
- A hidden sugar guidance program was prepared by the researchers after reviewing the literature; it included all available knowledge and information regarding the hidden sugar.
- Preparation of the audiovisual materials that are needed to implement the program such as posters, brochures, booklets, and PowerPoint presentations for each session.
- The researchers prepared the environment, in which they would meet the participants by selecting an appropriate room in the elderly club and a suitable class in the faculty. It has been ensured that it is well lit, ventilated, and calm.
- Preparation of the study subjects who meet the study criteria by explaining the purpose of the study, the proposed guidance program and ensured that the subjects were seated comfortably.
- The participants of both groups were asked to fill the pretest questionnaires which also include their sociodemographic data.
- Each questionnaire took about 20 to 30 minutes to fill; the printed questionnaire for the older adults was in a large font to be easily read. Minimum help was

introduced to them if they found any difficulties in reading the questionnaire.
- The researchers measured and recorded the subjects' weight, height and their random blood glucose level.

II- Implementation phase:
- The hidden sugar guidance program involves young and older adults attending a 60-minute group session and has a set of specific objectives once weekly over twelve-weeks. Each session included a 15-minutes revision of the previous session, 30 -minute presentation for the content by the researchers, who then chaired a 15- minute group discussion of the issues raised during the session and, summarization and feedback of the main points in the session.
- This was achieved through using different teaching audiovisual materials such as data show, pictures, posters, brochures, and booklet.
- The *first* session includes a simple introduction about the purpose of the study and the dissemination of the study questionnaire to be filled out by the study subjects.
- The *second* session aimed to explain the different definitions of sugars, types, and why sugars are added to the different types of food by manufacturers.
- The *third* session involved the definition of hidden sugar, its types and its sources.
- The *fourth* session aimed to help the subjects to understand the process of addiction to sugars, its effect on the brain, central nervous system, and mood, when and how the person becomes addicted to sugars, and the withdrawal signs and symptoms if the person tries to quit it.
- The *fifth and sixth* sessions described the effect of consuming sugars on the persons' health. The effects were explained on each body system in detail.
- The *seventh* session includes factors affecting the increase or decrease consumption of sugars.
- The *eighth, ninth, and tenth* sessions aimed to explain different strategies for reducing sugar consumption and establish healthy dietary habits. They include raising the awareness of young and older adults to choose healthy foods will ultimately lead to an improvement in diet. Furthermore, they included knowledge about eating five portions of arranging of fruits and vegetables each day, limit sugary food and drinks containing free sugars to an occasional treat and always have with a meal, no SSBs, consume

whole fresh fruits and raw vegetables as healthy snack between meals, be aware of hidden sugars by checking labels on foods and drinks and choose the one with no added sugar, drink fresh fruit juice than canned one, avoid processed food and fast food. The researchers instructed to the participant how to calculate their daily sugar intake with assistance of some online free applications.

- The ***eleventh***, and ***twelfth*** sessions involved a revision for program's full content and responding to questions by the participants.

III-   Evaluation phase:

- It was done one month following the program's completion, through using the study tools (tool II and part 1 of tool III) to identify the effect of the hidden sugar guidance program on the knowledge, and consumption pattern of the young and older adults.

Ethical Consideration:

Ethical considerations were considered across the study. Informed oral consent was obtained from the participants after a complete explanation of the study purpose. Privacy and anonymity of the study subjects and confidentiality of the collected data were assured throughout the study.

Statistical Analysis:

The collected data was coded, tabulated, and statistically analyzed using IBM SPSS statistics (Statistical Package for Social Sciences) software version **22.0, IBM Corp., Chicago, USA, 2013.** Descriptive statistics were done for the quantitative data as minimum& maximum of the range as well as mean ± SD (standard deviation) for quantitative parametric data, while it was done for qualitative data as number and percentage.

Inferential analyses for independent variables were done using the Chi-square test for differences between proportions and Fisher's exact test for variables with small expected numbers, while correlations were done using Pearson's correlation for numerical parametric data. A linear regression model was used to find out independent factors affecting different scales.

The level of significance was taken at P value < **0.050** is highly statistically significant, otherwise is non-significant. The p-value is a statistical measure for the probability that the results observed in a study could have occurred by chance.

Results:

Fig. 1: shows that the consumption pattern of hidden sugar in young adults, as recommended by the WHO, decreased after the program. 96.7 % of the young adults reported consumption of hidden sugar by > 25 gm. /day before the program compared to 48.3 % after the program with a statistically significant difference P = 0.001.

Fig. 2: illustrates that the consumption pattern of hidden sugar among older adults, as recommended by the WHO, also decreased after the implementation of the program from 88.3 % to 38.3 % in subjects who reported consumption of > 25 gm. /day with a statistically significant difference P = 0.001.

Table (1) shows the effect of the hidden sugar guidance program on the young and older adults' total level of knowledge score and total consumption pattern score. It was observed that the level of good and fair knowledge among young adults increased from 0 to 70% and from 10% to 20% respectively after the program than before it with a statistically significant difference P = 0.0001. Additionally, the level of knowledge improved in older adults from 0% to 60% in a good level of knowledge and from 0% to 31% as for a fair level of knowledge, with a statistically significant difference P = 0.0001. It was observed that before the implementation of the hidden sugar guidance program 16.7% of the young adults had lower consumption level of hidden sugar. After the implementation of the program 60% of them acquired healthy dietary habits and reported lower consumption level of hidden sugar with a statistically significant difference P = 0.001. The same ratio was observed in the older adults, 25% of them reported having lower consumption level, while the percent improved after the program to 63.3 % with a statistically significant difference P = 0.001.

Table (2) illustrates that the sex of both young and older adults had a significant relationship with their total knowledge score of hidden sugar P = 0.008 and P = 0.001 respectively. Females reported better level of total knowledge score than males in both groups. Furthermore, the young and older adults who reported higher grades, and level of education had a good level of total knowledge score than the lower education, with a statistically significant difference P = 0.013 and P = 0.006 respectively. Regarding the income, the young and older adults with enough income reported a better level of total knowledge score than the other group with a statistically significant difference P = 0.001 and P = 0.003 respectively. Although 90.5 % and 94.4% of the young and older adults who live with their families were found to have a good level of total knowledge score than others and there is

no statistically significant difference was found in both groups.

Table (3) displays that there is no significant relation between age, marital status of young, and older adults and their total consumption score of the hidden sugar. Females in both groups reported lower consumption score of hidden sugar than males, with a statistically significant difference P = 0.001 and P = 0.012 respectively. There is no relation between the level of education of young adults and their total consumption score of hidden sugar, while there is a statistically significant difference in older adults P = 0.039. A higher level of education is associated with lower consumption score of hidden sugar. Regarding the relation between the monthly income of both groups and their total score of hidden sugar consumption, it was found that young and older adults with enough income had lower consumption score than others with a statistically significant difference P = 0.011 and P = 0.016 for both respectively. Living with family members had a significant effect on the young adults' consumption of hidden sugar. While, 94.4% and 76.3% of young and older adults respectively who live with their families reported lower consumption score of hidden sugar, a statistically significant relation was found in young adults only P = 0.031.

Table (4) demonstrates that the young and older adults with a good total level of knowledge score of hidden sugar had lower random blood glucose levels than others, with a statistically significant difference P = 0.036 and P = 0.042 for both respectively. Also, in calculating the Body Mass Index (BMI) for both groups, it was found that 85.7% and 36.1% of normal weight young and older adults had a good total level of knowledge score, with a statistically significant difference P = 0.025 and P = 0.035 for both respectively. Regarding practicing routine exercises in their lifestyle, the young and older adults who reported an active lifestyle had a better level of total knowledge score, with a statistically significant difference P = 0.005 for both groups. The type of current diet consumed is associated with the total level of knowledge score after the program in both groups. It was found that young and older adults who consumed ordinary diet had either a good or

fair level of total knowledge score by 50%, 83.3 %, 47.2 %, and 89.5 % respectively, with a statistically significant difference P = 0.013 in both groups. There is no statistically significant relation between smoking and the subjects' total level of knowledge score of hidden sugar.

Table (5) illustrates that the young and older adults with lower consumption score of hidden sugar had lower Mean ±SD of random blood glucose level with a statistically significant difference P = 0.021 and P = 0.002 in both groups respectively. Regarding calculating BMI, it was found that subjects in both groups with normal body weight reported lower consumption score of hidden sugar, with a statistically significant difference P = 0.005 and P = 0.003 in both groups respectively. An active lifestyle in performing regular and routine exercises had a significant relation with young and older adults' pattern of consumption. Lower consumption score of hidden sugar associated with performing regular exercises with a statistically significant difference in both groups P = 0.011 and P = 0.006 respectively. The young and older adults who consume ordinary diet reported lower consumption score than others, with a statistically significant difference in both groups P = 0.001 and P = 0.022 respectively. Regarding the smoking habits in young and older adults and their total consumption pattern score of hidden sugar, it was observed that non-smokers in both groups reported lower consumption, a statistically significant difference was observed only in the young group P = 0.017.

Table (6) reveals that there is a significant relationship between attitude, beliefs, and/or knowledge about food and young adults' level of hidden sugar total knowledge score P = 0.012. Young adults' appetite and/or taste, mood and/or stress, attitude beliefs and/or knowledge about food and cost of food affect their level of total hidden sugar consumption score, with a statistically significant difference P = 0.031, P = 0.027, P = 0.006 and P = 0.009 respectively. The same figure was observed concerning factors affecting hidden sugar consumption among older adults, with a statistically significant difference P = 0.025, P = 0.021, P = 0.035 and P = 0.002 respectively.

Figure (1) Distribution of the young adults regarding amount of total added sugar consumption per day according to the WHO recommendations before and after the program
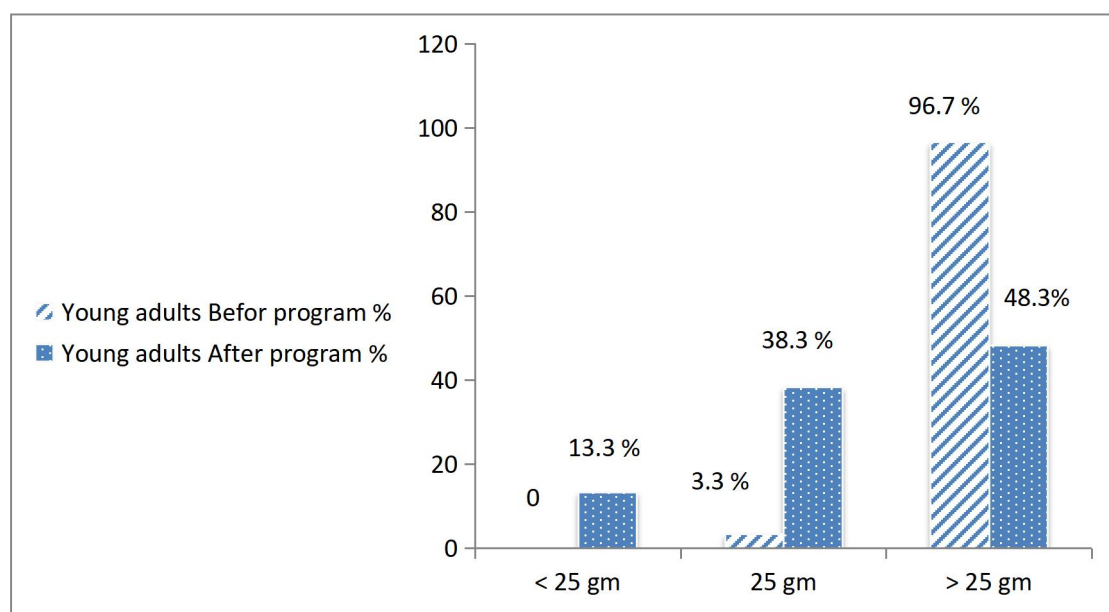
*P = 0.001

Figure (2) Distribution of the older adults regarding amount of total added sugar consumption per day according to the WHO recommendations before and after the program
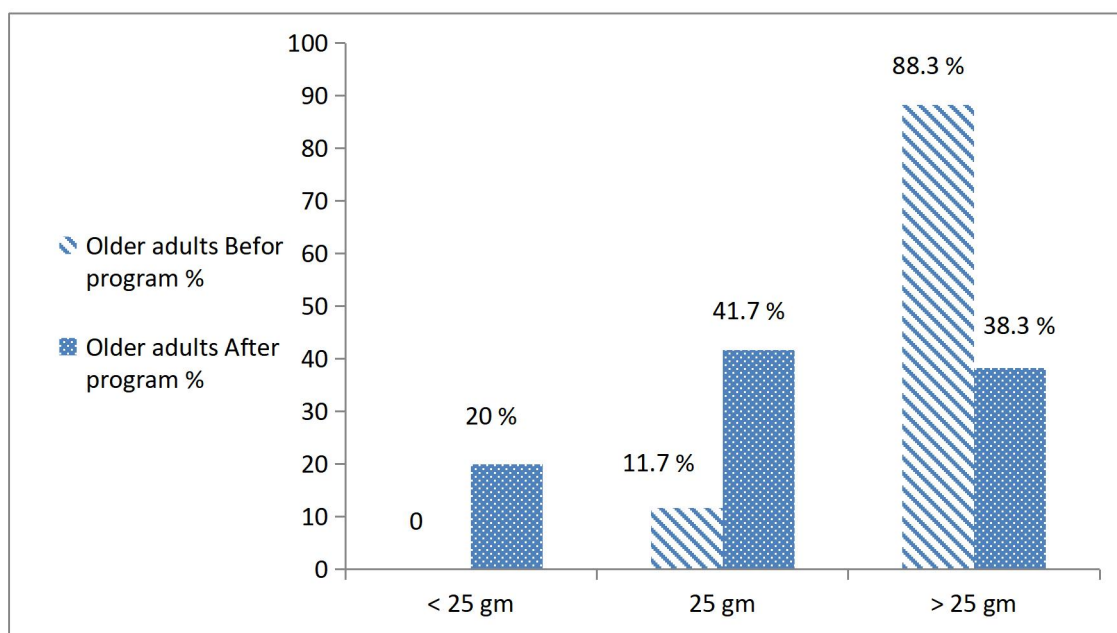
*P < 0.05   *P =   0.001

Table (1): Effect of hidden sugar guidance program on the young and older adults' level of total knowledge and consumption pattern score

Variables	Young adults				P value	Older adults				P value
	Before program		After program			Before program		After program		
	No	%	No	%		No	%	No	%	
Total knowledge score										
Good	0	0.0	42	70.0	**0.0001***	0	0.0	36	60.0	**0.0001***

Fair	6	10.0	12	20.0		0	0.0	19	31.7	
Poor	54	90.0	6	10.0		60	100.0	5	8.3	
Total Consumption pattern score of hidden sugar										
Lower consumption	10	16.7	36	60.0		15	25.0	38	63.3	
Moderate consumption	25	41.7	16	26.7	**0.001***	21	35.0	17	28.3	**0.001***
Higher consumption	25	41.7	8	13.3		24	40.0	5	8.3	

*P < 0.05

Table (2): Relation between sociodemographic characteristics of the young and older adults and their total knowledge score of hidden sugar

Variables	Level of total knowledge score in young adults												Total "n=60"	P value	Level of total knowledge score in older adults												Total "n=60"	P value
	Good "n=42"		Fair "n=12"		Poor "n=6"										Good "n=36"		Fair "n=19"		Poor "n=5"									
	No.	%	No.	%	No.	%									No.	%	No.	%	No.	%								
Age Mean ± SD	20.1±2.33		19.2±1.98		21.3±2.11								20.6 ±2.08	0.23	70.6±6.8		69.8±10.3		71.2±6.9								71.8 ±8.3	0.521
Marital status																												
Single	40	95.2	11	91.7	5	83.3							56		1	2.8	1	5.3	0	0.0							2	
Married	2	4.8	1	8.3	1	16.7							4	0.73	25	69.4	12	63.2	1	20.0							38	0.325
Widow	0	0.0	0	0.0	0	0.0							0		7	19.4	5	26.3	3	60.0							15	
Divorced	0	0.0	0	0.0	0	0.0							0		3	8.3	1	5.3	1	20.0							5	
Sex																												
Male	5	11.9	7	58.3	6	100.0							18	0.008*	6	16.7	5	26.3	5	100.0							16	0.001*
Female	37	88.1	5	41.7	0	0.0							42		30	83.3	14	73.7	0	0.0							44	
Grade																												
First grade /Read & write	9	21.4	10	83.3	3	50.0							22		0	0.0	16	84.2	5	100.0							21	
Second grade/ Primary education	10	23.8	0	0.0	0	0.0							10		11	30.6	2	10.5	0	0.0							13	
Third grade/ Preparatory education	5	11.9	2	16.7	3	50.0							10	0.013*	9	25.0	1	5.3	0	0.0							10	0.006*
Fourth grade/ Secondary education	18	42.9	0	0.0	0	0.0							18		9	25.0	0	0.0	0	0.0							9	
Higher education or more															7	19.4	0	0.0	0	0.0							7	
Monthly income																												
Not Enough	22	52.4	10	83.3	6	100.0							38	0.001*	18	50.0	19	100.0	5	100.0							42	0.003*
Enough	20	47.6	2	16.7	0	0.0							22		18	50.0	0	0.0	0	0.0							18	
Living arrangement																												
Living alone	1	2.4	2	16.7	0	0.0							3		2	5.6	8	42.1	4	80.0							14	
With family members	38	90.5	9	75.0	6	100.0							53	0.085	34	94.4	11	57.9	1	20.0							46	0.298
Peers and friends	3	7.1	1	8.3	0	0.0							4		0	0.0	0	0.0	0	0.0							0	

Table (3): Relation between sociodemographic characteristics of the young and older adults and their total score of consumption pattern of hidden sugar

Variables	Total consumption score in young adults									Total "n=60"	P value	Total consumption score in older adults									Total "n=60"	P value
	Healthy "n=36"		Moderate "n=16"		Low "n=8"							Healthy "n=38"		Moderate "n=17"		Low "n=5"						
	No.	%	No.	%	No.	%						No.	%	No.	%	No.	%					
Age Mean ± SD	21.2±1.65		19.6±1.42		20.1±2.07			20.6± 2.08	0.425			70.6±15.6		69.5±5.26		70.8±12.3		71.8 ±8.3	0.426			
Marital status																						
Single	32	88.9	16	100.0	8	100.0		56				0	0.0	1	5.9	1	20.0		2			
Married	4	11.1	0	0.0	0	0.0		4	0.692			25	65.8	12	70.6	1	20.0		38	0.63		
Widow	0	0.0	0	0.0	0	0.0		0				10	26.3	3	17.6	2	40.0		15			
Divorced	0	0.0	0	0.0	0	0.0		0				3	7.9	1	5.9	1	20.0		5			
Sex																						
Male	5	13.9	12	75.0	1	12.5		18	0.001*			9	23.7	3	17.6	4	80.0		16	0.012*		
Female	31	86.1	4	25.0	7	87.5		42				29	76.3	14	82.4	1	20.0		44			
Grade																						
First grade /Read & write	16	44.4	5	31.3	1	12.5		22				2	5.3	14	82.4	5	100.0		21			
Second grade/ Primary education	5	13.9	1	6.3	4	50.0		10	0.108			10	26.3	3	17.6	0	0.0		13			
Third grade/ Preparatory education	5	13.9	3	18.8	2	25.0		10				10	26.3	0	0.0	0	0.0		10	0.039*		
Fourth grade/ Secondary education	10	27.8	7	43.8	1	12.5		18				9	23.7	0	0.0	0	0.0		9			
Higher education or more												7	18.4	0	0.0	0	0.0		7			
Monthly income																						
Not Enough	14	38.9	16	100.0	8	100.0		38	0.011*			20	52.6	17	100.0	5	100.0		42	0.016*		
Enough	22	61.1	0	0.0	0	0.0		22				18	47.4	0	0.0	0	0.0		18			
Living arrangement																						
Living alone	2	5.6	0	0.0	1	12.5		3				9	23.7	5	29.4	0	0.0		14			
With family members	34	94.4	16	100.0	3	37.5		53	0.031*			29	76.3	12	70.6	5	100.0		46	0.241		
Peers and friends	0	0.0	0	0.0	4	50.0		4				0	0.0	0	0.0	0	0.0		0			

Table (4): Relation between health profile and life style of the young and older adults and their total level of knowledge score

Variables	Total knowledge score in young adults						Total "n=60"	P value	Total knowledge score in older adults						Total "n=60"	P value
	Good "n=42"		Fair "n=12"		Poor "n=6"				Good "n=36"		Fair "n=19"		Poor "n=5"			
	No.	%	No.	%	No.	%			No.	%	No.	%	No.	%		
Health profile																
Random Blood Sugar Mean ± SD	92.5±12.3		98.2±10.3		111.2±16.2		101.07 ± 15.34	0.036*	150.6±36.2		162.3±42.3		172.2±40.9		166.7 ±48.0	0.042*
BMI category																
Under weight	2	4.8	1	8.3	0	0.0	3	0.025*	2	5.6	0	0.0	0	0.0	2	0.035*
Normal weight	36	85.7	4	33.3	1	16.7	41		13	36.1	2	10.5	0	0.0	15	
Over weight	4	9.5	6	50.0	1	16.7	11		16	44.4	11	57.9	0	0.0	27	
Obese	0	0.0	1	8.3	4	66.7	5		5	13.9	6	31.6	5	100.0	16	
Life style																
Practicing physical exercises																
No	21	50.0	9	75.0	6	100.0	36	0.005*	20	55.6	19	100.0	5	100.0	44	0.005*
Walking	12	28.6	3	25.0	0	0.0	15		12	33.3	0	0.0	0	0.0	12	
Aerobic exercises	4	9.5	0	0.0	0	0.0	4		4	11.1	0	0.0	0	0.0	4	
Swimming	5	11.9	0	0.0	0	0.0	5		0	0.0	0	0.0	0	0.0	0	
Type of current diet																
Omnivorous	11	26.2	0	0.0	0	0.0	11	0.013*	8	22.2	1	5.3	0	0.0	9	0.013*
Vegetarian	5	11.9	0	0.0	0	0.0	5		6	16.7	1	5.3	0	0.0	7	
Weight loss	5	11.9	2	16.7	0	0.0	7		5	13.9	0	0.0	0	0.0	5	
Ordinary diet	21	50.0	10	83.3	6	100.0	37		17	47.2	17	89.5	5	100.0	39	
Smoking status																
No	30	71.4	5	41.7	0	0.0	35	0.082	28	77.8	10	52.6	0	0.0	38	0.287
Yes	12	28.6	3	25.0	6	100.0	21		4	11.1	5	26.3	5	100.0	14	
Ex-smoker	0	0.0	4	33.3	0	0.0	4		4	11.1	4	21.1	0	0.0	8	

Table (5): Relation between health profile and life style of the young and older adults and their total score of consumption pattern of hidden sugar

Variables	Total consumption score in young adults							Total "n=60"	P value	Total consumption score in older adults							Total "n=60"	P value
	Healthy "n=42"		Moderate "n=12"		Low "n=6"					Healthy "n=38"		Moderate "n=17"		Low "n=5"				
	No.	%	No.	%	No.	%				No.	%	No.	%	No.	%			
Health profile																		
Random Blood Sugar Mean ± SD	82.5±12.6		88.2±13.6		120.2±12.6			101.07 ± 15.34	0.021*	99.5±29.5		142.3±36.9		170.3±45.6			166.7 ±48.0	0.002*
BMI category																		
Under weight	2	5.6	1	6.3	0	0.0		3		2	5.3	0	0.0	0	0.0		2	
Normal weight	25	69.4	15	93.8	1	12.5		41	0.005*	10	26.3	5	29.4	0	0.0		15	0.003*
Over weight	9	25.0	0	0.0	2	25.0		11		18	47.4	9	52.9	0	0.0		27	
Obese	0	0.0	0	0.0	5	62.5		5		8	21.1	3	17.6	5	100.0		16	
Life style																		
Practicing physical exercises																		
No	12	33.3	16	100.0	8	100.0		36		22	57.9	17	100.0	5	100.0		44	
Walking	15	41.7	0	0.0	0	0.0		15	0.011*	12	31.6	0	0.0	0	0.0		12	0.006*
Aerobic exercises	4	11.1	0	0.0	0	0.0		4		4	10.5	0	0.0	0	0.0		4	
Swimming	5	13.9	0	0.0	0	0.0		5		0	0.0	0	0.0	0	0.0		0	
Type of current diet																		
Omnivorous	10	27.8	1	6.3	0	0.0		11		8	21.1	1	5.9	0	0.0		9	
Vegetarian	5	13.9	0	0.0	0	0.0		5	0.001*	6	15.8	1	5.9	0	0.0		7	0.022*
Weight loss	6	16.7	1	6.3	0	0.0		7		5	13.2	0	0.0	0	0.0		5	
Ordinary diet	15	41.7	14	87.5	8	100.0		37		19	50.0	15	88.2	5	100.0		39	
Smoking																		
No	25	69.4	7	43.8	3	37.5		35		28	73.7	8	47.1	2	40.0		38	
Yes	7	19.4	9	56.3	5	62.5		21	0.017*	2	5.3	9	52.9	3	60.0		14	0.106
Ex-smoker	4	11.1	0	0.0	0	0.0		4		8	21.1	0	0.0	0	0.0		8	

Table (6): Correlation between factors influencing consumption pattern, knowledge and consumption pattern of hidden sugar of young and older adults

Factors influencing the consumption of hidden sugar intake	Young adults				Older adults			
	Knowledge		Consumption of hidden sugar		Knowledge		Consumption of hidden sugar	
	r-value	P valve	r-value	P valve	r-value	P valve	r-value	P valve
Appetite and/or taste	-0.025	>0.05	0.365	0.031*	-0.092	>0.05	0.365	0.025*
Mood and/or stress	0.106	>0.05	0.41	0.027*	0.112	>0.05	0.38	0.021*
Attitude beliefs and/or knowledge about food	0.425	0.012*	0.511	0.006*	0.265	>0.05	0.34	0.035*
Cost	-0.088	>0.05	-0.465	0.009*	-0.152	>0.05	-0.422	0.002*
Access time and/or cooking skills	0.102	>0.05	0.251	>0.05	0.095	>0.05	0.233	>0.05
Family and/or peers	0.132	>0.05	0.113	>0.05	0.114	>0.05	0.113	>0.05

R= correlation coefficient

Discussion:

Sugar is a preferred component of the daily nutrition for many individuals, it is consumed in various forms: as a sweet snack, for sweetening coffee or tea, as a sugar-sweetened beverage (SSBs). It is often almost unknowingly in the form of hidden/added sugars in many processed foods that individuals may not be aware of its existence **(Hagmann et al., 2018)**. Excessive consumption of free/ added sugars increasingly being linked to the rising obesity epidemic, type 2 diabetes, dental caries, and several health problems **(Tierney et al., 2017 and Rauber et al., 2018)**. While the WHO recommends limiting added/hidden sugar to less than 10% of an individual's total calorie consumption as part of a healthy diet and added-sugar intake to less than 5% (approximately 25 g [6 teaspoons] per day) of the total calorie consumption is healthier **(WHO 2015b)**. A key message of a health education guidance program is to raise public awareness of "hidden" sugars, salt, and fats found in processed foods and sugar-sweetened beverages (SSBs), and to support individuals to change behaviors and unhealthy dietary habits **(Haque et al. 2020)**. Studies should be concentrated on obtaining more insights into the acceptance of interventions among young and older adults because sugar consumption is particularly high among these age groups **(Hagmann et al., 2018)**.

Evaluating the awareness of people can be helpful in programming for improving people's knowledge **(Farokh-Gisour et al., 2017)**. Hence, their consumption will be improved after understanding unhealthy dietary habits. The present study's findings revealed that the hidden sugar guidance program had a significant effect on the young and older adults' knowledge and their dietary habits toward the hidden sugar consumption (table 1). **Hagmann et al., 2018** supported the present study and revealed that the young and older people seem to be stronger supporters and higher responders to several governmental interventions to lower sugar intake. Also, the result of **Hedrick et al., 2017** is in agreement with the present finding and reported that interventions that target a single dietary change, such as limiting SSBs intake, improve the overall dietary quality health and provide motivation to make additional dietary changes.

The findings of the present study showed that the consumption of the hidden sugar of both young and older adult groups exceeded the recommended dietary guidelines of **WHO 2015a**. After the implementation of the program, the consumption decreased in both groups and the differences are statistically significant (figurs 1 & 2). The present result is in agreement with the results of **Mumena et al., 2020**, who revealed that 82%of the sample of Saudi young undergraduate students exceeded the recommendation of added sugar of <5% of total energy intake. On the same line the study of **Tierney et al., 2017** revealed that 65% of the participants were unaware of the WHO guidelines for sugar intake. Another study of college students in Portugal, done by **Prada et al., 2020** who observed that almost half of Portuguese young adults exceed the recommended sugar intake. **Amoutzopoulos et al., 2020** contradicted the present findings and reported that all age groups of young and older adults met the WHO free sugar guidelines except the children.

Regarding the relation between sociodemographic characteristics of the young and older adults and their total level of hidden sugar knowledge, the present study concluded that females with higher education and higher income had a better level of knowledge than others (table 2). This result is in the adheres to the report by **Park et al., 2013** that among sociodemographic groups with significant differences in knowledge of added sugar, a good level of knowledge was highest among women, higher education with higher income. In contrast to

the present result, the study of **Farokh-Gisour et al., 2017** reported that the majority of people with a high level of education were unaware of hidden sugar in foods and recommended that more studies should be conducted on evaluating the effectiveness of public educations in this field. Additionally, **Tierney et al., 2017** contradicted the present findings and reported that the level of awareness of sugar did not differ by gender and education whereas difference by age was observed. The present findings can be attributed to the fact that people with a higher level of education and higher income had the opportunity to access different sources of knowledge such as web-based knowledge.

The results of the present study revealed that there is no significant relationship between age, marital status of the young and older adults, and their total consumption score of hidden sugar. It also found that, females in both groups with higher income reported healthier dietary habits than males with lower income. Higher levels of education in older adults are associated with healthier dietary habits. Also, living with family members had a positive effect on young and older adults' dietary habits and consumption of sugar with a statistically significant relation was found in young adults (table 3). A study by **Genena et al., 2017** asserted the study's present finding in which they found a significant difference between the two genders concerning higher added/hidden sugar consumption among males. A study in the United States was done by **Ervin et al., 2013** found a higher intake of added/hidden sugar among low-income individuals. Also, another study conducted in the United States done by **Hane et al., 2014** came in the same vein with the present findings and reported that individuals of lower socioeconomic and educational status tend to consume a higher amount of SSBs, consequently resulting in a higher intake of added sugar. The result of **Hagmann et al. 2018** is in accordance with the present findings and reported that males consumed significantly more SSBs than females and contradicted the present study in which they found that, age was negatively correlated with the consumption frequency of SSBs. A study by **Anderson et al., 2020** supported the present finding and reported that higher consumption of added/hidden sugar was associated with lower income and lower educational levels in young adults. But, they contrasted the present finding in which they found that higher consumers of SSBs were more likely to be women.

To be continued to the previous findings, **Tayel et al., 2017** contradicted the present result in which they reported that the rate of using added/ hidden sugar (SSBs) was higher among females young adults. Also, they found a statistically significant difference

in age category with added sugar consumption. A study by **Mumena et al., in Saudi Arabia 2020** contradicted the present finding and concluded that excessive intake of added sugar was found among young females. These findings of the present study can be attributed to that, highly educated and highly socioeconomic subjects had the availability, opportunities, and awareness to reach the proper knowledge and can follow healthy dietary habits than others. Females were more compliant with the healthy dietary pattern may be due to the increased weight and obesity among them than males and they may have the desire to reduce their weight. Males may be more active than females and they need more energy especially the young adults. So, they consume more sugars than females. Marital status did not affect their consumption because most of the young adults were single.

Higher consumption of foods with added /hidden sugar could be a marker of poor lifestyle and dietary patterns, which are associated with physical decline and frailty in older adults **(Laclaustra et al., 2018)**. The present study revealed that the young and older adults with lower Mean ± SD of random blood glucose level, normal body weight in calculation BMI, active lifestyle in performing regular and routine exercises, and non-smoker had healthier dietary habits related to the consumption of hidden/added sugar (table 5). This result is in agreement with **Laclaustra et al., 2018**, who found that lower added sugar intake in older adults was associated with a lower frequency of diabetes and plasma glucose concentration. Also, they confirmed the present result and reported that the older adults who had lower physical activity tend to consume a higher level of added sugar. Another study which was done by **Anderson et al., 2020,** confirmed the present results and reported that higher consumption of SSBs is associated with higher BMI and higher consumers of artificially sweetened beverages were more likely to be less physically active.

The results of the present study are in the same context of **Koehler et al., 2019** that concluded that individuals who are moderate to high physically active tend to consume less energy-dense, nutrient–poor food such as added sugar from sugary foods and sugar from sugar-sweetened beverages- and ingest more nutrient-dense food such as fruits and vegetables. Multiple studies such as **Hagmann et al., 2018, Tayel et al., 2017 and Genena et al., 2017** supported the present finding and reported that the users of added/hidden sugars had an overweight problem and obesity in their BMI than non-users. A study done by **Mumena et al., 2020** contradicted the present study and reported that despite the high consumption of added sugar among undergraduate

students in their study, added sugar intake was not linked to BMI and weight status and they explained this result by the higher prevalence of underweight students observed among the study subjects.

The dietary pattern and attitude of individuals toward the consumption of added/hidden sugars are proposed to be linked with several factors. The findings of the present study revealed that there is a significant relationship between attitude, beliefs, and/or knowledge about food and young adults' level of hidden sugar knowledge. Hidden sugar consumption of young and older adults is affected by appetite and/or taste, mood and/or stress, attitude, beliefs, and /or knowledge about food, and cost of food (table 6). These results are consistent with **Murad's 2017** study who reported that variables that influence excess sugar consumption include taste preference, stress, and cost. Also, another study was done by **Block et al., 2013** confirmed the present findings and found that SSBs consumption was mainly driven by taste.

The findings of the present study supported the hypothesis and revealed that young and older adults who receive hidden sugar guidance program exhibit a higher level of knowledge with lower consumption level of hidden sugar after the program.

Conclusion:

It can be concluded from the findings of the present study that, the hidden sugar guidance program had a significant effect on the young and older adults' total level of knowledge score and hidden sugar consumption pattern. Females with a higher level of education, higher income had a better level of knowledge of hidden sugar. Active lifestyle participants with normal body weight and non-smoker had lower consumption score of hidden sugar.

Recommendations:

- Comprehensive public health education programs should be developed and implemented by the gerontological and community health nurse to inform the public about the risks of overconsumption of hidden added sugars, raise awareness, and support the young and older adults to change their behaviors.
- Governments have a central role in creating a healthy food environment through effective actions by policy-makers such as;
  1) Supervise, organize and control the web and mass media advertising of SSBs and processed foods
  2) Voluntary and mandatory labeling of beverage and processed food by industry, restaurants, fast food outlets by nutrition and public health organizations.

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