INTERNATIONAL JOURNAL OF ADVANCED BIOLOGICAL RESEARCH

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RELATIONSHIP BETWEEN DIFFERENT FOOD GROUPS AND PHYSICAL ACTIVITY IN ZINC DEFICIENT PEOPLE

Wajiha Saeed[1], Saddam Mustafa[1], Sundas Hina[2], Shahid Mahmood[1*], Tusneem Kausar[1], Ghulam Mueen-ud-Din[1], Ayesha Rafique[1], Syeda Mahvish Zahra[1], Muhammad Yousaf Quddoos[1], Muhammad Umair Khalid[3], Nagina Altaf[1] and Fahad Faisal[1]

[1]Institute of Food Science and Nutrition, University of Sargodha, Sargodha- 40100, Pakistan
[2]Department of Food Science and Technology, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan
[3]National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan
*Corresponding author email: shahid.mustafa@uos.edu.pk

ABSTRACT

The present study was carried out to assess the nutritional health status of boys with Zn deficiency. For the purpose, one thousand volunteers were selected from Comprehensive Model High School, Sargodha and University of Sargodha, Sargodha- Pakistan. The cross-sectional study design was adopted for research work. The selected volunteers were assessed for their health status in relation to nutrition. Family history, medical history, clinical signs and symptoms and food frequency questionnaire were used to assess the nutritional health status of volunteers. All food groups intake was significantly higher in both Zn deficient according to clinical signs and symptoms and normal volunteers. Zn deficient people have low dietary intake, *i.e.* fruits and vegetable, etc. while their water and milk intake were high.

KEY WORDS: Zinc deficiency, physical activity, food frequency questionnaire, nutrition.

INTRODUCTION

Health is a condition of complete physical, mental and social well-being and not merely the absence of disease or illness. But due to the use of the word "complete" and mainly due to its non- operational value this definition always has been the subject of debate yet it remains the most everlasting. Along water, humans have need of five types of nutrients from their food supply, out of five, three are required in relatively large amounts and are called macronutrients *i.e.* carbohydrates, proteins, and fats. The other two types of nutrients are vitamins and minerals that are required in small amounts and are known as micronutrients[1]. After Fe, Zn is the second richest transitional metal in organisms and it is the only metal which is present in all classes of enzymes[2]. More than 200 enzymes require Zn for their catalytic activity [3]. The normal serum Zn value is 70-125 µg/ dL and females have considerably lower levels[4]. Loss of Zn from the body is through the skin, intestine and kidneys [5]. Zn is absorbed more expertly from animal source food, *i.e*. meat, liver, eggs, and seafood and less competently from cereal and vegetables containing lots of phytates and fiber [6, 7]. Food containing high amount of phytate such as cereal based diets, reduces the availability of Fe and Zn in adolescents. A daily intake of Zn is essential for the maintenance of stable state because the body has no particular storage system for this element [8-10]. Watermelon seed contains a more Zn per serving compared to any other food, but red meat, particularly lamb, beef and liver contain higher amount of Zn. Other good food sources include beans, nuts, other types of seafood (such as crab and lobster), whole grains, sesame seeds, almonds, pumpkin seeds, sunflower seeds[11]. When system of transportation and storage of nutrients is not working properly, level and ratio of trace elements may develop abnormally and cause different deficiency diseases. To understand the extent and nature of nutritional deficiencies, it is important to study the lifestyle, dietary intakes and investigate their health risks. Therefore, international research reported that objectionable food habits of adolescent *i.e.* eating fast food, soft drinks and absence of fruits and vegetables in diet, lead towards nutritional insufficiency and micronutrient deficiency in adolescents. Zn deficiency reduces the immunity and cause loss of T-cell function in animal studies [13, 14]. However, it was not clear until in the early 1960s, when the first report on the adverse effects of Zn deficiency in man was described. These included dwarfism, hypogonadism, hepatosplenomegaly, rough and dry skin, mental lethargy and geophagy [15]. Experimental Zn deficiency in humans causes reduction in sperm count combined with reduced serum testosterone[14]. Zn deficiency in humans has also been connected with oligospermia[16]. Many kinds of mental and behavioral changes are also linked with Zn deficiency in humans, including amnesia, apathy, irritability, lethargy, paranoia and depression as well as mental retardation [17]. Zn deficiency in humans also leads to sleep disturbances, mental depression, neurosis and reduction in appetite [18]. Inadequate amounts of Zn may also cause cancers in both animals and in humans [19-21]. It may also lead to the development of AIDS [22]. There are many diseases that are treated with Zn therapy, *i.e*. improvement in wound healing [23-25], ulcers [26], acne [27] and rheumatoid arthritis

[28]. The objective of study was to find the Correlation of Zn deficiency with dietary intake.

MATERIALS AND METHODS

This study was carried out in the Institute of Food Science and Nutrition Sargodha, Sargodha. Comprehensive Model High School, Sargodha and University of Sargodha, Sargodha were selected as study site for the research. Boys were the target population for the study. The cross-sectional study design was adopted for research work which is utilized for estimation for correlation of diet with Zn deficiency. A wide spectrum of information about diet and health was collected.

Parameters

Food intake and eating habits were independent variables; and physiological status (Zn deficiency) were dependent variables while life style pattern and family back ground were confounding variables.

Population size

One thousand volunteers were selected from Comprehensive Model High School, Sargodha and University of Sargodha, Sargodha.

Nutritional Health Status Assessment

The selected volunteers were assessed for their health status in relation to nutrition as given below.

Clinical Sign and Symptoms

Viral infection (flue), sensitivity of eye to light, loss of hair color, texture and color of nails, skin texture and infection, muscular degradation, texture of lip, loss of taste and smell, acne where the clinical sign and symptoms of Zn deficiency.

Medical and Family History

Medical and family histories of the volunteers were explored. For this purpose, a questionnaire was designed to find out any disease related to Zn deficiency found in the family of volunteers.

Dietary Intakes Assessment

The dietary intake assessment of volunteers was carried out by Food Frequency Questionnaire (FFQ). FFQ based on Food Guide Pyramid. The intake of serving no. of each volunteer was calculated to draw out the mean serving no. of each food group that was compared with the reference no. of servings as given in Food Guide Pyramid.

RESULT

The purpose of the present study was to assess the nutritional health status of Zn deficiency and its correlation with diet in boys. The cross-sectional study includes demographics, anthropometrics, vital signs, family and medical history and food frequency questionnaire to assess nutritional health status of volunteers. Physical activity of each volunteer was assessed by asking questions.

Physical Activity and Physiological Status of Volunteers

People around the globe are at risk of zinc deficiency and a small percentage of people are zinc deficient also as per NNS Pakistan 2011, 20% of population is zinc deficient, similar patterns can be seen in results of current study. There was a limitation in the study that only one person was at very active physical activity level, belonging to normal/ healthy volunteers' category. Singh *et al.* (1991) observed the low level of Zn in plasma in those men who joined the five days training of U.S. Navy, which shows that high physical activity may reduce the amount of Zn from the body due to its loss from the skin through sweating [30].

TABLE 1: Physical Activity and Physiological Status of Volunteers

Physical Activity		Zn deficient acc. to clinical sign and symptoms	Normal	Total
Sedentary	*f*	2	3	5
	%	40	60	100.0
Light Active	*f*	7	56	63
	%	11.11	88.89	100.0
Moderate Active	*f*	11	20	31
	%	35.48	64.51	100.0
Very Active	*f*	0	1	1
	%	0.0	100.0	100.0

Chi-square: 4.1136 [a] Degree of freedom: 6 $p < 0.6613$ [NS] NS=Non-Significant

Intake for cereals/legumes group on physiological status and physical activity of volunteers

Zn deficient according to clinical signs and symptoms illustrated that people with light active and moderate active lifestyle have significant relationship with sedentary lifestyle and people with light active and moderate active showed non-significant correlation with each other (Table 2). Outmoded essential foods, like legumes, cereals and tubers, are consist of Zn, but its bioavailability is low due to the occurrence of fiber, phytate and lignin. These inhibitors make insoluble substances with Zn which inhibit its absorption [6].

Intake of fruits group on physiological status and physical activity of volunteers

Intake of fruits in Zn deficient people at different physical activity level. Zn deficiency according to clinical signs and symptoms revealed a significant relation between light active, moderate active and sedentary physical activity (Table. 3). Fruits and vegetables give very small amount of dietary Zn intake, but if fruits are taken with cereals enhance the bioavailability of Zn [29].

TABLE 2: Mean squares for intake of cereals/legumes group on physiological status and physical activity of volunteers

Physical activity	Zn deficient acc. to clinical signs and symptoms			Normal		
	Mean	SD	Sig.	Mean	SD	Sig.
Moderate Active	3.758750	1.682094	B	4.713750	2.003966	a
light Active	6.008333	1.0807418	A	4.564500	2.053796	a
Sedentary	3.855000	0.1450000	Ab	4.763333	1.353563	a
Very Active	-	-		5.430000	NA	a

TABLE 3: Mean squares for intake of fruits group on physiological status and physical activity of volunteers

Physical activity	Zn deficient acc. to clinical signs and symptoms			Normal		
	Mean	SD	Sig.	Mean	SD	Sig.
Moderate Active	1.510000	0.945561058	A	1.602143	0.9674009	a
Light Active	1.831667	1.914788935	A	1.882500	1.3680908	a
Sedentary	1.855000	0.007071068	A	1.856667	1.3801932	a
Very Active	-	-		0.430000	NA	a

Intake of vegetable group on physiological status and physical activity of volunteers

Those people who showed Zn deficiency according to clinical signs and symptoms illustrated that light active and moderate active had a significant relation to sedentary physical activity but light active and moderate active volunteers in this group showed a non-significant relationship with each other (Table. 4). Fruits and vegetables give very small amount of dietary Zn intake, but if fruits are taken with cereals enhance the bioavailability of Zn [29].

TABLE 4: Mean squares for intake of vegetable group on physiological status and physical activity of volunteers

Physical activity	Zn deficient acc. to clinical signs and symptoms			Normal		
	Mean	SD	Sig.	Mean	SD	Sig.
Moderate Active	1.962500	0.9802004	b	2.113036	0.8334963	a
Light Active	2.996667	1.4459553	a	2.153500	0.8936812	a
Sedentary	2.785000	0.1060660	ab	2.190000	0.9551963	a
Very Active	-	-	-	2.430000	NA	a

Intake of meat group on physiological status and physical activity of volunteers

Zn deficiency according to clinical signs and symptoms elaborated that moderate active and sedentary active had a significant relation, but light active showed non-significant relation with moderate active and sedentary lifestyle (Table. 5). Lower intake of protein from animal source may unfavorably affect the bioavailability of Fe, Zn, Se, vitamin B12, and omega-3 fat [12].

Table 5: Mean squares for intake of meat group on physiological status and physical activity of volunteers

Physical activity	Zn deficient acc. to clinical signs and symptoms			Normal		
	Mean	SD	Sig.	Mean	SD	Sig.
Moderate Active	0.750000	0.6496593	B	1.3837500	0.5867989	a
Light Active	1.426667	1.4048725	A	1.6280000	1.3817251	a
Sedentary	1.000000	0.6081118	A	0.8533333	0.3817504	a
Very Active	-	-	-	1.4300000	NA	a

Intake of milk and dairy product group on physiological status and physical activity of volunteers

Zn deficiency according to clinical signs and symptoms exposed that light active, moderate active and sedentary active had a significant relation with each other (Table. 6). Due to the high level of Ca, phytate content and casein in milk, it may lower down the absorption of dietary Zn [6].

TABLE 6. Mean squares for intake of milk and dairy product group on physiological status and physical activity of volunteers

Physical activity	Zn deficient acc. to clinical signs and symptoms			Normal		
	Mean	SD	Sig.	Mean	SD	Sig.
Moderate Active	3.123750	2.3030473	A	1.899107	1.056348	ab
Light Active	1.786667	0.7327937	A	2.697500	1.545908	a
Sedentary	2.710000	0.1979899	A	2.903333	1.951470	a
Very Active	-	-	-	0.710000	NA	ab

Intake of fats and oils and junk food group on physiological status and physical activity of volunteers

Zn deficiency according to clinical signs and symptoms also revealed the significant relation between light active, moderate active and sedentary lifestyle (Table- 7). If children consume high amount of food which is poor in nutrients could lead toward deficiency of different micronutrients like Fe, Zn, which are essential for the growth and development of children.

TABLE7: Mean squares for intake of fats and oils group on physiological status and physical activity of volunteers

Physical activity	Zn deficient acc. to clinical signs and symptoms			Normal		
	Mean	SD	Sig.	Mean	SD	Sig.
Moderate Active	2.695	1.454176	A	3.229821	1.825101	a
Light Active	3.070	1.903943	A	3.137000	1.285269	ab
Sedentary	1.785	1.110158	A	1.570000	0.514490	ab
Very Active	-	-	-	3.290000	NA	a

Zn deficiency according to clinical signs and symptoms also demonstrated the significant relation between light active, moderate active and sedentary lifestyle (Table. 8). If children consume high amount of food which is poor in nutrients like fats and oil and junk food could lead toward deficiency of different micronutrients like Fe, Zn, which are essential for the growth and development of children [24].

TABLE 8: Mean squares for intake of snacks, fast and junk food group on physiological status and physical activity of volunteers

Physical activity	Zn deficient acc. to clinical signs and symptoms			Normal		
	Mean	SD	Sig.	Mean	SD	Sig.
Moderate Active	3.97375	3.810245	A	5.069286	3.132400	a
Light Active	5.36500	4.814170	A	4.639500	4.040763	a
Sedentary	2.57000	1.414214	A	2.380000	1.583572	A
Very Active	-	-	-	2.710000	NA	A

DISCUSSION

Zn is an essential micronutrient required for different body functioning as it is part of different enzymes. After iron it is the most abundant nutrient in the body and its minor deficiency could lead to number of diseases i.e. sleep disturbances, mental depression, neurosis and reduction in appetite [2]. Current study revealed the correlation of Zn with different food groups and physical activity. It is concluded that those people who are Zn deficient are actually having less intake of fruit and vegetables, while lesser protein servings from animal sources, comparatively taking more number servings from cereals and dairy yet lesser then recommended by USDA. It was indicated that instead of minimal intake from fats & oils and zero number of servings from junk and snacks, they intended to consume over-whelming amount. Cereals contained different inhibitors like phytates and fibers which reduces the bioavailability of Zn to the body and milk contains Ca and casein which lowers down the availability of Zn [6]. Junk food is poor nutrient food which ultimately causes Zn deficiency [25]. On the other hand, fruit and vegetables give lower amount of dietary Zn. If we consume fruit and vegetable below the USDA recommended serving then it may cause Zn deficiency [29]. Lower intake of protein from animal sources contributes to restriction of Zn bioavailability [12]. Statistically analyzed data was explicitly in accordance with results of Singh *et al*. (1991) indicating that people with high activity level tends to have high Zn deficiency, majorly due to loss of fluids and electrolytes through sweating [30].

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