

The effect of intake pecan nuts on improving the nutritional, behavioral and cognitive status of deaf students with learning disability in late adolescence

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Abstract

Deaf and hard of hearing students suffer from some developmental disorders, such as learning disability, which continue with them until late adolescence without improvement in the condition. It is one of the most serious behavioral problems, as more than 13% of late adolescence students suffer from learning disability. The Study aims to investigate effect of intake pecan nuts on improving the nutritional, behavioral and cognitive status of deaf students with learning disability in late adolescence. The investigated sample of student includes 30 students (15 females and 15 males), their age (18-20yrs.) had deaf and suffering from learning disability (Lack of attention, perception and memory). They were selected from one place; Faculty of Specific Education, Ain Shams University, Cairo, Egypt. The nutritional status was studied through some forms of nutrition and the behavioral by applying a scale of Behavioral Indicators to Developmental Learning Disability (BIDL) for adolescents to all groups to assess the behavioral status before and after the dietary intervention, it was done by providing 25 g/day of pecan nuts for 3 months. The important results showed: a decrease in the intake of pecans before the dietary intervention, with an improvement in some nutrients after the dietary intervention compared to Recommended Dietary Allowances RDA for students in late adolescence in both (Zinc, Magnesium, Vitamin E, Thiamin, Niacin and Vitamin B5 by (111.1, 210.1, 135.7, 180.7, 115.76 and 129%) respectively, beside some polyphenols such as Gallic acid, Catechin, Epicatechin, and Ellagic acid by (479, 23.65, 30.2 and 343 mg) respectively, and there were a statistically significant relationship between all of them before and after the dietary intervention at $p < 0.01$. In addition, there were a significant improvement in attention, perception, memory and the level of academic achievement among students after the dietary intervention with pecans. There were a strong positive correlation coefficient between some nutrients and some polyphenols that pecans contain and degree of (BIDL) scale for the students. Finally, there were a significant improvement in the complete blood count CBC and the level of blood lipids after the dietary intervention for each of (HGB, RBCs, WBCs, CH, LDL and HDL) by 11.45 g/Dl, $4.8 \times 10^6 \mu\text{L}$, 8058 μL , 161 mmol/L, 58.6 mmol/L and 72 mmol/L) respectively. **Conclusion**, the study recommended that importance of intake pecan for students in late adolescence to improve attention, perception, memory and academic achievement, as well as CBC and Lipid Profile.

Keywords:

Behavioral status - dietary intervention - pecan - Complete Blood Count - Lipid Profile.

1. Introduction

Late Adolescence called also (Young Adulthood) their age ranges 18 – 24 years, after puberty, the rate of physical growth slows down. Boys continue to grow taller until they are eighteen or twenty years old, but girls cease growing taller at the age of sixteen. Adolescents during this period of life experience a number of psychological and emotional changes, one of which is the need for independence as they forge separate identities from their families **(Polan et al., 2003)**.

Teenagers should be guided towards appropriate, nutritious food choices by parents, other carers, and authority figures as they make an increasing number of dietary decision **(Jaworska et al., 2015)**. Making food choices is one way that teens show their independence. They typically eat more meals out from home and have the money to buy food. Additionally, older teenagers can be inquisitive and receptive to new ideas, which include experimenting with their nutrition and trying out new foods **(Cooney, 2016)**. Teens, for instance, occasionally choose to snack in place of their main meal, this is something that must be avoided, and taking into account the type of food they eat and choose **(Shin et al., 2012)**.

However, too many poor choices can make young people nutritionally vulnerable, which may negatively effect on health and developmental and behavioural abilities. Adolescents, especially in late adolescence, suffer from some developmental problems such as learning disability, which may be with them from childhood and continue even in late adolescence and in youth, which may be one of the most important reasons for following wrong food habits **(Ochola and Masibo, 2014 and Afshin et al., 2017)**.

Deafness is defined by the World Health Organization as "a person who was born deaf to a degree that makes spoken speech impossible - with or without - hearing aids, and whose causes are due to genetic factors or accidents after birth. The deaf person suffers from some sensory and developmental disabilities associated with the state of

hearing loss such as learning disability (**Ladd, 2003 and Campbell, 2007**)

Learning disability, indicate a disparity between an individual's perceived ability to learn and their degree of accomplishment (**Price et al., 2000**). It is also defined as difficulty in some processes related to learning: such as understanding, thinking, perception, attention, reading (dyslexia), writing, spelling, pronunciation, or performing mathematical operations, or in skills related to each of the previous processes, Cases of learning difficulties include people with mental disabilities, emotional disturbances, people with hearing and vision diseases and defects, and people with disabilities, provided that such disability is not the cause of the difficulty (**Williams et al., 2005 and Mercedes and Frank, 2023**). Learning disabilities occur in very young children, they are typically not identified until the child enters school, it can continue even into late adolescence and young adulthood (**Taymans et al., 2012 and Sinfeld, 2021**).

Their level of intelligence, like ordinary individuals, is 90 degrees or more, it affect males more than females and spread among individuals in the late adolescence stage affecting one out of every ten student, while It is more common among people with deafness than any other disability, as more than 40 percent of them suffer from learning disability (**Frisby et al., 2013 and Loughreyet al., 2018**). And it is divided into two types developmental learning disabilities and academic learning disabilities. Its causes are due to hereditary factors, problems during pregnancy and childbirth, environmental pollution, and incorrect food habits, such as frequent intake of foods containing preservatives and artificial colours, and frequent intake of sugars (**Crawley, 2009**).

There are many treatment methods for learning difficulties, such as educational programs and medications that help increase attention, but have a negative impact on the health of the individual, as it increases the sense of lethargy and laziness, and there are nutritional therapy programs that depend on avoiding eating foods that increase the

difficulty of perception and attention, and eating foods that improve the condition (**Haeun et al., 2009**). Hence the need to study the effect of some foods that improve the conditions of people with learning difficulties, such as pecan.

Pecan (*Carya illinoensis*) is a species of hickory native to the southern United States, the seed is an edible nut used as a snack and It may be eaten fresh or roasted, or added to some meals, Pecans, like the fruit of all other hickory species, are technically drupes, which are fruits with a single stone or pit and a husk around them rather than true nuts, the outer tissue of the flower serves as the source for the husks, whereas the endocarp tissue, which forms the nut, is where the seed is found, the husk is itself heterogeneous, or brassy greenish-gold in colour, and shaped in an oval to oblong (**Smith et al., 2017 and Greg, 2018**).

Pecans contain many important nutrients such as protein, magnesium, zinc , iron, vitamins B and polyphenols such as Gallic acid, Catechin, Epicatechin and Ellagic acid, which is one of the antioxidants that have a major role in raising the body's immunity and protecting it from many diseases, as well as in terms of behaviour and mentality, as it works to improve the states of attention, memory and hyperactivity (**Conner, 2018 and Delgadillo et al 2023**).

Through what has been presented, **the aim** of the research is clear; investigate the effect of intake pecan nuts on improving the nutritional, behavioural and cognitive status of deaf students with learning disability in late adolescence.

2. Materials and Methods

A-Total polyphenols content for pecan:

Evaluation of total Polyphenol content for pecan, with minor adjustments, the total phenolic content was calculated using the methodology outlined by **Singleton and Rossi (1965)**, Gallic acid and Ellagic acid were utilized as the standard phenolic compounds in conjunction with the Folin-Ciocalteu reagent. Test tubes were filled with

approximately 0.5 mL of the extract, 2.5 mL of the 10% Folin-Ciocalteu reagent, and 2 mL of the 7.5% Na₂CO₃. The tubes were then shaken violently to thoroughly homogenize the mixture. After 30 minutes, the mixture was left to stand, and the absorbance at 765 nm was measured. The amount of total phenol content was given as mg GAE/g DM, or milligram of Gallic acid equivalent (GAE) per gram of dry matter extract.

Total Flavonoid Content Assessment was conducted using the colorimetric method with aluminum chloride, as reported by **Aiyegoro and Okoh (2010)**, about 0.2 mL aliquot of an extract was added to 0.2 mL of aluminum chloride (AlCl₃, 10%). This was followed by the addition of 1.12 mL of distilled water and 0.2 mL of potassium acetate (CH₃COOK, 1 M). After thoroughly mixing the mixture and letting it sit at room temperature, the absorbance at 415 nm was measured in comparison to the reagent blank. The results were expressed as mg QE/g DM, with Catechin and Epicatechin (0–1000 µg/mL) serving as a standard thirty minutes later.

B-Antioxidant activity for pecan:

DPPH (2,2-diphenyl-1-picrylhydrazyl), Free radical scavenging assay, Pecan nuts were measured for their DPPH, or free radical scavenging activity, in accordance with **Ravichandran et al. (2012)**. After giving the mixture a good shake, it was left to stand at room temperature. The positive control was Butyl Hydroxy toluene (BHT, Sigma), and the negative control contained all of the reaction reagents (except for the extracts), the absorbance was then computed at 515 nm against a blank. The following formula was used to determine the DPPH radical's scavenging capacity:

$[(Ac - As) / Ac] \times 100$ is the DPPH. Scavenging effect inhibition proportion. Where: The absorbance of the control reaction is denoted by Ac. In addition, absorbance increases when plant extracts are present.

C-Subjects:

The present study was carried out in one places; Faculty of Specific Education, Ain Shams University, Cairo, Egypt. The investigated sample of student includes thirty students deaf with learning disability student (DLDS) (15 females and 15 males), their age (18-20yrs.) had deaf (there hearing loss are 91 decibel and more), and suffering from learning disability (Lack of attention, perception and memory).

D- Evaluation of nutritional status:

All children groups were subjected to the following:

a. Personal data & Socio economic data: Name, sex, age, address, intelligence quotient (IQ), number of children, parents' occupation and teaching style, parent-child relationship, family income, illness causes, and medical history were all included.

b. Nutritional statuses were assessed through:

Assessing a person's nutritional status is thought to be the most crucial stage in assessing and monitoring them in both normal and diseased conditions, especially for adolescents students in the present study, it include:

b.1. Food Habits.

The necessary data was obtained directly from the students using a questionnaire that the researcher prepared. The questions covered breakfast, the number of main meals /day, the number and kinds of snacks /day, the units of milk and its products /day, the units of fresh fruits and vegetables /day, water cups/day, juice intakes, soft drinks, and tea cups /day.

b.2. 24 hr. Dietary Recall.

The 24 hours dietary recall was applied for followed 3days pre & another 3days post dietary intervention. Using the National Nutrition Institute's food composition tables, food quantities were computed, examined, and compared to the Recommended Dietary Allowances RDA (WHO, 2020 and USDA, 2020).

b.3. Dietary Intervention.

After evaluating the nutritional status for student with learning disability, dietary intervention was applied for 3 months, to improve nutritional and behavioral status for children with learning disability. Dietary intervention in the present study includes 25g pecan nuts /day for 3 months and it was purchased from the local market in Egypt.

b.4. Anthropometric Measurements.

It is used in the present study include weight (WT) nearest 0.1kg, height (HT) nearest 0.5cm, body mass index BMI was calculated according to (Garrow, 1988), measure upper arm circumference (MUAC) and Skin fold were taken using callipers three different locations. Lower back, subscapular and triceps (TLS) (WHO, 2020).

b.5. Clinical signs (It was applied twice pre &post Dietary Intervention).

A crucial and useful technique for evaluating the behavioral and nutritional status of students with learning disabilities was clinical examination. The categories for clinical signs were: face, teeth, gums, nails, skin, and speech.

E- Behavioral status:

It is a crucial evaluation step of behavioral status through Behavioral Indicators to Developmental Learning Disability scale (BIDLD) for adolescents Al-Najjar and Salama, (2014).

The scale of (BIDLD) has 37clause in three dimensions:

- 1- **Attention** includes 18 clauses.
- 2- **Perception** (Audio and visual) include 10 clauses.
- 3- **Memory** includes 9 clauses.

Grade number were calculated from the test and interpreted according the test author as follow: Degree from (37-111) indicate high class on the scale to lowest level of developmental learning disability, while low class to the highest level of developmental learning disability (Al-Najjar and Salama 2014).

F- Biochemical Analysis:

Hemoglobin (HGB), Red Blood Cells count (RBCs) and total White Blood Cells (WBCs) counts were determined by **(Baskurt et al, 1998)**. Enzymatic colorimetric method **Allain et al. (1974)** was used to determine the serum total cholesterol (CH). While method for **(Warnick et al. 1990)** was used to calculate the serum levels of low-density lipoprotein cholesterol (LDL) and high-density lipoprotein cholesterol (HDL).

G-Statistical Analysis:

The current study's data were categorised, the findings were discussed, and the data were statistically analysed using the SPSS Windows package software, mean, standard deviation (\pm SD), t-test, analysis of variance (ANOVA), and correlation matrix **(Vandallen, 1997)**.

3. Results and Discussion

A&B- Total polyphenols content, Nutritional value analysis and Antioxidant activity for pecan.

Table (1) showed, the content of fresh pecan nuts from polyphenols, it has been noted that pecans contain a large amount of polyphenols, as each 25 gram of it contains, Gallic acid, Catechin, Ellagic acid and Epicatechin by (211, 9.1, 17.3, and 112 mg) respectively, the highest amount was in Gallic acid followed by Ellagic acid. These results are consistent with the result of United States Department of Agriculture (USDA), which showed that every 100 g of pecans contains (850, 35.2, 70.3, and 450 mg) for Gallic acid, Catechin, Ellagic acid and Epicatechin respectively **(USDA, 2023)**.

Table (1): The content of fresh pecan nuts from polyphenols

Nutrient	Quantity	Gallic acid (mg)	Catechin (mg)	Epicatechin (mg)	Ellagic acid (mg)
pecan nuts	25 g	211	9.1	17.3	112

Table (2) demonstrated the analysis of pecan nuts nutritional value, high percentage of the Recommended Dietary Allowance (RDA) for Zinc, Manganese, Vitamin E, Niacin, Thiamin, and Vitamin B5 (56.4, 100.3, 63.28, 41.6, 43, and 48.8%) respectively in 25 g of pecan nuts **USDA, (2023)**. **Rosa et al., (2018)** showed that all of these nutrients had a significant role in improving mental and cognitive abilities and improving attention, cognition and memory.

Table (2a): Nutritional value analysis of fresh pecan nuts

Nutrient	Quantity	Energy (Kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Fiber (g)	Calcium (mg)
pecan nuts	25 g	175	3.2	6.5	3.5	2.5	17.5
% RDA		8.32	4.3	11.5	2.7	9	1.45

Table (2b):

Magnesium (mg)	Iron (mg)	Zink (mg)	Selenium (mg)	Manganese (mg)	Vitamin E Tocopherol	Vitamin A (I.U)	Vitamin C (mg)
31.85	0.65	5.1	1.1	2.2	8.9	15.5	0.4
15.12	5.1	56.4	2	100.3	63.28	5.7	1.2

USDA, 2023

Table (2c):

Niacin B3 (mg)	Thiamin B1 (mg)	Folate B9 (mcg)	Vitamin B6 Pyridoxine (mg)	Vitamin B5 Pantothenic acid (mg)
5.6	0.32	6.2	0.7	2.48
41.6	43	7.1	4.2	48.8

USDA, 2023

Table 3 showed that DPPH scavenging activities of pecan nuts in Aqueous extracts. It observed the highest DPPH scavenging activity was in aqueous extract 100 (77.11%) followed by extract 50 (69.85%), extract 30 (40.15%), and extract 10 (21.81%). This result has been confirmed (Cameron et al., 2021) who observed that antiradical activity for pecan of aqueous extracts ranged from 64.6($\mu\text{g/ml}$) in concentration 50%.

Table (3): DPPH scavenging activities of pecan nuts in Aqueous extracts

Conc. of extracts ($\mu\text{g/ml}$)	Quantity
10	21.81 \pm .05 ^d
30	40.15 \pm .06 ^c
50	69.85 \pm .04 ^b
100	77.11 \pm .03 ^a

Each value is the mean \pm SD.

Mean values in each column having different superscript (a, b, c and d).

D- Evaluation of nutritional status:

a. Socio Economical Data:

Mothers of deaf students had lower university education levels than fathers of deaf students (18% and 23%, respectively). In the secondary school sample as a whole, mothers made up the largest percentage (47%) compared to fathers. The percentage of illiterate individuals in the sample was 19% for fathers and 35 percent for mothers. The group's highest percentage of mothers who were housewives was 80.9%. Regarding occupation of fathers who working as government employee, private work and retired was (51%, 37% and 12%) respectively. The majority of families (75.3%) in the study samples had three or four children. The social and economic level of all samples was average according to the scale (Ayman, 2018).

The average IQ for all samples was 85 \pm 6 when applying the Wechsler adult intelligence scale.

b.Nutritional Status Results

b.1- Food habits.

A questionnaire with some food-related questions was used to describe the study samples eating habits, the students were given the questionnaire about their eating habits, table (4) contained these data, it has been found, approximately more than half of study samples had taken breakfast about 60% and this percentage is not large. Accordingly, the data in the same table concluded that about half of the sample ate two meals / day and the other half ate three meals /day. It may be due to, the careless or low educational knowledge for

students of the current study. Similar result was obtained with **Reed et al., (2015)** who reported that more than 40% of students deaf with learning disability didn't have breakfast.

It should be noted that the investigated sample had approximately (1.7) units of dairy milk and (2.15) units of fresh vegetables per day. If not, the FAO advised eating two units of dairy food and four units of fruits and vegetables each day. It is possible to draw the conclusion that the examined sample does not consume the required vitamins and minerals, which come from fruits and vegetables, based on a comparison of this result with the FAO recommendation. This result was consistent with that of **Trainor, (2005)**, who found that children with learning disabilities experience vitamin and mineral deficiencies as a result of not consuming adequate amounts of fruits and vegetables. It is obvious that adolescence who consume inadequate amounts of fruits and vegetables run the risk of developing psychological issues as well as conditions like constipation, high blood pressure, immune deficiencies, and cancer in the future (**Rolfes et al., 2011**).

Table (4): Eating breakfast, no. of meals, and snakes/day, dairy milk and fresh vegetables and fruit /day in deaf with learning disability students (DLDS)

Sex	Break fast		Nu of Meals /Day				Nu of snacks /Day				Dairy milk (Yogurt and milk and Cheese /day			Fresh ve and fru	
	Nu	%	2 Meals		3 Meals		1 – 3		4 – 6		Child Nu	%	Mean Unit	Child Nu	%
			Nu	%	Nu	%	Nu	%	Nu	%					
F (15)	8	53	5	33.3	10	66.6	3	20	12	80	15	100	1.9	15	100
M (15)	10	66.6	10	66.6	5	33.3	4	26.6	11	73.3	15	100	1.5	15	100
Total (30)	18	60	15	50	15	50	7	23.3	23	76.6	30	100	1.7	30	100

*Milk & its products unit = one cup yogurt (75g) =one cup milk (240g) =2ΔΔprocessed cheese=60gm cottage cheese or 30 gm. processed cheese (roomy).

F=Female

M=Male

Nu =Number

Data presented in table (5) showed that the mean intake of water for tested students was (775 ml/day). It should be noted that, **Govfnic et al., (2012)**, recommended adolescents in this age should consume 2000 ml/day. Accordingly, the samples in the current study were consumed only 38.75% from water as compared to this reference.

Also, it was found that the intake of commercial juices in the current study group was higher than fresh juices. Soft drink and ready-made corn and potato products were represented (2.25& 3 unit/week) respectively. These results in agreement with **Overby et al., (2013)**, who reported that children and adults with learning disability had high intake of (sugar, soft drinks, sweets, savory snacks, and ready-made corn and potato products) that were significantly associated with increased odds of learning disabilities. These findings concur with those of **Vincenzo et al. (2011)**, who demonstrated that the scant epidemiological data on the relationship between consumption of fruits and vegetables and cognition generally supports a protective role of these

macronutrients against dementia, Alzheimer's disease, and cognitive decline.

Table (5): Consumption of water, commercial juices, Soft drinks and ready-made corn and potato products for DLDS

Sex	*Water/ day	fresh juices unit / week	Commercial juices unit / week	Soft drinks unit /week	Ready-made corn and potato products unit /week
	Mean ml	**Unit	**Unit	**Unit	***Unit
F (15)	700	1.5	2	1.5	4
M (15)	850	1.3	3	3	2
Total (30)	775	1.4	2.5	2.25	3

*Recommended for adolescence 18-21 yrs.=2000 ml/D. Govfnic et al., (2012).

**Unit = 240 ml.

***Unit=100g

b.2 & b.3 - 24hr dietary recall and dietary intervention.

Table (6) showed the eating pecan nuts / day among deaf with learning disability student (DLDS) pre and post intervention. It showed that DLDS had intake a small amount from pecan nuts /day, about 2 and 1.27g /day for female and male respectively pre dietary intervention, while post intervention, the consumption of pecan nuts was an average of 25 g/day for males and females, which is the amount designated for the nutritional intervention, there were statistically significant increase between pre and post dietary intervention by pecan at $p < 0.01$.

Nuts are nutrient rich foods known to improve human health when consumed regularly in the diet, the consumption of children between the ages of 8 to 18 years did not exceed 5 grams per week, there were inconsistent effects on biomarkers of cardio metabolic health

(improve lipid profiles, micro vascular reactivity and inflammation) and gastrointestinal health (increase in the proportion of beneficial fecal bacteria) **Lauren et al., (2021)**.

Table (6): Eating pecan nuts/day among DLDS pre and post intervention

Groups DLDS (30 students)	Pecan nuts g/day	
	Pre Intervention	post intervention
Female (15)	2	25g
Male (15)	1.27	25g
Sig.	0.00	

The aforementioned information suggests that there were a significant risk of food insufficiency among the current sample of deaf people with learning disabilities. Furthermore, some earlier research found that certain critical nutrients, like antioxidants and polyphenols, are necessary for adolescence with learning disabilities (**David, 2012**). 24 hr dietary recall for three days were done pre and post dietary intervention, while the dietary intervention from pecan nuts were by 25 g/day to intervention groups for 3 months.

It could be observe from table (7) for deaf students with learning disability pre dietary intervention, deficiency in mean intakes for, Zink, Manganese, Vitamin E, Thiamin B1, Niacin B3 and Vitamin B5, were documented by 17.58, 61, 39.3, 35.7, 24.6 and 38.2% respectively as compared with RDA **USDA, (2023)**. Also post dietary intervention, there were notice increase in this elements were documented by 111.1, 262.5, 135.7, 180.7, 115.76 and 129% respectively.

There were a statistically significant differences between pre and post dietary intervention for total sample in Zink,

Manganese, Vitamin E, Thiamin B1, Niacin B3 and Vitamin B5 at $p < 0.01$. After dietary intervention with pecan, the dietary intake of those elements has been increased and it was approximately 100% of RDA. These results were consistent with (Memić et al., 2023), who explained that students with learning difficulties suffer from a deficiency of some nutrients in their diet, such as zinc, vitamin E, and thiamin.

Table (7): Mean intake and percentage of RDA for some minerals and vitamins/day pre and post dietary intervention for DLDS

Element	Zink (mg)		Manganese (mg)		Vitamin E (mg)		Thiamin B1 (mg)		Niacin B3 (mg)		Vitamin B5 Pantothenic acid (mg)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
F (15)	2.2	10.7	1.3	4.1	4	18	0.3	1.03	3.5	15.2	1.7	6.5
M (15)	4.2	9.3	1.1 4	4.3	7	20	0.2	1.5	2.9	14.9	2.1 2	7.3
Total (30)	3.2	10	1.2 2	4.2	5.5	19	0.2 5	1.26	3.2	15.05	1.9 1	6.45
SD±	0.23	0.71	0.66	0.47	1.1	1.9	0.11	0.43	0.27	0.61	0.19	1.01
% of RDA	35.1 6	111.1	61	210.1	39.3	135.7	35.7	180.7	24.6	115.76	38.2	129
Sig.	0.00**		0.00**		0.00**		0.021*		0.034*		0.032*	

RDA&USDA, 2020.

* $p < 0.05$

** $p < 0.01$

It could be seen from table (8) for deaf students with learning disability pre dietary intervention, deficiency in mean intakes for, Gallic acid, Catechin, Epicatechin and Ellagic acid, were documented by 51.5, 5.55, 4.25 and 39.5 mg respectively as compared with USDA, (2023). Also post dietary intervention, there were notice increase in this polyphenols were documented by 479, 23.65, 30.2 and 343 mg respectively.

There were a statistically significant differences between pre and post dietary intervention for total sample in Gallic acid, Catechin, Epicatechin and Ellagic acid at $p < 0.01$.

This result in line with (Qinghan et al., 2020) whose showed that university students do not eat foods rich in polyphenols in sufficient quantity per day, the mean value about phenolics intake was 33.78 mg/day, and most of it was from Catechin, the main polyphenols consumed were flavonoids followed by phenolic acids.

The results of the current study agree with the objective of the study of Maria et al (2022), whose research sought to determine the amount of polyphenols consumed by college students and the association between those amounts and their health-related behaviors. To this end, 270 students responded to validated versions of the food consumption frequency questionnaire (FFQ), the physical activity questionnaire (IPAQ), and the health and lifestyle questionnaire. The daily consumption of polyphenol classes and subclasses was computed using the FFQ. About 115 mg of polyphenols were ingested daily, with flavonoids and phenolic acids being the most common types.

Table (8): Mean intake for some polyphenols /day pre and post dietary intervention for DLDS

Element Sex & Nu	Gallic acid (mg)		Catechin (mg)		Epicatechin (mg)		Ellagic acid (mg)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
F (15)	48	471	3.3	21.1	4.9	29.9	43	347
M (15)	55	487	7.8	26.2	3.6	30.5	36	339
Total (30)	51.5	479	5.55	23.65	4.25	30.2	39.5	343
SD±	4.3	11.4	1.4	4.2	0.98	5.2	3.21	12.3
Sig.	0.001*		0.004*		0.006*		0.002*	

USDA, 2020.

*p< 0.01

b.4. Anthropometric Measurements.

It could be seen in all DLDS groups had normal height and weight compared with standard measurements, by average 161cm and 66 kg (WHO, 2020).

It could be seen in table (9) average measurement physical standards (pre and post dietary intervention) for DLDS groups. It showed BMI for all students was normal and ranged were (21-21.1%) for all sample pre and post dietary intervention respectively, beside total sample had normal MUAC by average 21.7 and 21.95cm pre and post dietary intervention respectively, while (20: 23 cm mean normal nutritional status for male and female 18-21years), and normal TLS by average 17mm pre and post dietary intervention, while (normal ranged between 16:24 mm for male and female 18-21years) WHO, (2020).

No significant statistical in MUAC and TLS pre and post dietary intervention in two group, and this refer to students deaf with learning disability not suffer from obesity and malnutrition, but suffer from lack in some nutrients. This results consistent with (Robinson et al., 2021) who endorse that girls had higher TLS values at all ages compared with boys, the percentile of TLS ranged from to 23 and 20 mm for girls and boys respectively in 17-22 years, beside BMI was

normal and ranged 19:20% .and MUAC also normal and ranged 22mm for female and male both.

Table (9): Average measurement of Physical standards (pre & post dietary intervention) for DLDS

Groups DLDS	BMI %		*MUAC (cm)		** TLS (mm)	
	Pre	Post	Pre	Post	Pre	Post
F (15)	22	22.2	21.2	21.5	20.2	20.3
M (15)	20	20	22.2	22.4	18	18
Total (30)	21	21.1	21.7	21.95	19.1	19.15
SD±	0.02	0.04	0.98	0.7	0.77	0.89
Sig	0.32		0.12		0.21	

*MUAC=Measure Upper Arm Circumference.

**TLS= Measure skin fold by average for triceps, Lower back and sub scapular

b.5. Clinical signs: (It was applied twice pre and post Dietary Intervention).

Clinical examination has been and continues to be a crucial, useful technique for determining a community's nutritional condition (Jelliffe, 1966). The data illustrated in table (10) for clinical sings (skin, teeth, gums and nails) between pre & post dietary intervention in DLDS, it noticed that improve for number of DLDS in post intervention than pre intervention in pale skin, bleeding gums and white spots nails, where all cases improved after the intervention in the pale skin, and only two cases remained, suffering from bleeding gums, and one case suffering from white nails.

The study findings corroborated those of Yamada et al. (2013), who noted that deficiencies in zinc and vitamin B5 can lead to hypogonadism, baldness, weakened immunity, anorexia, dermatitis, night blindness, anemia, fatigue, and slowed wound healing. Hegyi et al. (2004) and Carmel et al. (2005) reported that niacin and vitamin

B1 (vitamin B3) had a significant impact on the management of dementia and dermatitis. Vitamin E (tocopherol) is an antioxidant, it protects cells against damage by free radicals, which are by-products of normal cell activity and which participate in chemical reactions within cells so , it and Polyphenols increases the immunity of the body, which helps heal wounds and freshness of the face (Israel et al., 2021).

Table (10): Clinical sings (skin, teeth, gums and nails) between pre &post dietary intervention for DLDS

Groups DLDS	Skin Nu %		Teeth Nu %		Gums Nu %		Nails Nu %	
	Pale		Caries		Bleeding		White spots	
	Pre	Post	Pre	Post	pre	Post	Pre	Post
F (15)	26.6	0	13.3	13.3	26.6	6.66	20	0
M (15)	33.3	0	6.66	6.66	20	6.66	26.6	6.66
Total (30)	29.95	0	10	10	14.3	6.66	23	3.33

Nu. = Number

E- Behavioral status :

The data present in table (11) illustrated the effect of intervention with 25g pecan nuts for three month on behavioral status. Accordingly, test of BISDL D was applied for investigated group before and after intervention. The result illustrated that, the score of BISDL D test was much higher for investigated sample after intervention than before intervention and it were (59 and 100.5 grade) respectively. It should be noted that, BISDL D score for female were higher than males in attention, perception and memory post intervention, the scores for attention, perception and memory were 50, 28 and 25 grade for female respectively, while this scores were

48, 25 and 25 grade for male post dietary intervention respectively. It was noted that the scores of females improved over males in both attention and perception, but the results of the memory axis were similar for both after the nutritional intervention. There was a statistically significant differences between degree test pre and post dietary intervention in total group at attention, perception and memory ($P = 0.000$) for all scale axes.

On the other hand, this table showed the effect of intake pecans on the academic achievement of the students sample pre and post dietary intervention, and proved that there were significant improvements in the level of academic achievement for deaf students with learning disabilities post dietary intervention. The results of the students were monitored in the first term, and it was found that all students failed with an average of two subjects in the term, with weak estimates, all of them acceptable for the rest of the subjects, before the dietary intervention, Where the results of deaf students with learning disabilities for females and males (49.3% and 50.1%) respectively. While after the dietary intervention, there were a significant improvements for all students in the second term of the study, in which the intervention was done with pecans, and the result of all students were higher than the first term, with no failure in any subject, with a variety of grades between good and acceptable, the average success rate for deaf students with learning disabilities for female and male (71.4% and 65.8%) respectively.

Polyphenols help improve memory, attention, cognitive functions and higher functions of the human brain (**Parbora et al., 2011**) Pecans are a good source of natural polyphenols, without a doubt, polyphenols are outstanding antioxidants. Preclinical research has demonstrated that, via their antioxidant and anti-inflammatory properties, polyphenols exhibit neuroprotective effects, improve neuronal functions, stimulate brain flow, induce neurogenesis, and fend off age-related damage (**Kesse et al., 2012**).

Beside **Letenneur et al., (2007)**, published the findings of a prospective study that looked at the relationship between flavonoid intake and cognitive decline. At the beginning of the study, 1640 subjects who were 65 years of age or older and free of dementia were adjusted for age, sex, and educational attainment. Over the course of the next ten years, the subjects were evaluated at home four times by a psychologist by means of mini-mental at ate examination, Benton's Visual Retention Test, and a thorough dietary survey, it has been shown that consuming flavonoids improves cognitive levels

The results of the current study agree with (**Fedor and Olag, 2015**) whose findings demonstrated that even a single polyphenol administration may considerably raise the level of total brain cortex activation and performance on cognitive function tests, helping to improve memory and cognition in both adults and the elderly. This was in line with study (**Ziółkiewicz et al., 2023**), who emphasized the importance of polyphenols in protecting the brain and nerve cells and improving memory.

Table (11): Result of applying BIDLD test in LDC and the effect of intake pecans on the academic achievement

Groups DLDS	Attention (54)		Perception (30)		Memory (27)		Total degree test (111)		The academic achievement %	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
F (15)	25	50	15	28	15	25	55	103	49.3	71.4
M (15)	30	48	19	25	14	25	63	98	50.1	65.8
Total 30	27.5	49	17	26.5	14.5	25	59	100.5	49.85	68.6
Sig.	0.00 (*)		0.00 (*)		0.002 (*)		0.00 (*)		0.001 (*)	

*P< 0.01

It could be noticed in table (12) correlation coefficient between some nutrients in pecan nuts for DLDS and degree of (BIDLD) scale. A positive correlation coefficient means that the greater the intake of some nutrients induce higher in degree of (BIDLD) scale and this means that their condition improves. There was strong positive correlation between some nutrients in pecan nuts and degree of (BIDLD) scale in Vitamin E, Thiamin B1, Niacin B3 and Catechin by (+0.812, +0.717, +0.788 and +0.827) respectively, beside moderate positive correlation between (Zink, Manganese, Vitamin B5 Pantothenic acid, Gallic acid, Epicatechin and Ellagic acid) and DLDS at (+0.613, +0.431, +0.452, +0.553, +0.442 and +0.576) respectively.

This result agreement with **Katherine, (2016)**, who showed antioxidant vitamins (including vitamin E) Maintaining a nutritious diet that minimises added sugar consumption and increases intake of fish, fruits, vegetables, nuts, and seeds will help prevent cognitive impairment. Additionally, in agreement with **(Vincenza et al., 2010)**,

who found that consuming meals high in manganese and zinc enhances cognitive function and fortifies memory.

Table (12): Correlation coefficient between some nutrients in pecan nuts for DLDS and degree of (BIDLDE) scale

Items	Correlation Coefficient Degree
Zink	+0.613**
Manganese	+0.431**
Vitamin E	+0.812*
Thiamin B1	+0.717*
Niacin B3	+0.788*
Vitamin B5 Pantothenic acid	+0.452**
Gallic acid	+0.553**
Catechin	+0.872*
Epicatechin	+0.442**
Ellagic acid	+0.576**

* Strong positive correlation = $\geq +0.7$: -1

** moderate positive correlation = $\geq +0.4$: - 0.7

F- Biochemical Analysis:

It could be seen in table (13) Blood levels of HGB, RBCs, WBCs and blood lipids (pre & post dietary intervention) for DLDS, there were statistically significant increase between pre and post dietary intervention with pecan in HGB, RBCs, WBCs, and HDL at $P < 0.05$, but there are statistically significant decrease pre and post dietary intervention with pecan in CH and LDL at $P < 0.05$. Where there were a significant improvement in the blood levels and blood lipids after the dietary intervention for HGB, RBCs, WBCs, CH, LDL and HDL, where the results were recorded pre dietary intervention (10.49, 4.65, 8653, 165, 70.5 and 61) respectively, while post dietary intervention it were (11.45, 4.8, 8058, 161, 58.5 and 72) respectively for all sample. The results for both males and females were somewhat close in blood levels (HGB, RBCs and WBCs) and blood lipids (CH, LDL and HDL).

This result agreement with (Rajaram et al., 2001) who showed that Pecan nuts are a great source of phenolic antioxidants and rich in monounsaturated fatty acids like oleic acid. Including pecan nuts in

the diet on a regular basis can help lower blood levels of LDL (bad cholesterol) and raise HDL (good cholesterol).. It is consistent with the results shown by (Ella et al., 2006) confirmed that, eating nuts lowers the risk of coronary heart disease, and studies on dietary interventions that include pecans reveal better lipid profiles. Because pecans contain significant amounts of polymeric flavanols and γ -tocopherol, their unsaturated fats provide protection against oxidation. Furthermore, consumption pecans and other nuts has been connected to a lower risk of physiological markers linked to metabolic or cardiovascular diseases, it improves the whole blood picture, especially hemoglobin and red blood cells (Atanas et al., 2017).

Table (13): Blood levels of HGB, RBCs, WBCs and blood lipids (pre & post dietary intervention) for DLDS

Groups DLDS	HGB (g/dL)		RBCs ($\times 10^6 / \mu\text{L}$)		WBCs (μL)		CH (mmol/L)		LDL (mmol/L)		HDL (mmol/L)	
	Pre	Post	Pre	Post	Pre	Post	pre	Post	Pre	Post	Pre	Post
F (15)	10.1	11.2	4.7	4.9	8702	8012	160	157	68	57	66	71
M (15)	10.88	11.7	4.6	4.7	8604	8104	170	165	73	60	56	73
Total (30)	10.49	11.45	4.65	4.8	8653	8058	165	161	70.5	58.5	61	72
SD\pm	0.4	0.9	0.12	0.23	2.1	3.1	1.4	1.6	1.9	2.3	1.4	1.2
Sig	0.011*		0.027*		0.014*		0.03*		0.041*		0.02*	

*P< 0.05 significant between per and post dietary intervention.

4. Conclusion

Paying attention to nutritional education for students in the late adolescence stage, which is the end of adolescence and the beginning of adulthood, especially for deaf students with learning disability, with the importance of intake pecans at an amount of 25 g/day , as it works to improve their developmental mental abilities through increases attention, perception, memory and the achievement level and improves cases of learning disability, it also has a positive effect in reducing the level of harmful cholesterol LDL raising the level of beneficial cholesterol HDL in the blood, beside improving the level of hemoglobin, red and white blood cells.

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تأثير تناول جوز البيكان علي تحسين الحاله الغذائيه والسلوكيه والمعرفيه لدي الطلاب الصم

ذوي صعوبات التعلم في مرحله المراهقه المتأخره

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الملخص العربي

يعاني الطلاب الصم وضعاف السمع من بعض الاضطرابات النمائية مثل صعوبات التعلم والتي تستمر معهم حتي سن المراهقه المتأخره دون علاج او تحسن للحاله, والذي يعد من أخطر المشاكل السلوكيه حيث يعاني أكثر من ١٣ % من الطلاب في سن المراهقه المتأخره من صعوبات التعلم. ولذلك تحدف هذه الدراسة إلى التحقق من تأثير تناول جوز البيكان علي تحسين الحاله الغذائيه والسلوكيه والمعرفيه لدي الطلاب الصم وضعاف السمع ذوي صعوبات التعلم في مرحله

المراهقه المتأخره. وقد أجريت الدراسة على 30 طالب جامعي (١٥ أنث + ١٥ ذكور) من ذوي صعوبات التعلم (كلية التربية النوعية -جامعه عين شمس) من سن ١٨- ٢٠ عام. و قد تم دراسة الحالة الغذائية عن طريق بعض استمارات التغذية والسلوك من خلال تطبيق مقياس المؤشرات السلوكية لصعوبات التعلم النمائية للمراقبين علي كل المجموعه لتقييم الحاله السلوكيه قبل وبعد التدخل الغذائي. وقد تم التدخل الغذائي بتقديم 25 جرام /يوميًا من جوز البيكان لمدة ثلاث شهور. وأظهرت أهم النتائج: نقص المأخوذ من البيكان قبل التدخل الغذائي , مع تحسن في بعض العناصر الغذائية بعد التدخل الغذائي بالمقارنه بالتوصيات الغذائية المسوح بها RDA للطلاب بمرحلة المراهقه المتأخره في كلا من (الزنك و الماغنسيوم و فيتامين هـ و الثيامين و النياسين و فيتامين B5 بواقع (١٨٠,٧,١٣٥,٧,٢١٠,١,١١١,١,١٢٩,١١٥,٧٦,١١٥)٪) علي التوالي بجانب بعض البوليفينول مثل حمض الجالليك و الكاتيشين وأبيكاتشين وحمض الإيلاجيك بواقع (٤٧٩, ٢٣,٦٥, ٣٠,٢, ٣٤٣ ملجم) علي التوالي وكان هناك علاقه ذات دلالة أحصائية بينهم جميعا قبل وبعد التدخل الغذائي عند $p < 0.01$. بالاضافه الي وجود تحسن ملحوظ في الانتباه والادراك والذاكره ومستوي التحصيل الدراسي لدي الطلاب بعد التدخل الغذائي بالبيكان. وكان هناك معامل ارتباط قوي موجب بين بعض العناصر الغذائية وبعض البولي فينول التي يحتوي عليها البيكان وبين درجات مقياس صعوبات التعلم للطلاب. وأخيراً كان هناك تحسن ملحوظ في تعداد الدم الكامل ومستوي دهون الدم بعد التدخل الغذائي لكلا من (HGB, RBCs, WBCs, CH, LDL and HDL) بواقع (١١,٤٥ -g/dL - $4,8 \times 10^6 \mu L$ - $80,85 \mu L$ - 161 mmol/L - $58,6 \text{ mmol/L}$ - 72 mmol/L) علي التوالي. الخلاصه : توصي الدراسة بأهمية تناول جوز البيكان للطلاب بمرحلة المراهقه المتأخره لتحسين حالات صعوبات التعلم النمائية (الانتباه والادراك والذاكره) بالاضافه الي التحصيل الدراسي لديهم وكذلك صوره الدم الكامله ودهون الدم. الكلمات المفتاحيه : الحالة السلوكية - التدخل الغذائي - البيكان - تعداد الدم الكامل - مستوى دهون الدم.