

## Effectiveness of Interactive Nutrition Education on Knowledge of Adolescent Females Regarding Vitamin D

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### Abstract

**Objective:** The objective of the research study was to assess the effectiveness of nutrition education on knowledge of adolescent girls about vitamin D.

**Design:** Pretest posttest quasi-experimental research design without control group.

**Setting:** Colleges of Lahore, Pakistan.

**Participants:** The sample comprised of 350 adolescent college going girls of age between 16 - 19 years through purposive random sampling. All were pretested. Nutrition education was given to only 156 students selected through purposeful random sampling.

**Main Outcome Measure:** Positive impact of nutrition education on knowledge of vitamin D and its deficiency

**Intervention:** A multiple choice questionnaire was developed by the researcher, including questions on nutrition knowledge about vitamin D. After the pretest, interventions based on nutrition education were administered in 4 sessions. The interventions included multiple nutrition education materials. Same questionnaire was used for posttest.

**Analysis:** Descriptive statistics were calculated for continuous variables. T-test was applied and a p-value < 0.05 was taken as significant. SPSS version 17 was used to analyze data.

**Results:** Results showed that knowledge of girls improved after nutrition education. A statistically significant difference was found between pre-test and post-test score. The value of  $t(155) = -41.334$ ,  $p = 0.000$ ,  $< 0.05$  showed statistically significant difference between the pre-test and post-test score.

**Conclusion and Implications:** It was concluded that effective nutrition education increases knowledge about vitamin D. Similar cost effective strategies can be employed to educate other population groups about other essential micronutrients.

**Keywords:** Nutrition Education; Adolescent; Vitamin D

### Introduction

Hypovitaminosis or Vitamin D Deficiency (VDD) affects over one billion people globally [1,2]. Its prevalence has been reported in almost all continents throughout the world in various research studies. Studies also conclude that severe form of VDD exists in China, India, South America, and the Middle East [3]. VDD also emerges as one of the major public health issues residing in Pakistani population irrespective of age and gender [4]. Pakistan is a tropical country with abundant sunshine throughout the year but despite of this Pakistani population is vitamin D deficient [5,6]. According to a recent large scale research study conducted in Pakistan, 53.5% of Pakistani popula-

tion is vitamin D deficient [1]. Results of National Nutrition Survey of Pakistan (NNS) conducted in 2011 show that 66.2% non-pregnant and 68.5% pregnant mothers are vitamin D deficient [7].

Besides inadequate sun exposure, the other contributory factors leading to high prevalence of VDD particularly in Pakistan include a lack of dietary sources of vitamin D, absence of vitamin D food fortification policy and lack of public awareness about the importance of vitamin D and its deficiency [8]. Multiple researches conclude that public awareness plays an important part in overcoming micronutrient deficiencies.

Nutrition education is defined as “any combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other food and nutrition- related behaviors conducive to health and well-being; nutrition education is delivered through multiple venues and involves activities at the individual, community, and policy levels” [9]. Despite several barriers and challenges in nutrition education process, it is still considered to be an effective tool when it comes to improving dietary information and preventing chronic diseases [7,10]. Adolescents strive to achieve independence but they are also affected by their peers. They are developing conceptual way of thinking, however they may revert to more concrete cognitive skills when faced with new challenges or perceived stressful situations. These aspects of adolescent development can be incorporated into nutrition education whether they occur as classroom nutrition education presentations or individual counseling sessions [11-13]. Multiple researches conducted on effects of nutrition education conclude that it plays a pivotal role during adolescence in improving dietary habits and increasing nutrition knowledge [7,10,14,15].

### Purpose of the Study

The purpose of this study was threefold: 1) To explore present knowledge of adolescent girls towards Vitamin D and its deficiency. 2) To develop nutrition education materials in order to improve knowledge regarding vitamin D and its deficiency. 3) To assess improvement in knowledge of adolescent girls towards vitamin D after implementation of nutrition education. The present intervention is unique in combining the use of multiple conventional education materials with interactive feedback.

### Methodology

#### Study design and population

The current study was a quasi-experimental research design with a pretest and posttest without control group. The study setting was three famous colleges of Lahore, Pakistan. A sample of 350 college going females was selected through random purposive sampling technique. An exclusion criterion was subjects who had studied nutrition as a subject.

#### Data collection tools

A closed ended multiple choice questionnaire was formulated by the researcher.

Questionnaire consisted of 20 structured questions. Questions related to participant’s demographic data, data on knowledge about vitamins and particularly vitamins D were included. The questionnaire included simple questions. Awareness of participants was evaluated by asking participants if they know the name of fat soluble vitamins and which is the most important fat soluble vitamin for bone health. Knowledge of vitamin D was assessed by asking participants questions related to the nature of vitamin D, various sources of vitamin D and its requirement for females. They were also questioned about the vitamin D fortified food sources. A part of the questionnaire was designed to assess the knowledge about vitamin D deficiency. This section included basic questions related to the causes, symptoms

and definition of vitamin D deficiency. A section of the questionnaire was also designed to assess attitudes to sun exposure. This section included questions such as time and duration for sunlight exposure. A few questions were also asked related to prevention and basic treatment of VDD.

### Data collection procedure

Data collection was conducted in three steps: Pretest, Intervention and Posttest. After acquiring an informed consent from all participants, pretest was conducted. After pretesting, only 321 questionnaires were received. A sample of 156 was randomly selected from the pretested group. Based on the data collected, nutrition education materials were developed and administered. After implementation, a posttest was conducted in order to assess the effectiveness of nutrition education among participants. Same questionnaire was designed for pretest and posttest.

### Nutrition intervention

The research study was designed as nutrition education intervention based on print/audio-visual media, discussions, class games and activities, brochures and handouts. Nutrition intervention was planned in series of educational lectures once every week. Intervention continued for four weeks. The lessons were planned to impart nutrition knowledge related to vitamin D and its deficiency. Lessons were prepared from various recent data sources.

Adjustments were made according to the research study and sample characteristics. All the reading materials were prepared in easy and simple English language. The lesson plans were prepared a week before the implementation of nutrition education. All these activities and materials were developed on knowledge related to vitamin D and its deficiency. Participants were presented with appreciation certificates.

### Data analysis and interpretation

The data were compiled and tabulated using Statistical Package of Social Sciences (SPSS) version 17. The statistical techniques included frequency, percentages, mean score, standard deviation and t-test. Bar charts were used to present data. The awareness of girls before and after the nutrition education (pre-testing Vs. Post-testing) was evaluated using Paired sample t-test. A value of  $P < 0.05$  was considered statistically significant. The data was presented in MS Word through tables and graphs. Descriptive interpretations were also given.

## Results

All of the participants were college going females with ages between 16 and 19 years studying arts subject. None of the participants had an educational background of human nutrition.

### General knowledge of vitamin D

Table 1 show the results of pretest and posttest scores regarding knowledge about Vitamin D. Out of 156, only 58.3% (n = 91) participants were aware about the nature of vitamin D. This percentage increased to 98.7% (n = 154) in posttest. The value of  $t(155) = -9.985$ ,  $p = 0.000$ , is less than  $\alpha = 0.05$  showing statistically significant difference between the pre-test and post-test score of girls regarding their knowledge about nature of vitamin D.

Variable	Pre-test		Post-test		p-value
	N (%)	Mean ± sd	N (%)	Mean ± sd	
<b>General Knowledge: Vitamin D</b>					
Nature of Vitamin D	91 (58.3)		154 (98.7)		<0.001
Is vitamin D important for health	147 (94.2)		149 (95.5)		
Health Implications	0		149 (95.5)		
Sources of vitamin D	0	1.71 ± 0.84	154 (98.7)	5.77 ± 1.22	
Vitamin D fortification	9 (5.8)		93 (59.6)		
Fortified foods	12 (7.7)		92 (59)		
Vitamin D supplementation	9 (5.8)		110 (70.5)		
RDA of vitamin D for girls	43 (27.6)		150 (96.2)		
<b>General Knowledge: Vitamin D Deficiency (VDD)</b>					
Value that defines VDD	48 (30.8)		141 (90.4)		< 0.001
Causes of VDD	7 (4.5)		131 (84)		
Signs & symptoms of VDD	14 (9)	1.53 ± 0.66	139 (89.1)	4.50.619	
Gender that is more prone to VDD	128 (82)		156 (100)		
Reason why VDD is common in females	6 (38)		119 (76.3)		
<b>Prevention of VDD</b>					
Time of day best for getting sunlight exposure	77 (49.4)		151 (96.8)		< 0.001
Adequate time duration for sunlight exposure/day	47 (30)	0.94 ± 0.95	146 (96.3)	3.44 ± 0.77	
Ways of prevention	17 (10.9)		121 (77.6)		
<b>Treatment of VDD</b>					
Ways of treatment	12 (7.7)	0.07 ± 0.26	114 (73.1)	0.73 ± 0.44	< 0.001

Table 1

The results of the study reveal that there was a slight difference in pretest posttest scores regarding importance of vitamin D. In pretest 94.2% (n = 147) respondents were aware that vitamin D is important for health. This percentage increased to 95.5% (n = 149) in posttest. The value of  $t(155) = -5.333$ ,  $p = 0.595$ , is greater than  $\alpha = 0.05$  therefore there is no statistically significant difference between the pre-test and post-test score. None of the participants in pretest were able to answer the question regarding the health implications of vitamin D. In posttest 95.5% (n = 149) respondents were aware about the health implications. The value of  $t(155) = -57.439$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score.

In pretest, none of the respondents were aware about sources of vitamin D. Out of 156 participants 98.7% (n = 154) respondents in posttest were aware about the sources of vitamin D. The value of  $t(155) = -109.247$ ,  $p = 0.000$ , is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score. The results show that in pretest only 5.8% (n = 9) participants were aware about vitamin D fortification. In posttest 59.6% (n = 93) participants were able to answer the question regarding vitamin D fortification. The value of  $t(155) = -12.803$ ,  $p = 0.000$ , is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score. Results show that 7.7% (n = 12) participants were aware of foods that are fortified in pretest. Knowledge about foods that are fortified increased in posttest 59% (n = 92). The value of  $t(155) = -12.164$ ,  $p = 0.000$ , is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score.

In pretest only 5.8% (n = 9) respondents were aware about vitamin D supplementation.

This percentage increased to 70.5% (n = 110) in posttest. The value of  $t(155) = -16.416$ ,  $p = 0.000$ , is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score. Only 27.6% (n = 43) participants were aware about RDA of vitamin D in pretest. In posttest 96.2% (150) respondents were aware about the RDA of vitamin D. The value of  $t(155) = -17.392$ ,  $p = 0.000$ , is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score.

### General knowledge about VDD

Results show that in pretest only 30.8% (n = 48) participants were aware about the defining value of vitamin D deficiency. In posttest 90.4% (n = 141) participants responded correctly. The value of  $t(155) = -14.046$ ,  $p = 0.000$ , is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score. In pretest only 4.5% (n = 7) were aware about the causes of vitamin D deficiency. In posttest 84% (n = 131) were correct responses. The value of  $t(155) = -24.508$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score.

Pretest results reveal that only 9% (n = 14) participants responded to signs and symptoms of VDD. The response rate increased in posttest showing 89% (n = 139). The value of  $t(155) = -25.000$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score. Results show that in pretest only 82% (n = 128) respondents were aware that females are more prone to VDD. This percentage increased to 100% (n = 156) in posttest. The value of  $t(155) = -5.823$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$ . Only 38% (n = 6) were aware of the reason of higher prevalence of VDD in females in pretest. In posttest 76.3% (n = 119) answered correctly. The value of  $t(155) = -19.564$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score.

### Knowledge about prevention of VDD

Results of the pretest reveal that 49.4% (n = 77) respondents were aware about the time of the day that is best for sunlight exposure. The correct response rate increased in posttest 96.8% (n = 151). The value of  $t(155) = -11.008$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score. Pretest results reveal that only 30% (n = 47) participants had knowledge about adequate time duration for sunlight exposure. The response rate was increased in posttest 96.3% (n = 146). The value of  $t(155) = -14.848$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$  showing statistically significant difference between the pre-test and post-test score. Only 10.9% (n = 17) respondents were aware about prevention of VDD in pretest. In posttest 77.6% (n = 121) respondents were aware about the ways of preventing VDD. The value of  $t(155) = -16.256$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$  showing statistically significant difference between the pre-test and post-test score.

### Knowledge about treatment of VDD

The results show that in pretest only 7.7% (n = 12) were aware about ways of treating VDD. In posttest 73.1% (n = 114) responded correctly. The value of  $t(155) = -15.819$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$  therefore there is a statistically significant difference between the pre-test and post-test score. Overall, the results of the study show that knowledge of girls improved after nutrition education. There was a statistically significant difference between post-test score (M = 16.18, SD = 02.29) which is greater than pre-test score (Mean = 5.8, SD = 2.07). The value of  $t(155) = -41.334$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$  showing statistically significant difference between the pre-test and post-test score.

Overall, the results of the study show that knowledge of girls improved after nutrition education. There was a statistically significant difference between post-test score (M = 16.18, SD = 02.29) which is greater than pre-test score (Mean = 5.8, SD = 2.07). The value of  $t(155) = -41.334$ ,  $p = 0.000$ , it is less than  $\alpha = 0.05$  showing statistically significant difference between the pre-test and post-test score.

	Mean	Standard Deviation	Mean Difference	t-test	p-value
Pre-test	5.81	2.07	10.37	41.33	< 0.001
<b>Scores</b>					
Post-test	16.18	2.29			

**Table 2:** Mean scores of knowledge - pre and post intervention (N = 156).

**Discussion**

The results of the current research study provided evidence that effective nutrition education can aid in increasing knowledge about vitamin D and its deficiency among adolescent girls. A similar research study on iron intake showed the same results [16]. Another study concluded that nutrition education is an effective tool to reduce iron deficiency anemia among adolescent girls [17]. Calcium intake also improved among adolescents following effective nutrition education [17].

Over the last decade studies reveal that vitamin D deficiency has become a public health issue all over the world especially among South East Asian countries [18]. According to National Nutrition Survey of Pakistan 2011, Vitamin D deficiency is markedly present in Pakistan especially among females [17]. Public health strategies such as public awareness are needed to address high VDD rates [1,19-21]. Furthermore, nutrition education is an effective tool to increase nutrition knowledge [12]. So, the present study aims on assessing the effect of nutrition education on knowledge of adolescent girls about vitamin D and its deficiency.

Nutrition education intervention can be conducted at multiple venues and different materials and strategies can be used to deliver effective nutrition education [10]. The current study was implemented in a class based setting for four weeks which proved to be helpful in collecting data from the participants. It also helped in retaining the sample size. A previous research also showed increased effectiveness of nutrition education intervention conducted in a class based setting [22]. Nutrition education was imparted using different education materials including lectures, class activities including games, class discussion, power point presentation, pamphlets and brochures. A previous research also recommended that nutrition education materials should be made using different styles and designs in order to create interest among participants [23].

The current study involved three steps; pretest, nutrition intervention and posttest. Results of a previous study show that there exists a lack of knowledge and awareness about vitamin D and its deficiency among adolescents [24]. The results of our study showed similar results.

There was a major lack of knowledge observed in the pretest which markedly improved in posttest that was conducted after nutrition education was administered. In order to prevent vitamin D deficiency, it's important that individuals should be aware about the functions, importance and sources of vitamin D. Results of pretest show that none of the respondents (100%) were aware of the sources of vitamin D. Results of a similar study revealed that people are unaware of the correct sources of vitamin D and some were even unaware that sunlight is a source of vitamin D [25]. According to a study training improves knowledge related to sources and functions of vitamin D among adolescents [26]. Results of the research study also revealed that nutrition education improved knowledge about sources and functions of vitamin D.

Very few foods contain vitamin D naturally but fortification is one way to improve vitamin D content of foods. At present Pakistan does not have any mandatory fortification policy [27]. It is important that people are aware about fortification and foods that are fortified.

Respondent's pretest results show that majority of girls (98.7%) girls were unaware about fortification and were unaware about foods (92.3%) that are vitamin D fortified. After nutrition education was given more than half of the respondents (59.6%) were able to answer correctly about fortification and answered correctly about foods that are vitamin D fortified. But more effort is required to improve

knowledge on fortification. Supplementation is another method to improve vitamin D levels but results of pretest show that majority of respondents (94.2%) were unaware about it. It is important to make adolescents aware about supplementation and different forms in which supplements are available. This pretest percentage reduced to 29.5% after nutrition education. Post testing results also show that majority of girls (96.2%) responded correctly their Recommended Dietary Allowances (RDA) of vitamin D. Nutrition education brought significant improvement regarding general information on vitamin D.

Post testing results show that majority of respondents (90.4%) were able to point the correct blood values that define vitamin D deficiency. Knowledge about causes of vitamin D deficiency was also improved among majority of girls (84%). Nutrition education showed a positive impact in educating majority of girls (89%). Results of pretesting show that every girl was aware that women are more prone to vitamin D deficiency and most of the girls (76.3%) were able to point the correct reason as to why women are more prone to vitamin D deficiency as compared to males. According to a study carried out on people with vitamin D deficiency 45% women were unaware about the symptoms of vitamin D deficiency [28]. Results of the present study reveal that majority of girls (95%) were unaware about the signs and symptoms of vitamin D deficiency in pretesting. This percentage improved after nutrition education was imparted.

Results reveal that nutrition education made a positive impact in increasing knowledge about vitamin D deficiency.

Sunlight is the major source of vitamin D and proper sunlight exposure is essential for the cutaneous synthesis of vitamin D [29]. Several factors affect the cutaneous synthesis of vitamin D [30]. It is important that one should be aware of the ideal recommendations for sunlight exposure. According to a research study people are unaware of the recommendations about exposure to sunlight and believed that greater time is required for vitamin D synthesis [25].

Postesting results show that nutrition education brought a positive effect on knowledge about adequate time to be spent it sunlight for vitamin D synthesis. Data suggests that majority of girls (96.8%) were able to answer the correct time duration for sunlight exposure. Also most of the respondents (96.3%) answered the correct time span between which sunlight exposure is effective. By the end of the session 77.6% girls were aware of ways of preventing vitamin D deficiency in posttest as compared to pretest results which were only 10.9%. Nutrition education improved knowledge related to vitamin D deficiency prevention and treatment.

### Limitations

There were several limitations in our study. Sample size of the study was small. The study may involve biasness on the part of the respondents.

### Conclusion

The study concludes that nutrition education is an effective tool to increase knowledge about vitamin D and its deficiency. Multiple nutrition education materials and tools can be used to impart nutrition education. Similar effective strategies can be employed to educate other population groups about different micronutrients.

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