

## **Student nutritional knowledge and dietary behavior: The mediating role of students' self-efficacy and the moderating role of nutrition education**

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### **Abstract**

Poor dietary behavior is a main contributor to malnutrition, which is a global challenge with enormous social and economic costs. The present study aims to identify the factors that are probably associated with dietary behavior to improve dietary choices. The E-GNKQ questionnaire was adopted and distributed to 230 students enrolled in the Faculty of Tourism and Hotels, University of Sadat City. The results revealed that nutritional knowledge significantly affects the dietary behavior of the respondents. In addition, nutrition education (department type) has positively and significantly moderated the relationship between nutritional knowledge and dietary behavior, and self-efficacy has a mediating role in the relationship between nutrition knowledge and dietary behavior. The study recommends that higher education institutions pay attention to the critical role of nutrition education and self-efficacy to enhance the relationship between nutritional knowledge and dietary behavior by introducing nutritional courses in a wider range of academic programs.

**Keywords:** Nutrition education, nutrition knowledge, self-efficacy, dietary behavior, university students

### **Introduction**

There is no doubt that nutrition is an extremely important part of the health and development of all members of society. Good nutrition enables individuals to grow naturally, reduce their susceptibility to diseases, and have good physical, mental, and social health throughout their life (Branca, 2016; Bekele, 2020). Good nutrition is extremely essential during the fast-growing periods (i.e., adolescence/young adulthood) of one's life because these are significant times for the normal physical, mental, and social development of people. Furthermore, adhering to healthy dietary customs aids in the prevention of undernutrition, delayed growth, and chronic health problems associated with nutrition, such as obesity, type 2 diabetes, and others (Nicklas et al., 2008; Greenstone, 2009).

Students in adolescence/young adulthood drink more high-calorie drinks (O'Neil et al., 2012; Han & Powell, 2013; Branum et al., 2014); drink less plain water (Sebastian et al., 2012); eat too much fast food (Powell & Nguyen, 2013); eat too few vegetables and fruits (Krebs-Smith et al., 2010; Kim et al., 2014); skip breakfast (Smith et al., 2010; Nurul-Fadhilah et al., 2013); overconsumption of calories from fats and sugars (Krebs-Smith et al., 2010; Reedy & Krebs-Smith, 2010; O'Neil et al., 2012); and they do not practice physical activities required for good health, and prevent diseases (Vadiveloo et al., 2009). Without proper nutrition education, students who consume inadequate meals may suffer from deficiencies in specific vitamins and minerals, delay in growth, lower academic performance, and the incidence of chronic diseases over time (Antova et al., 2003).

Nutrition education is recommended to limit the prevalence of malnutrition diseases among adolescents and young adults through modifying or encouraging behaviors and highlighting the significance of healthy eating for better health (Barlow & Expert Committee, 2007; Van der Horst et al., 2007). These behaviors involve: reducing sugar-sweetened beverage consumption, decreasing fast food consumption, supporting eating meals at home, eating the recommended portion of fruits and vegetables, consuming breakfast daily, consuming balanced meals, restricting screen time, practicing physical activities for an hour daily, and

sleeping for adequate time (Barlow & Expert Committee 2007; Reedy & Krebs-Smith, 2010; Luckner et al., 2012). Nutrition education is the content of curriculums and lessons that qualifies learners to understand nutritional requirements, identify practices related to food safety and make healthy meals that will produce either short-term or long-term advantages (Wang & Stewart, 2013). Nutrition education was shown to be a convenient and effective way of promoting healthy practices related to nutrition and eating habits in youth (Inchley et al., 2001; Wang & Stewart, 2013). Furthermore, adolescents and young adults who have received nutrition education can act as change agents for poor practices by disseminating nutrition knowledge among the community's population (Massey-Stokes, 2002; Sunguya et al., 2013).

Few studies in recent years have looked at students' food habits as being influenced by their academic level (e.g., Balestracci, 2018). However, very few studies have looked at its moderating function in the context of higher education. Although prior studies have looked at how education type affects dietary knowledge and behavior, education type has not been studied in these studies. To address such a gap the present study aims to identify the relationship between the nutritional knowledge of students and their dietary behavior, revealing the mediating role of students' self-efficacy between nutritional knowledge and dietary behavior. The study also aims to indicate the moderating role of nutrition education (department type) in the relationship between nutritional knowledge and dietary behavior.

## **Theoretical Background and Hypotheses Development**

### **Nutritional Knowledge and Dietary Behavior**

Proper nutrition is an important concern for most people, as it is needed to facilitate the acquisition of healthy foods to maintain a healthy diet. People are confused about a healthy diet, due to the countless different views about the description of a healthy diet and its characteristics. Therefore, it is found that appropriate nutrition education is effective in promoting nutrition knowledge and clearing any overlap (Trabucco et al., 2013; Wang & Stewart, 2013). Nutrition education is considered one of the most effective sources for improving individual nutritional knowledge, as many previous studies have indicated (that is, Sunguya et al., 2013; Atencio, 2017; Bowers, 2020; Noronha et al., 2020). Educating students about nutrition can help increase their nutrition knowledge and improve their dietary behaviors, in addition to their ability to convey and distribute the right nutrition information effectively (Sunguya et al., 2013). Where Wall-Bassett et al. (2012) noted that the level of nutrition knowledge of students significantly increased after studying a nutrition curriculum, particularly in the topics regarding food groups, dietary recommendations, nutrition-related diseases, and food safety and hygiene. Another study indicated that participants' ability to distinguish food components accurately and sort fats and vitamins significantly improved after participating in a nutrition education class (Oldewage-Theron & Egal, 2012).

Cooking classes are regarded as a type of nutrition education that provides an opportunity for students to taste, touch, and smell foods. Furthermore, one can learn nutrition knowledge, improve cooking skills, and learn standard meal recipes from direct interactions and practical training (Karvinen et al., 2015). There was an improvement in the nutrition knowledge level of students along with a significant increase in their practical skills regarding preparing foods after a set of lessons about nutrition, preparing food, and tasting food (Townsend et al., 2006; Moreau et al., 2015).

Nutritional knowledge is the key outcome of nutrition education programs. Nutrition education provides learning of notions, facts, and processes regarding nutrition and health. These concepts involve information about nutrition relationships with other topics such as health, disease, food groups, dietary guidelines, and nutrition recommendations. Nutrition

education performs an essential role in increasing people's nutritional knowledge and promoting the health of the community eventually (Ritu & Mukul, 2020).

Students typically transition from high school to college between the ages of 18 and 24. This age ranges between the periods of adolescence and young adulthood, which is a critical age in which one's behaviors and attitudes are formed (Patton et al., 2016). It is critical to instill healthy eating habits in individuals during these times to maintain them indefinitely. Because once these behaviors are established, it is extremely hard to change them (Reed & Phillips, 2005). Many college students often do not care enough about their nutritional requirements or may ignore them due to young adulthood, transitioning to college life, living away from their home, being more independent, having different financial commitments, facing new cultural and social differences, and building new friendships and social networks (Das & Evans, 2014). These factors caused students to face ongoing challenges in making healthy food choices in addition to unhealthy eating practices, resulting in the development of a new set of poor behavior patterns such as drinking alcohol, smoking, and a decrease in their level of physical activity (Lacaille et al., 2011; Allom & Mullan, 2014; Hutchesson et al., 2015; Stok et al., 2018).

Dietary behavior is related to an individual's nutritional knowledge, and studies indicate that providing nutritional education to individuals leads to an improvement in their nutritional knowledge in addition to their dietary behavior. The consumption of vegetables, fruits, and dairy products increased, and they became more confident in their ability to adopt these behaviors into their lifestyle after growing their nutritional knowledge (Powers et al., 2005; Fahlman et al., 2008). Neumark-Sztainer (2006) pointed out that the lack of nutritional knowledge among students explains many of the bad eating behaviors they follow in their lives. Nutritional knowledge is the ideal way to achieve appropriate dietary behaviors to improve the health and performance of individuals. Individuals who lack nutritional knowledge do not have good dietary behaviors and do not feed themselves adequately. Therefore, nutritional knowledge is a prerequisite to achieving the right dietary habits and changing bad behaviors (Long et al., 2011). Previous research has found a link between nutritional knowledge and dietary behavior. For instance, Jeong et al. (2014) and Hakli et al. (2016) concluded that there was a positive relationship between participants' nutritional knowledge scores and their dietary behavioral scores. The better the students' nutritional knowledge score, the better their dietary habits were, according to this correlation. Some dietary behaviors are closely related to individuals' nutritional knowledge, so students need systematic and ongoing nutritional education to apply their nutritional knowledge to real life. Thus, this study proposes that:

*H1. Nutritional knowledge is positively related to dietary behavior.*

### **Nutritional Knowledge and Nutritional Self-Efficacy**

Theory-based nutrition education is one of the most effective tools for increasing the nutritional knowledge, self-efficacy, and healthy dietary behaviors of individuals. The social cognitive theory (SCT), developed by Bandura in 1986, is one of the most widely used approaches in designing and evaluating nutrition education. This theory assumes that individuals learn through observation and modeling. In addition, it considers behavioral, personal, and environmental aspects as interacting determinants that drive individuals' behavior. Self-efficacy refers to a person's confidence in his ability to perform a task or perform a specific behavior. Self-efficacy was described as a significant mediator between a person's knowledge and behavior (Bandura, 1997; Contento et al., 2007).

Nutrition education plays a significant role in nutritional knowledge, promoting healthy dietary behavior, and raising a person's self-efficacy regarding diet-related behaviors

(Contento et al., 2007; Franko et al., 2008; Roseman et al., 2011; Dodge, 2014). Nutrition education improved students' nutritional knowledge and eating behaviors and improved the general and academic self-efficacy of students who study nutrition major (Walter et al., 2018). It was shown that people's lack of nutrition education can reduce their self-efficacy in nutrition and consequently affect the quality of their dietary behavior and nutrition advice for others (Kushner et al., 2014).

Many previous studies revealed that providing nutritional education to students improves their nutritional knowledge and self-efficacy in some aspects such as meal planning, shopping, and cooking (Haylee, 2016), acquiring new culinary skills as well as their dietary habits (Zimmerman & Keller, 2016), the use of basic cooking techniques and methods, the use of spices, vegetables and fruits to prepare highly nutritious meals, and the ability to select and purchase low-cost products within the specified budget (Kerrison et al., 2017), providing nutritional counseling to others (Gotwals, 2011; Gotwals, 2018; Magallanes et al., 2021), serving fruits and vegetables, and supported food security practices for low-income households (Seguin-Fowler et al., 2021). Walter et al. (2018) illustrated that nutrition education improved students' nutritional knowledge and dietary behaviors and improved the general and academic self-efficacy of students who study nutrition majors. On the other hand, not all studies found a positive impact of nutrition education on individuals' self-efficacy. A study by Karpinski (2011) on a sample of college athletes found that introducing nutrition education to college athletes positively influenced their nutritional knowledge and dietary behavior but had no effect on their self-efficacy.

Although nutrition education provides students with the proper nutritional knowledge required to promote healthy dietary habits and lifestyles, the rise in individuals' nutritional knowledge alone does not lead to instant changes in individuals' attitudes towards nutrition or dietary behaviors (Worsley, 2002; Ficken, 2010). Poddar et al. (2010) indicated in their study the effectiveness of nutritional education in modifying the dietary behavior of university students by enhancing students' self-efficacy and self-regulation. Self-efficacy has a powerful impact on creating healthy changes in individuals' dietary behavior, as nutritional knowledge alone does not have sufficient power to make this change (Guntzviller et al., 2017).

Francis et al. (2009) showed that nutrition education led to an improvement in people's self-efficacy in choosing healthy foods and complying with positive nutritional behaviors and attitudes. McCaughtry et al. (2011) demonstrated that teaching nutrition education to students resulted in positive changes in their nutritional knowledge and dietary behavior with a rise in their self-efficacy in eating some types of foods such as vegetables, fruits, and meat. Yao et al. (2013) found that nutrition education led to a significant improvement in participants' consumption of whole grains, as well as an increase in their self-efficacy in choosing and preparing varieties of foods that contain whole grains for themselves and their family members as well. McNeal (2016) showed that providing people with nutrition education led to improving their self-efficacy in consuming vegetables and fruits and adopting positive attitudes and behaviors toward eating healthy foods. Gordali et al. (2021) indicated that providing nutrition education to overweight or obese people can increase their intention and encourage them to modify their dietary behavior by increasing their self-efficacy to consume less fat, in addition to improving their adherence to an adequate diet and exercise. Thus, this study proposes that:

*H2. Nutritional knowledge is positively related to nutritional self-efficacy.*

### **Nutritional Knowledge, Nutrition Self-Efficacy and Dietary Behavior**

Many studies have shown that most college students engage in negative/unhealthy eating habits such as irregular meal times, fast foods, excess intake (i.e., candy, dessert, ice cream,

chocolate), poor snacks, excess salty and fatty foods, overeating, skipping breakfast, consuming little water, drinking more soda, consuming less fruit, vegetables, and dairy, and excessive coffee consumption (Ogden et al., 2006; Brown et al., 2014; El Ansari et al., 2015; Pendergast et al., 2016; Abraham et al., 2018; Sogari et al., 2018). Studies conducted in Egypt (i.e. Abdel-Hady et al., 2014; Aljefree & Ahmed, 2015; El-Ahmady & El-Wakeel, 2017; Ali, 2018; Muhammad, 2019) supported this finding, as they found that college students in Egypt favored consuming ready-to-eat meals while roaming rather than sitting and eating a proper healthy meal. Along with their unhealthy eating practices, college students also lack knowledge about aspects related to food safety and have poor food preparation skills (Ferk et al., 2016). It was noted that when college students prepare their foods alone, they are more likely to follow unhealthy practices when handling foods, like not cleaning their hands well, not properly washing tools and cutting surfaces, incompetent washing of raw materials, or not cooking food at the right temperature (Anderson et al., 2004; Abbot et al., 2009; Fein et al., 2011).

Nutrition self-efficacy is a reliable predictor of healthy dietary behavior. Where individuals with higher nutrition self-efficacy to purchase and eat nutritious foods were more likely to do so (Anderson et al., 2000). Some studies examined the relationship between nutrition self-efficacy and dietary behaviors. The studies revealed that self-efficacy raised when associated with fruit and vegetable intake and decreased when associated with fat and carbohydrate intake (Anderson et al., 2007; Luszczynska et al., 2007; Strachan & Brawley, 2009; Fitzgerald et al., 2013; Conklin et al., 2014). It is thought that educating students with topics related to groups of food along with recommended dietary intakes of these groups, salt, recommended intakes of vegetables and fruits, sugar, sweetened drinks with sugar, nutrition labels, and how to get costless healthy foods will provide them with the adequate nutritional knowledge that assists in fostering healthier dietary behaviors (Vittrup & McClure, 2018). The efficacy of nutrition education in providing proper nutritional knowledge and modifying dietary behaviors depends on many aspects, including the duration of the curriculum, the frequency of the curriculum, the number of curriculum goals and relatedness, the design of the curriculum and the theory, and dedication to teaching the curriculum (Murimi et al., 2017). Thus, this study posits that:

*H3. Nutritional self-efficacy is positively related to dietary behavior.*

*H4. Self-efficacy mediates the relationship between nutritional knowledge and dietary behavior.*

### **Nutrition Education, Nutritional Knowledge, and Dietary Behavior**

Deshpande (2003) defined nutrition education as ‘the process of teaching the science of nutrition to an individual or group’ (p. 4164). The main objective of nutrition education is not only disseminating knowledge and facts but also developing individuals' enduring behavioral changes. Nutrition education act by dividing the huge bulk of knowledge into small single parts and presenting it to individuals easily and understandably. Effective nutrition education offers nutrition information sound, comprehensible, and useable in every situation (Deshpande, 2003). Nutrition education may also describe as the content of the curriculums and lessons that qualify learners to understand nutritional requirements, identify practices related to food safety, and make healthy meals that produce either short-term or long-term advantages (Wang & Stewart, 2013).

Nutrition education is considered a versatile strategy to promote nutritional knowledge, health, and nutrition habits in individuals. It may be presented in multiple forms and means, such as nutritional consultations for people or groups, through online and printed materials,

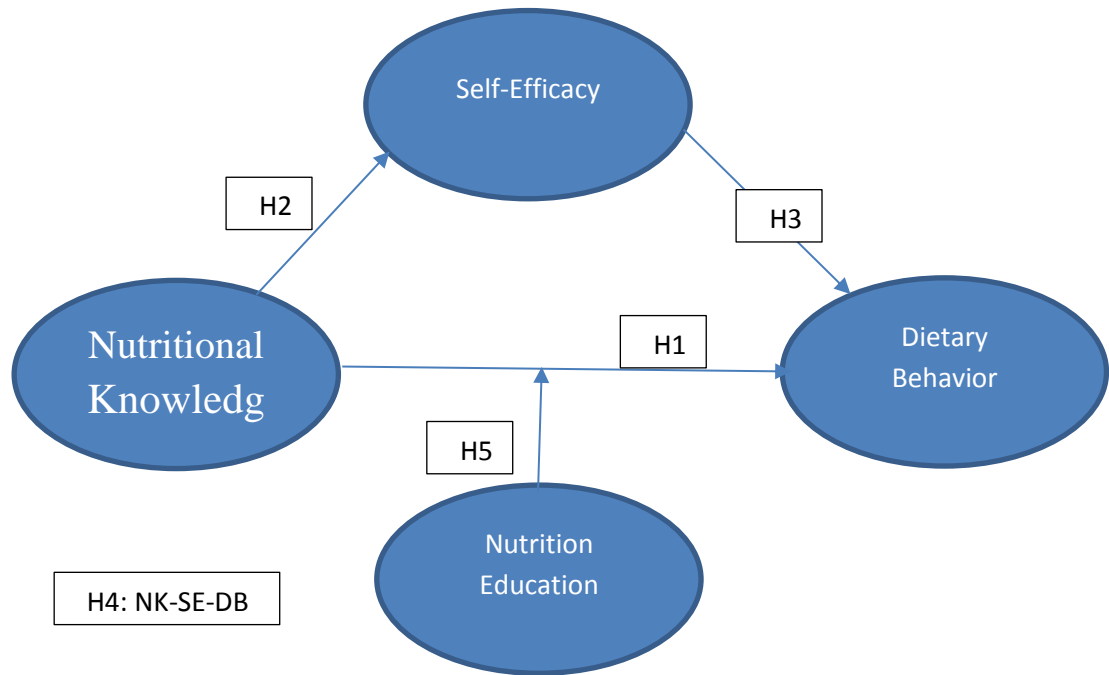
or practical courses/curricula such as cooking shows, culinary lessons, and hand-to-hand culinary training (Gupta et al., 2006; Monlezun et al., 2015). Professionals and healthcare associations indicated that nutrition education can help students learn solid food safety practices and improve their food preparation skills, in addition to improving their health and healthy eating habits (Ferk et al., 2016; Hayes et al., 2018). Nutrition education has proven its effectiveness in increasing people's nutritional knowledge (Noronha et al., 2020), supporting positive modifications in eating behavior (Yahia et al., 2016), and decreasing risk agents for nutrition-related diseases among individuals (Rustad & Smith, 2013).

Nutrition knowledge is correlated with individuals' attitudes. In cases where it was observed that people who have higher levels of nutrition knowledge were linked to their positive attitudes towards nutrition (Dissen et al., 2011). There is an influential relationship between nutrition knowledge and healthy eating behavior, as a deficiency of nutrition knowledge is considered a significant factor in poor eating behaviors among individuals (Spronk et al., 2015; Ishaq et al., 2020). Studies stated that people have misunderstandings regarding some nutrition topics and haven't adequate knowledge about dietary guidelines. This poor knowledge leads them to make negative food decisions (Heaney et al., 2011; Spronk et al., 2015). However, it was noticed that college students with good nutrition knowledge are inclined to choose healthier food options compared to students with less or no nutrition knowledge, in addition to engaging in healthy eating behavior/lifestyle and achieving more health benefits (Brown et al., 2014; Boucher et al., 2015; Metzgar & Nickols-Richardson, 2016; Miedema et al., 2016; York, 2018; Ishaq et al., 2020).

Nutrition education improves people's knowledge of nutrition and fosters healthy dietary practices that help them gain health benefits. There were positive changes in nutritional behavior after finishing a nutrition education curriculum, along with an increase in their nutritional knowledge and physical activity (Atella & Kopinska, 2014). Nutritional knowledge of individuals was increased along with positive changes in their dietary behavior such as consuming more fruits and vegetables, decreasing food waste from meals, increasing their consumption of dairy products particularly fat-free milk or low-fat milk, limiting their intakes of unhealthy food options, and salt intakes (Groh & Alexander, 2015; Williams et al., 2015; Metzgar & Nickols-Richardson, 2016; Miedema et al., 2016; Ko et al., 2016; Takada et al., 2016; Yahia et al., 2016; Au et al., 2017). Balestracci (2018) reported that students' dietary behaviors and nutritional knowledge were positively affected after receiving a nutrition education program. In this case, attitudes towards the selection of unhealthy foods, such as sweets and salty snacks, were decreased for themselves or their families. Williams (2018) noted a reduction in the consumption of soda and sugar-sweetened beverages by adolescents along with an enhancement in their intake of fruits and vegetables after exposure to nutrition education. Another study found that students engaged in healthier eating behaviors after they participated in a direct nutrition education curriculum, but there is no improvement in their physical activity or practices related to food safety (York, 2018). Thus, this study proposes that:

*H5. Nutrition education moderates the relationship between nutritional knowledge and dietary behavior.*

The conceptual framework of the study is illustrated in Figure 1.



**Figure 1:** The proposed Research Model

## Methodology

### Sample

The study targeted students in the fourth year at the Faculty of Tourism and Hotels, University of Sadat City. A total of 230 questionnaires were distributed to a convenient sample of senior students. 207 valid questionnaires were obtained (including 60 students in the Department of Hotel Studies, 97 students in the Department of Tourism Studies, and 50 students in the Department of Tourist Guidance) with a recovery rate of 90%. Senior students of the Faculty of Tourism and Hotels were selected because they completed studying nutrition courses. The questionnaire was distributed to students online using Google Forms from January 2022 to June 2022. As shown in Table 1, the majority of students are female (n = 122) and the majority of students are 21 years old (n = 103). In addition, most of the students (n = 173) study in the Arabic language branch.

**Table 1: Demographic Information (n = 207)**

		Frequency	Percentage
<b>Department</b>	Hotel studies	60	29%
	Tourism studies	97	46.8%
	Tourist guidance	50	24.2%
<b>Branch</b>	Arabic section	173	83.6%
	English section	34	16.4%
<b>Gender</b>	Male	85	41.1%
	Female	122	58.9%
<b>Age</b>	21 years	103	49.8%
	22 years	74	35.7%
	23 years	21	10.1%
	24 years	8	3.9%
	25 years	1	0.5%
<b>Total sample</b>		207	100%

### **Survey Instrument Development**

The questionnaire consisted of four sections. The first section contained the participants' demographic data, the second section assessed nutritional knowledge scores using the E-GNKQ (Hashad & Abou-Taleb, 2021), this scale was the first of its kind which accommodate the Egyptian context. This method can improve the validity of the methodology employed in the current study. The third part measured self-efficacy (SE) using 18 questions with a five-point Likert scale (SE1, SE2, SE3, and SE4) adapted from Haylee, 2016; Oden, 2017; Yasin, 2019, for example, 'I am confident in my ability to use the food pyramid to plan meals and 'I am confident in my ability to calculate the right amount of calories everyone needs. While the fourth section evaluated the student's dietary behavior (DB) through 14 questions with a five-point Likert scale (DB1, DB2, DB3, and DB4) adapted from Hoglund, 2014; Blomain, 2016; for example, 'I eat at least 5 portions of fruits and vegetables daily and 'I have regular times for my daily meals.

### **Data Analysis**

Data analysis was performed with SPSS v.26 and SmartPLS 3. The SPSS was used to calculate the overall nutritional knowledge overall scores. The current study used "Structural Equation Modeling" (SEM) using the "Partial least squares PLS" technique to examine the hypotheses of the research with SmartPLS-3.0. The proposed theoretical model was examined using a two-step approach suggested by Leguina (2015) as follows.

### **Results**

#### **Measurement Model**

To perform the SEM analysis, the measurement model's reliability and validity were assessed. The internal consistency reliability, the indicator reliability, the convergence validity, and the discriminant validity were tested. First, the internal consistency reliability was tested. Table 2 shows the values of composite reliability and alpha of students' nutritional knowledge (CR 0.988; alpha 0.987); students' self-efficacy (CR = 0.978; alpha = 0.976); and students' dietary behavior (CR = 0.972; alpha = 0.969). All CR and CA are acceptable, as they exceed the threshold of 0.70 (Hair et al., 2011). Secondly, the indicators' reliability was acceptable as all loading values of the structure indicators were higher than 0.60. Third, the convergence validity was tested by the extracted value of the average variance (AVE), and the values should exceed 0.50 (Henseler et al., 2009; Henseler et al., 2016). Table 2 shows the acceptable values of AVE: students' nutritional knowledge (0.676); students' self-efficacy (0.720); and students' dietary behavior (0.714). Eventually, 3 criteria were executed to evaluate the discriminant validity of the constructs. They were cross-loading, Fornell-Larcker criterion, and heterotrait-monotrait ratio (HTMT) Leguina (2015). Table 3 indicates that the outer loading per latent variable (underlined) was above the cross-loading with different measurements. As revealed in Table 4, the square root of the AVE of each construct is larger than all the cross-correlations among the variables (Fornell & Larcker, 1981). As indicated in table 5, HTMT readings are less than the threshold 0.90 which is recommended by Gold (2001). The results show that the model structure has proper discriminant validity. As a result, the outputs of the outer measurement model were regarded sufficient to proceed with the evaluation of the structural model.



**Table 2: Assessment of Measurement Model**

Construct	Items	Outer Loading	Cronbach Alpha	Composite reliability	AVE
<b>Nutritional Knowledge</b>			0.987	0.988	0.676
<b>Self-efficacy</b>	Self-efficacy-1	0.917	0.976	0.978	0.720
	Self-efficacy-2	0.874			
	Self-efficacy-3	0.866			
	Self-efficacy-4	0.826			
	Self-efficacy-5	0.875			
	Self-efficacy-6	0.866			
	Self-efficacy-7	0.811			
	Self-efficacy-8	0.886			
	Self-efficacy-9	0.811			
	Self-efficacy-10	0.760			
	Self-efficacy-11	0.795			
	Self-efficacy-12	0.804			
	Self-efficacy-13	0.845			
	Self-efficacy-14	0.862			
	Self-efficacy-15	0.882			
	Self-efficacy-16	0.872			
	Self-efficacy-17	0.859			
<b>Nutrition behavior</b>	Nutrition behavior-1	0.839	0.969	0.972	0.714
	Nutrition behavior-2	0.847			
	Nutrition behavior-3	0.807			
	Nutrition behavior-4	0.838			
	Nutrition behavior-5	0.845			
	Nutrition behavior-6	0.837			
	Nutrition behavior-7	0.876			
	Nutrition behavior-8	0.838			
	Nutrition behavior-9	0.817			
	Nutrition behavior-10	0.895			
	Nutrition behavior-11	0.837			
	Nutrition behavior-12	0.855			
	Nutrition behavior-13	0.869			
	Nutrition behavior-14	0.824			

AVE, average variance extracted; CA, Cronbach's alpha; CR, composite reliability

**Table 3: Cross-Loading Results**

Item	Dietary Behavior	Nutritional Knowledge	Self-efficacy
<b>a1</b>	0.765	<b>0.785</b>	0.751
<b>a2</b>	0.808	<b>0.834</b>	0.816
<b>a4</b>	0.834	<b>0.851</b>	0.832
<b>a5</b>	0.951	<b>0.974</b>	0.960
<b>a6</b>	0.836	<b>0.848</b>	0.829
<b>b12</b>	0.746	<b>0.761</b>	0.753
<b>b13</b>	0.679	<b>0.700</b>	0.668

b16	0.708	<b>0.715</b>	0.703
b18	0.769	<b>0.788</b>	0.763
b2	0.734	<b>0.775</b>	0.759
b24	0.714	<b>0.716</b>	0.692
b25	0.759	<b>0.778</b>	0.771
b26	0.730	<b>0.741</b>	0.720
b3	0.701	<b>0.717</b>	0.706
b32	0.772	<b>0.794</b>	0.765
b33	0.680	<b>0.703</b>	0.667
b35	0.865	<b>0.892</b>	0.869
b5	0.713	<b>0.720</b>	0.697
c1	0.717	<b>0.745</b>	0.739
c12	0.743	<b>0.770</b>	0.774
c2	0.822	<b>0.832</b>	0.811
c3	0.732	<b>0.734</b>	0.706
c5	0.784	<b>0.804</b>	0.788
c9	0.778	<b>0.797</b>	0.765
d1	0.731	<b>0.737</b>	0.717
d12	0.882	<b>0.910</b>	0.893
d13	0.908	<b>0.929</b>	0.910
d14	0.879	<b>0.911</b>	0.893
d15	0.831	<b>0.835</b>	0.811
d16	0.902	<b>0.932</b>	0.911
d17	0.901	<b>0.919</b>	0.914
d18	0.896	<b>0.930</b>	0.907
d19	0.886	<b>0.911</b>	0.894
d2	0.822	<b>0.844</b>	0.817
d20	0.897	<b>0.920</b>	0.893
d21	0.865	<b>0.887</b>	0.866
d3	0.820	<b>0.846</b>	0.831
d5	0.808	<b>0.836</b>	0.823
d8	0.824	<b>0.844</b>	0.830
d9	0.772	<b>0.789</b>	0.768
e1	0.906	0.922	<b>0.917</b>
e10	0.702	0.718	<b>0.760</b>
e11	0.743	0.747	<b>0.795</b>
e12	0.757	0.766	<b>0.804</b>
e13	0.801	0.811	<b>0.845</b>
e14	0.807	0.821	<b>0.862</b>
e15	0.852	0.855	<b>0.882</b>
e16	0.834	0.839	<b>0.872</b>
e17	0.821	0.836	<b>0.859</b>
e2	0.849	0.865	<b>0.874</b>
e3	0.842	0.868	<b>0.866</b>

<b>e4</b>	0.815	0.821	<b>0.826</b>
<b>e5</b>	0.861	0.871	<b>0.875</b>
<b>e6</b>	0.850	0.850	<b>0.866</b>
<b>e7</b>	0.780	0.798	<b>0.811</b>
<b>e8</b>	0.860	0.881	<b>0.886</b>
<b>e9</b>	0.772	0.794	<b>0.811</b>
<b>f1</b>	<b>0.839</b>	0.795	0.786
<b>f10</b>	<b>0.906</b>	0.903	0.895
<b>f11</b>	<b>0.837</b>	0.812	0.801
<b>f12</b>	<b>0.855</b>	0.817	0.792
<b>f13</b>	<b>0.869</b>	0.844	0.819
<b>f14</b>	<b>0.824</b>	0.789	0.773
<b>f2</b>	<b>0.847</b>	0.827	0.811
<b>f3</b>	<b>0.807</b>	0.778	0.769
<b>f4</b>	<b>0.844</b>	0.838	0.834
<b>f5</b>	<b>0.845</b>	0.817	0.814
<b>f6</b>	<b>0.837</b>	0.803	0.785
<b>f7</b>	<b>0.876</b>	0.869	0.860
<b>f8</b>	<b>0.858</b>	0.834	0.844
<b>f9</b>	<b>0.817</b>	0.795	0.772

**Table 4: Inter-construct Correlations, the Square Root of AVE, and HTMT Results**

AVEs Values				HTMT Results			
	Students' Dietary Behavior	Students' Nutritional Knowledge	Students Self-Efficacy		Dietary Behavior	Nutritional Knowledge	Self-efficacy
Dietary Behavior	0.978			Dietary Behavior			
Nutritional Knowledge	0.976	0.995		Nutritional Knowledge	0.801		
Self-Efficacy	0.962	0.971	0.979	Self-efficacy	0.881	0.853	

**Assessment of Structural Model**

This study assessed the structural model using the method of 5000 bootstraps in Smart-PLS software. The determination coefficient R<sup>2</sup> values for variables are acceptable. The structural model explained the %96 variances in dietary behavior explained by students' nutritional knowledge and students' self-efficacy and 95.4% variance in students' self-efficacy defined by students' nutritional knowledge; the acceptable values of R<sup>2</sup> must be greater than 0.10, as suggested by Chin (1998). Furthermore, the Q<sup>2</sup> test indicates self-efficacy and dietary behavior values are greater than zero, indicating adequate predictive validity of the model (Henseler et al., 2009). Consequently, sufficient predictive validity for the structural model was also confirmed.

**Table 5: Coefficients of Determination (R<sup>2</sup>) and (Q<sup>2</sup>) of the Model**

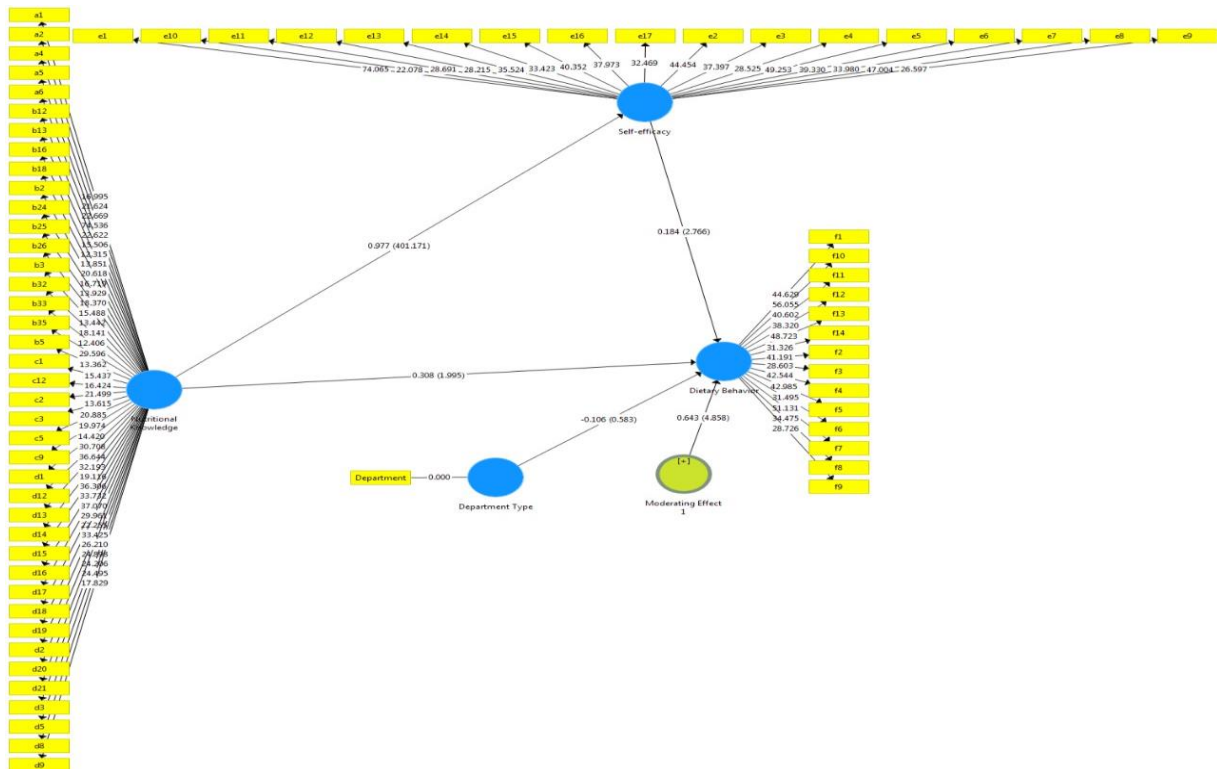
Construct	R <sup>2</sup>	Q <sup>2</sup>
Self-Efficacy	0.954	0.64
Dietary Behavior	0.960	0.48

Lastly, the results show that nutritional knowledge positively and significantly improved students' self-efficacy ( $\beta = 0.977$ ,  $t = 418.419$ ,  $P = <0.05$ ). Students' self-efficacy positively and significantly influenced dietary behavior ( $\beta = 0.184$ ,  $t = 2.707$ ,  $P = <0.05$ ). Similarly, nutritional knowledge positively and significantly influenced dietary behavior ( $\beta = 0.307$ ,  $t = 2.139$ ,  $P = <0.05$ ). Moreover, the current study identified the significance of indirect effects through the bootstrapping method. The results exhibited that the specific indirect effects of self-efficacy between the relationships of nutritional knowledge and dietary behavior are positive and significant ( $\beta = 0.180$ ,  $t = 2.708$ ,  $P = <0.05$ ) (Table 6).

**Table 6: Results of the Structural Model**

Effects	Relationships	Beta	Mean	S. D	t-value	p-value	Decision
Direct							
H1	NK $\rightarrow$ SE	0.977	0.977	0.002	418.419	0.000	supported
H2	SE $\rightarrow$ DB	0.184	0.186	0.068	2.707	0.007	supported
H3	NK $\rightarrow$ DB	0.307	0.321	0.143	2.139	0.033	supported
Mediating/Moderating							
H4	NK $\rightarrow$ SE $\rightarrow$ DB	0.180	0.182	0.066	2.708	0.007	supported
H5	NK* ET $\rightarrow$ DB	0.642	0.633	0.133	4.837	0.000	supported

\* p value <0.05



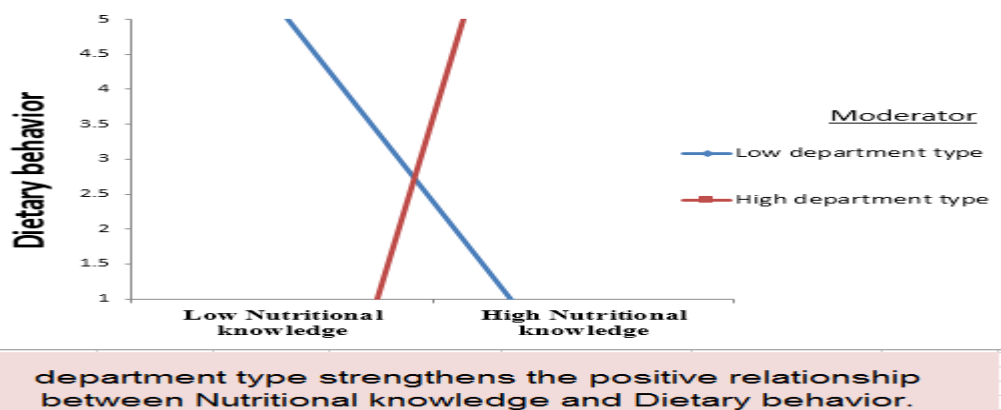
**Figure 2: The Tested Structural and Measurement Model**

## The Mediating Role of Self-Efficacy between Nutritional Knowledge and Dietary Behavior

The findings show that direct effects from nutritional knowledge on dietary behavior ( $\beta = 0.307$ ,  $P = 0.033$ ) and self-efficacy on dietary behavior ( $\beta = 0.184$ ,  $P = 0.007$ ) were positive and significant. Nitzl et al. (2016) defined that if both direct and indirect effects are substantial, partial mediation has occurred and when direct effects are insignificant while the indirect effect is positive and significant complete mediation has occurred. The results show that partial mediation has occurred in this study (Table 6).

### Assessing the Moderating Effect

This study examined nutrition education (of the educational type) as a moderator to the relationship between nutritional knowledge and dietary behavior. The results in Table 6 show that nutrition education (department type) has positively and significantly moderated the relationship between nutritional knowledge and dietary behavior ( $\beta = 0.642$ ,  $t = 4.837$ ,  $P < 0.05$ ). Furthermore, Figure 3 shows the interaction of nutrition education (of the educational type) with the relationship between nutritional knowledge and dietary behavior. The lines in the graph show that if students are enrolled in hospitality discourse, their dietary behavior will be improved predicted by nutritional knowledge. As shown in Figure 3, the interaction values of the moderator ( $0.307 + 0.642$ ) = 0.949. Therefore, it can be concluded that nutrition education strengthened the relationship between nutritional knowledge and dietary behavior.



**Figure 3: Interaction Diagram of Department Type between Nutritional Knowledge and Dietary Behavior**

### Discussion and Implications

This study proposed a self-efficacy mediation model affecting dietary behavior and a moderation model of nutrition education (department type) between the relationships of nutritional knowledge and dietary behavior. As the results demonstrated, nutritional knowledge positively and significantly affected self-efficacy, and H1 was accepted. Furthermore, the findings revealed that self-efficacy and nutritional knowledge completely and significantly affected dietary behavior, respectively, supporting H2 and H3. Furthermore, the results show that self-efficacy positively and significantly mediated the relationship between nutritional knowledge and dietary behavior; therefore, H4 was approved. The results explained that the type of education (department type) positively and significantly moderates the relationship between nutritional knowledge and dietary behavior, which supported the H5.

This study has several theoretical contributions and draws attention to the significance of the mediator role of self-efficacy and the moderating role of educational type in the university context. Several studies have explored the effects of nutritional knowledge on self-efficacy and dietary behavior (Bandura, 1997; Contento et al., 2007; Jeong et al., 2014; Hakli et al., 2016); however, the literature is limited in the university or higher education context. This empirical study was thus carried out to build further knowledge on how probable self-efficacy strategies can be implemented to improve dietary behavior using nutritional knowledge the students acquired during their undergraduate study. This study advances the conceptual understanding of the association between nutritional knowledge and dietary behavior. The nutritional knowledge variable was built on the intended learning objectives (ILOs) of the courses being taught to students in the faculty of tourism and hotels.

The results of the current study show that nutritional knowledge significantly affects the dietary behavior of graduates. Furthermore, this study develops evidence that self-efficacy has a significant direct and indirect positive influence on the dietary behavior of graduates. This study adds to the limited current literature on nutrition since many developing countries began to focus on modifying the dietary behavior of adolescents to improve their health and quality of life in general. This study provides explicit knowledge of self-efficacy and its role and benefits. Furthermore, the evaluation of the indirect or mediating function of self-efficacy in nutritional knowledge - dietary behavior is another significant contribution to the existing body of knowledge; because only a few studies have examined the mediating role of self-efficacy (see, e.g., Vittrup & McClure, 2018). The results of the current study show that only implementing nutritional knowledge to improve dietary behavior is not sufficient, supporting the literature that nutritional knowledge on dietary behavior can be enhanced by self-efficacy. In the last few years, few studies have examined education type as influential factors in the dietary behavior of students (e.g., Balestracci, 2018). However, almost no studies have examined its moderating role in the higher education context. Although previous studies have examined the role of type of education in nutritional knowledge and dietary behavior, education type is not explored. Thus, the current analysis was performed to add to the limited literature on moderating role of education type. This study has addressed some of the gaps in the perspectives of higher education. Furthermore, based on research on the influence of student dietary behavior, this study first examined the likely effects of the type of education. The results revealed a positive moderating role for the type of education in the relationship between nutritional knowledge and dietary behavior. This study explains that the type of education enhances dietary behavior when nutritional knowledge is gained.

This study proposes that higher education institutions should be aware of the effects of nutritional knowledge on improving student dietary behavior. The study's findings show that nutritional knowledge can be used to enhance students' dietary behavior. Higher education institutions can implement or develop nutritional courses to support the students' self-efficacy, which should further lead to better dietary behavior.

This study also has practical implications from the moderation aspect. It is found that educational type positively relates to proper dietary behavior. Higher education institutions should not neglect the critical role of educational type to enhance the relationship of nutritional knowledge and dietary behavior by introducing nutritional courses in a wider range of academic programs. Having done this, the dietary knowledge of graduates could be enhanced and they, in turn, become more able to make correct dietary choices in their lives. Thus, the study could contribute to enhancing the public health of citizens and overcoming malnutrition with enormous social and economic benefits in Egyptian society.

### **Limitations and Avenues for Future Research**

The study population was limited only to the students enrolled in the Faculty of Tourism and Hotels, University of Sadat City. Students of other faculties or majors can also be investigated for generalization purposes. The sample size could be further enhanced to enlarge the scope of the study. Future studies can also add more mediators or moderators to the proposed model.

### **Conclusions**

The purpose of this study was to: (1) investigate the effect of the knowledge of nutrition students have on their dietary behavior. (2) explore the role of educational type as a moderator on the relationship between nutrition knowledge and dietary behavior; and (3) examine the role of self-efficacy as a mediator in the relationship between nutrition knowledge and dietary behavior. To examine these proposed hypotheses, a questionnaire was developed, consisting of 71 questions divided into 3 sections. Data were collected from students enrolled in the faculty of tourism and hotels. A total of 230 questionnaires were distributed to a convenient sample of students and 207 valid. Samples were collected with a response rate of 90%. Smart PLS-3.0 was employed to test the hypotheses. The results revealed that nutritional knowledge significantly affects the dietary behavior of graduates. In addition, nutrition education (department type) has positively and significantly moderated the relationship between nutritional knowledge and dietary behavior, and self-efficacy had a mediating role in the relationship between nutrition knowledge and dietary behavior. Based on these results, the study filled the gap in the previous literature and added to body of knowledge by adding the moderating role of education type in the relationship between student nutritional knowledge and dietary behavior. Understanding such role and working on developing updated nutrition courses can lead to sound dietary behavior of graduates. The study recommends that higher education institutions pay attention to the critical role of educational type to improve the relationship between nutritional knowledge and dietary behavior by introducing nutritional courses in a wider range of academic programs.

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## المعرفة التغذوية للطلاب والسلوك الغذائي: الدور الوسيط للكفاءة الذاتية للطلاب والدور المعدل للتعليم التغذوي

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### الملخص العربي

يعد السلوك الغذائي السيئ عاملاً رئيسياً في سوء التغذية، وهو تحدٍ عالمي له تكاليف اجتماعية واقتصادية هائلة. تهدف الدراسة الحالية إلى تحديد العوامل التي ترتبط بالسلوك الغذائي لتحسين الخيارات الغذائية. تم تبنى استبانة المعرفة التغذوية العامة المصرية (E-GNKO) وتوزيعها على 230 طالب وطالبة بكلية السياحة والفنادق، جامعة مدينة السادات. أظهرت النتائج أن المعرفة التغذوية تؤثر بشكل كبير على السلوك الغذائي للمستجيبين. كما أن التعليم التغذوي (نوع القسم) قد عدل العلاقة بين المعرفة التغذوية والسلوك الغذائي، وكان للكفاءة الذاتية دور وسيط في العلاقة بين المعرفة التغذوية والسلوك الغذائي. توصي الدراسة بأن تولي مؤسسات التعليم الاهتمام للدور الحاسم للتعليم التغذوي والكفاءة الذاتية لتعزيز العلاقة بين المعرفة الغذائية والسلوك الغذائي من خلال تقديم مقررات التغذية في مجموعة متنوعة من البرامج الأكاديمية.

الكلمات المفتاحية: التعليم التغذوي، المعرفة التغذوية، الكفاءة الذاتية، السلوك الغذائي، طلاب الجامعة.