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RESEARCH ARTICLE

A SOCIAL SURVEY ON HEALTH IMPLICATIONS OF IODINE DEFICIENCY IN WOMEN AND CHILDREN IN HILLY AREAS OF PAKISTAN

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ABSTRACT

Iodine deficiencies are common in hilly areas which leads to serious health implication. The study investigated health implications in women and children related to iodine deficiency. 210 female respondents were randomly selected from three union councils, (UCs) i.e., Namli Mehra, Nathia Gali and Pala of District Abbottabad, Pakistan. Lower education and income levels decreased knowledge and understanding about iodine related health issues. The children were more affected, especially the growth of girls was more impacted due to iodine deficiency. Factor analysis revealed that lower education levels were the main cause of iodine deficiency disorders in the study area.

KEYWORDS

Iodine; deficiency; women; children

1. INTRODUCTION

Estimates show that one billion people are at risk for iodine deficiency, with 710 million in Asia, 60 million in Latin America, 227 million in Africa, and 20-30 million in Europe. Of these, at least 200 to 300 million have goiter or another demonstrable consequence of iodine deficiency, and at least six million are cretins (Andersson et al., 2012). Unfortunately, the iodine deficiency issues are not well addressed in hilly areas of Pakistan. The iodine deficiency can lead to major health problems like goiter. It means that the size of the thyroid gland is much bigger than normal people having iodine deficiency have goiter. The goiter is a sign that the body is trying to compensate for a lack of iodine (Haldimann, 2005). Hypothyroidism is also caused due to lack of iodine in body. Hypothyroidism is responsible in producing sluggishness, sleepiness, dry skin, cold intolerance, and constipation.

In young children it also causes mental retardation and this retardation caused by hypothyroidism is permanent and cannot be cure (Johnson et al., 2010). Children suffering from Cretinism have severe irreversible mental retardation. They may have several other signs, including deaf mutes, short stature, and retarded development of the musculoskeletal system. Reproductive failure is also a result of severe iodine deficiency. Woman suffering from iodine deficiency experience more still births miscarriages and other serious complication during pregnancy. Iodine deficiency in the fetus is the result of iodine deficiency in the mother. The consequence of iodine deficiency during pregnancy is impaired synthesis of thyroid hormones by the mother and the fetus. An insufficient supply of thyroid hormones to the developing brain may result in neurocognitive impairment. Child morality is also caused by lack of iodine in body (WHO, 2007).

Globally 1.88 billion people have in adequate iodine intake and 241 million of them are children who are at risk caused by iodine deficiency (Haldimann, 2005). UNICEF evaluates that not exactly 20 for each penny of families in the creating world were utilizing iodized salt in the mid-1990s (Dunn, and Haar, 1990). By 2000, the normal had bounced to approximately 70 for every penny. This is an amazing accomplishment, particularly thinking about that as late as 1994, 48 nations with set up IDD issues had no salt iodization programs by any means. By 2006, around 120 nations were executing salt iodization programs – an expansion of one third in only six years over the 90 nations with such projects in 2000. With all the more developing countries detailing, the worldwide database may mirror a bigger number of countries starting salt iodization programs. Iodine deficiency disorders are still a big challenge in developed and developing countries (Lazarus, 2014).

Despite remarkable progress in many countries, approximately 38 million newborns in developing countries risk the lifelong consequences of brain damage associated with iodine deficiency annually. The South Asia region, with 18 million infants born at risk of IDD every year, carries the highest burden. In Latin America and the Caribbean is closer to achieving the salt iodization goals. Approximately 85 percent of households of this region consumes iodized salt about 14 countries throughout the region is successful in achieving the goals. Many of these countries, including Bangladesh, Egypt, Kyrgyzstan and the Philippines, have been making steady progress even during recent years (Pearce et al., 2013).

In Pakistan 135 million people are having insufficient iodine intake. According to National Nutrition. Survey, 2001- 2002 in Pakistan palpable goiter was found among 4.4% school age children and visible goiter was present among 2.3% of such children. Pakistan has shown a notable improvement in recent times (Mull et al., 1990) Wah Cantt and Hazara Division are included in goiter endemic belt, but very little work has been done on this aspect. Northern Areas where 34 % women were found having goiters followed by 28% in Azad Jammu & Kashmir, 27% in the KP and 21% in Punjab. Baluchistan and Sindh revealed lower prevalence

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rates of goiter. The prevalence of goiter among school-age children was 6.7%. The urinary iodine test results reveal that about 36.5% mothers were having severe iodine deficiency. The problem is relatively more pronounced in rural areas as 41% mothers were having severe iodine deficiency as compared to 27% in urban areas. The severe iodine deficiency is also detected among 23% pre-school children. The sub-clinical prevalence of iodine deficiency is showing even adverse situation of the iodine deficiency in the country (Saira et al., 2014).

The goiter hypothyroidism and other serious health problems associated with inadequate intake of iodine may cause social and economic loss by the people as these diseases affects the person's ability to perform normal activities of life. These diseases make the person dependent on other members of the household and also contribute to poverty. Therefore, a social survey was designed in district Abbottabad, Pakistan to investigate the health implications of iodine deficiency in women and children.

2. Materials and Methods

Current study was carried out in three union council of the Abbottabad. Abbottabad is situated between 33° 50' and 34° 23' North, and 73° 35' and 73° 31'East Abbottabad is bordered by Mansehra district in the North, Muzzafarabad and Rawalpindi districts in the East, Haripur and Rawalpindi districts in the South and Haripur district in the West. Spread over 178,401 ha of predominantly mountainous terrain, population density in the district is high, at 466 persons per km (Ahmad and Talib, 2010). According to census report of 2017, the population of UC Namli mera was 33400, UC Palak, 28997 and UC Nathiagali with a population of 32456. Being at a high altitude, this region hosts extreme winters (starting October) and a temperate and slightly humid summer (April onwards) which temperatures reaching 30 0C. July and August there is monsoon which causes a pleasant drop in temperature.

Farming is the main occupation of the population. The two crops grown there are rabi and kharif. The major rabi crops grown in the area are potato and maize and the kharif crop is only wheat in a very small area of village. The wheat is used for cattle and for grain only. Some vegetables are also found here, including turnip, radish, peas, pumpkin, beans and mustard (Haq et al., 2007). Most of the area around these mountain villages is covered with trees. Peaks are covered with evergreen trees including pine, walnut, oak and maple trees. Herbs, shrubs, wild flowers and thorny bushes can be seen in abundance. Goats and other pet animals graze the pastures (Lodhi et al., 2010).

The main occupation of the people is subsistence farming and cattle breeding. Farmers cultivate one crop per season as climatic conditions do not permit double cropping. The other occupation is cattle breeding. Cows, sheep and goats are kept supplying milk for daily use of the household. Bullocks are used to work the plough. Poverty has forced many people to seek economic opportunities in the plains. Besides earning livelihood doing odd jobs in nearby towns, many have joined the army and civil service. Hotels in the nearby hill towns of Nathiagali, Ayubia and Murree provide another source of employment to the locals. Wood is the primary source of fuel and home construction, as there is no gas in study area. People go to forests and cut trees so that they can light fires for cooking and other activities. Those who can afford them use LPG gas cylinders.

There is no precise data and information available regarding iodine nutritional status in district Abbottabad. Therefore, this study was undertaken to investigate the iodine status and goiter prevalence in three union council of district Abbottabad. The study provides baseline information for iodine nutritional status in the whole valley. This will help the policy makers in launching the iodine prophylaxis program in the region or at national level. Random sampling technique was used for data collection. This will help in representation of the target population and eliminate sampling bias. A total of 210 questionnaires were filled from three union councils i.e., 70 from each union council. From each union council 35 questionnaire was filled from lactating women and 35 from pregnant women. The questionnaire was designed with mixed questions containing multiple choices, close ended questions for the assessment of iodine intake and iodine deficiency detection as used (Angela et al., 2011). Statistical analysis was done by using SPSS. Mean, average, percentage and factor analysis of the data set was determined for the analysis of data.

3. Results

3.1 Socio-demographic information of the respondents

The age, education and income level of the respondents is presented in Figure 1. Age of the respondent in all three-union councils varied between 19 to 35 years. Both lactating and pregnant women fall in this age group in study area. The results showed in Figure 1 clearly illustrate that all the union councils had maximum percentage of illiterate respondents in all the union councils of study area. The highest illiteracy percentage (49) was observed in Namli Mera, followed by 44 and 41 % in Pala and Nathiagali union councils. The respondents who have passed primary education were 34 % in Nathiagali, 24 % in Pala and only 20 % in Namli Mera. Matric passed respondents ranged between 10-11 % in all the UCs. The respondents with higher education were even less and constituted about 5-8% of the total respondents in all the UCs. Through the education level of the respondents, it is easy to understand their awareness level specifically with regards to iodine deficiency and its negative impacts.

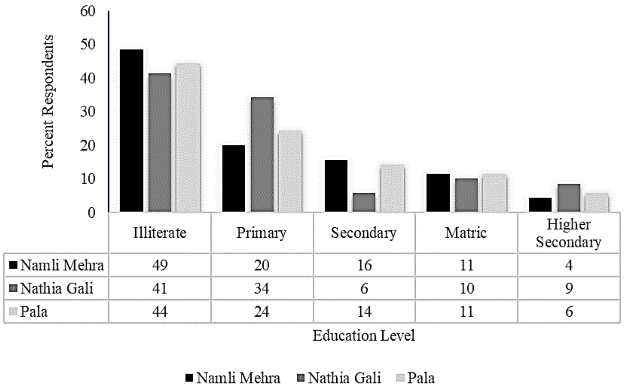

Figure 1: Comparison of education status of respondents in three union councils

Income level of the respondents of the three union councils is shown in Figure 2. According to survey, the average household income of 37% (Pala) to 54 % (Namli Mera) respondents ranged between 16000 to 30000 PKR. Around 31% to 46 % of the respondent receive between 5000-15000 PKR monthly in three UCs. A very little percentage of respondents (10-20%) earn household income of more than 30000 PKR per month all the UCs.

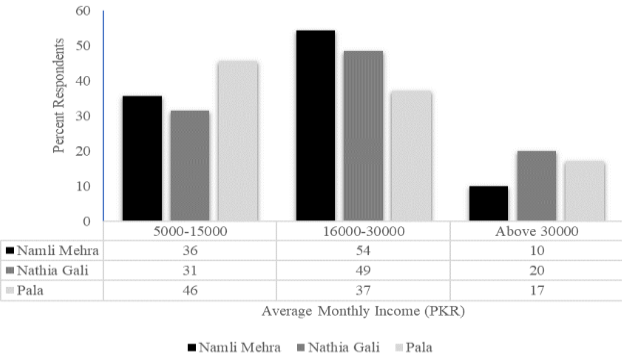

Figure 2: Comparison of Household income level in three union councils

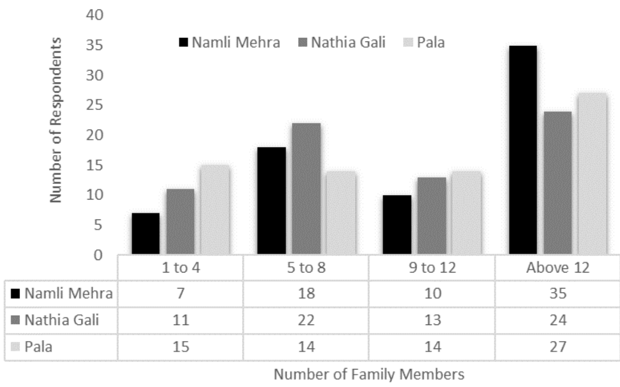

Figure 3: Number of family members in a household in three union councils

3.2 Weight and height of children in the study area

A total of 131 children data regaring their height and weight were collected during the survey. The average height and weight of boys in comparison with the medically recommended weights and heights of boys with respect to age is shown in Table 1 and Table 2. Table 1 presents the data on observed and recommended weights of the boys and the girls of the study area. The results clearly indicate the weight of both boys and girls were less when compared with the recommended values. It was also observed that the difference in observed and recommended weights was more in girls as compared to the boys. This suggests the overall nutrition level of the children in the study area. The girls suffered more with the lack of nutrition resulting in the regressed weights. Such results indicate the vulnerability of the children, especially the girls toward the iodine deficiency disorders. This trend is also illustrated in Fig. 4 which shows a more positive correlation between growth (age in years) and the difference in observed and recommended weight (kg) in girls (R^2=0.98) compared to the boys (R^2=0.87).

Table 1: Difference in weights of boys and the girls against recommended values

Boys				Girls		
Age	Observed weight (kg)	Recommended weight (kg)	Difference	Observed weight (kg)	Recommended weight (kg)	DF
Birth	2.4	2.6	0.2	2.2	2.6	0.4
3 Months	5.1	5.3	0.2	4.743	5	0.257
6 Months	6.2	6.7	0.5	5.766	6.2	0.434
9 Months	7.2	7.4	0.2	6.696	6.9	0.204
1 Year	7.84	8.4	0.56	7.2912	7.8	0.5088
2 Year	9.65	10.1	0.45	8.9745	9.6	0.6255
3 Year	10.8	11.8	1	10.044	11.2	1.156
4 Year	12.3	13.5	1.2	11.439	12.9	1.461
5 Year	13.9	14.8	0.9	12.927	14.5	1.573
6 Year	14.5	16.3	1.8	13.485	16	2.515
7 Year	16.3	18	1.7	15.159	17.6	2.441
8 Year	17.6	19.7	2.1	16.368	19.4	3.032
9 Year	19.5	21.5	2	18.135	21.3	3.165
10 Year	21.5	23.5	2	19.995	23.6	3.605

Table 2 shows the data on observed and recommended heights (cm) of the boys and the girls of the study area. The data suggested that the height of both boys and girls were less when compared with the recommended values. It was also observed that the difference in observed and recommended heights was very high in girls as compared to the boys. This suggests the overall nutrition level and the stunted growth of the children in the study area. The girls suffered more with the lack of nutrition resulting in the regressed heights and it seems that girls are specifically not taken care in terms of proper nutrition. Similar to results on weight data, the results also indicate the vulnerability of the children, especially the girls toward the iodine deficiency disorders. In a relationship between the growth (age in years) of boys and the girls and the difference in observed and recommended heights (cm), it was observed that more positive relation was observed in girls (R2=0.93) as compared to boys (R2=0.90). Such a trend suggested that girls heights reduced more with the increase in the age as depicted in Fig. 5.

Table 2: Difference in heights (cm) of boys and the girls against recommended values

	Boys			Girls		
Age	Observed Height (cm)	Recommended height (cm)	Difference	Observed Height (cm)	Recommended height (cm)	Difference
Birth	45.4	47.1	1.7	45.8	46.7	0.9
3 Months	56.2	59.1	2.9	52.266	58.4	6.134
6 Months	63.4	64.7	1.3	58.962	63.7	4.738
9 Months	67.5	68.2	0.7	62.775	67	4.225
1 Year	72.6	73.9	1.3	67.518	72.5	4.982
2 Year	80.4	81.6	1.2	74.772	80.1	5.328
3 Year	87.4	88.9	1.5	81.282	87.2	5.918
4 Year	95.6	96	0.4	88.908	94.5	5.592
5 Year	101.5	102.1	0.6	94.395	101.4	7.005
6 Year	107.6	108.5	0.9	100.068	107.4	7.332
7 Year	112.6	113.9	1.3	104.718	112.8	8.082
8 Year	117.5	119.3	1.8	109.275	118.2	8.925
9 Year	120.6	122.7	2.1	112.158	122.9	10.742
10 Year	123.9	124.4	0.5	115.227	123.4	8.173

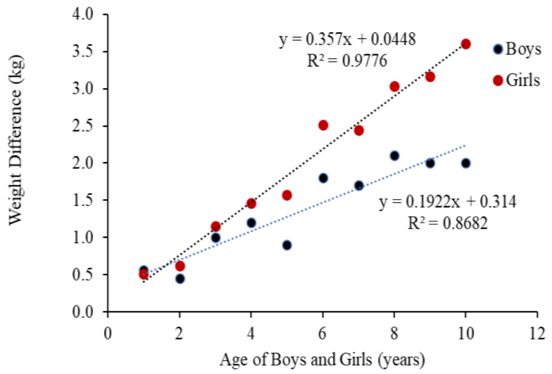

Figure 4: Relationship between age (years) and the difference in observed and recommended weights (kg) of boys and girls

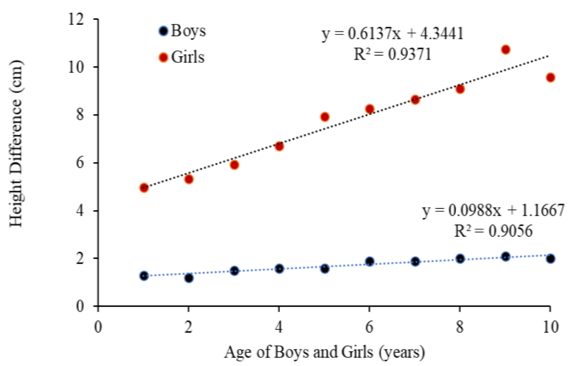

Figure 5: Relationship between age (years) and the difference in observed and recommended heights (cm) of boys and girls

3.3 Knowledge of respondents regarding iodine deficiency disorders (IDD)

In UC Nathiagali, 58.58% of the respondent knew about the iodized salt whereas 41.42% did not know used the iodized salt in their daily cooking. But 60% of the respondent did not know about the purpose of using iodized salt in their diet. About 45% of the respondent heard about the iodine disorders from the TV and radio, 10% from the print media, 3% from medical worker, 5% from their family members and 37% did not respond the question. About 24.58% respondents know about the prevalence of iodine deficiency in the area and rest did not know about it.

In UC Pala, 47.14% of the respondent heard about the iodized salt where as 52.85% did not know used the iodized salt in their daily cooking. The knowledge about the iodine purpose in diet was very low. About 72% of the respondent did not know about the purpose of the iodine in their diet. 32.5% of the respondent heard about the iodine disorders from the TV and radio, 7.2% from the print media, 6.8% from medical worker, 7.4% from their family members and 46.1% did not respond the question. 12.15% respondents know about the prevalence of iodine deficiency in the area and rest did not know about it.

In UC Namli Mera, 36.18% of the respondent heard about the iodized salt whereas 63.82% did not know used the iodized salt in their daily cooking. About 68.5% of the respondent did not know about the purpose of the iodine in their diet. 38.7% of the respondent heard about the iodine disorders from the TV and radio, 11.8% from the print media, 8.4% from medical worker, 6.4% from their family members and 34.7% did not respond the question. 17% respondents know about the prevalence of iodine deficiency in the area and rest did not know about it.

The overall results showed that 47.17% of the respondent in three union councils heard about purpose of the iodine salt in cooking whereas majority of the people did not heard about iodized salt. It showed that most of the respondents are still using normal salt because it is cheaper. The respondents have vey less knowledge about the iodine deficiency disorders. Results also showed that 66.83% respondents did not know about the problem caused by the iodine deficiency though a very proportion of the respondents heard about the iodine deficiency related disease such as goiter but a large number of respondents remain unaware about such disease in the area caused by deficiency of iodine.

The source of the information is mainly the medical worker; 38.73% of the respondents know about the iodine and their effects through TV and radio. The data obtained through the questionnaire showed that 39.26% of the respondents have no response to the source of the information. Source of information though printed material was indicated by 9.66% of the respondents and 6.06% respondent's awareness was through medical worker while 6.26% have knowledge through family discussions. It is also seen that respondents' age, education, family income, place of residence, and occupation had significant association with good knowledge and positive attitude toward consumption of iodized salt.

3.4 Medical history of Iodine syndrome in family members of the respondents

Survey showed that 21.42% of the respondents of Nathiagali have family goiter history. 4% are diagnosed for hyperthyroidism, 5.71% for hypothyroidism and 2.85% had thyroid cancer. 58.57% respondents have no family history of the iodine deficiency disorder (Figure 6). In Namli Mera, 32.85% of the respondents have family goiter history. 7.14% are diagnosed for hyperthyroidism, 11.42% for hypothyroidism, 12.85% had/have thyroid cancer and 11.42% have thyroid nodules. 24.28% respondents have no family history of the iodine deficiency disorder. While in Pala UC, 38.57% of the respondents have family goiter history. 5.71% are diagnosed for hyperthyroidism, 7.14% for hypothyroidism, 5.71% had/have thyroid cancer and 12.85% have thyroid nodules. 30% respondents have no family history of the iodine deficiency disorder. The results indicate that a fair percentage of respondents had iodine deficiency symptoms in their family and the measures should be taken to eradicate the disorders relating to iodine deficiency

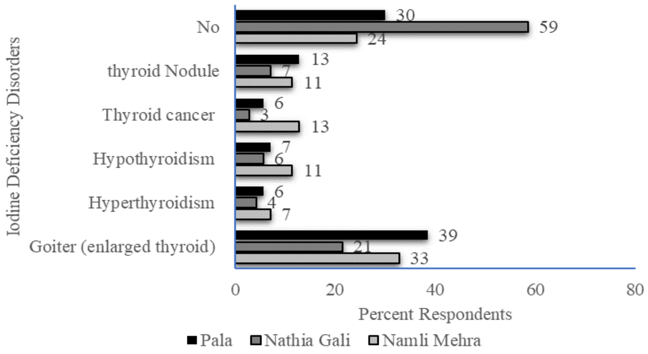

Figure 6: Comparison of Iodine Deficiency Disorders (IDD) in three union councils

3.5 Understanding of the respondents about dietary iodine intake

The respondents were asked to determine the understanding about the importance of iodized salt in their diet (Figure 7). The results showed that in Namli Mera, 21% women said that less iodine is required for women who are not pregnant, while 36% women answered that same iodine amount is required as for pregnant women, whereas 26% told that more iodine is required for women who are not pregnant. A few (17%) did not know about anything regarding dietary iodine.

In Nathiagali, 36% women told that less iodine is required for women who are not pregnant, 40% women answered that same iodine is required as for pregnant women, 20% told that more iodine is required for women who are not pregnant while 4% did not know about anything regarding dietary iodine. The results showed that 26% women in UC Pala told that less iodine is required for women who are not pregnant, 34% women answered that same iodine is required as for pregnant women, 27% told that more iodine is required for women who are not pregnant while 13 did not know about anything regarding dietary iodine. In short, women had little knowledge about the requirement of iodine during pregnancy. It is suggested that an awareness campaign must be carried out to increase the understanding of the respondents regarding importance of dietary intake of iodine.

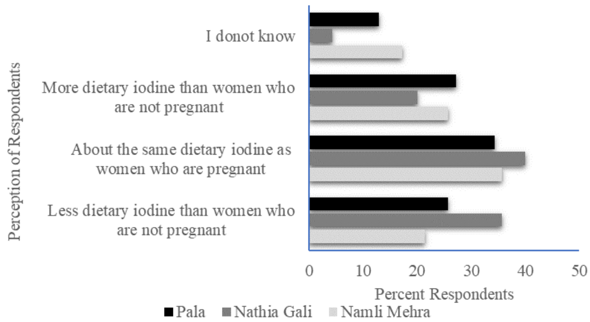

Figure 7: Understanding of the respondents regarding dietary iodine in three union councils

3.6 Factor analysis of the data

Factor analysis was carried out to determine the factors that are significant in current study. Fig. 8 illustrate the Eigen values against the components of the study. Factor analysis is usually adopted in scientific studies for i) the purpose of reducing the number of variables and ii) detecting structure in the relationships between variables. The former is referred to as common factor analysis, whereas the later is known as component analysis when both variables are operated as statistical techniques. While factor analysis expresses the underlying common factors for entire group of variables, it also helps researchers differentiate these factors by grouping variables into different dimensions or factors, each of which is ideally correlated with the other variables. Result showed that education have high Eigen value (above 3) followed by income and family size. It means that education is most important variable to overcome the myths regarding the use of iodized salt. Moreover, education is a key factor to address the problem caused by the low intake of iodine. Secondary, income also played an essential role in overcoming the problem. Increase in income means more purchasing power. Due to low income status of the study area, many peoples cannot afford the iodized salt as it is expensive than the normal salt. Third important factor came out to be the size of the family. The greater number of family members in a household with low income makes it difficult for the family to meet its nutritional requirements and especially the females, whether elder or younger, are equally not taken care in such a social setting. Therefore, the vulnerabilities of the people, especially the women towards iodine deficiency, can be reduced by eradicating poverty and enhancing their education level.

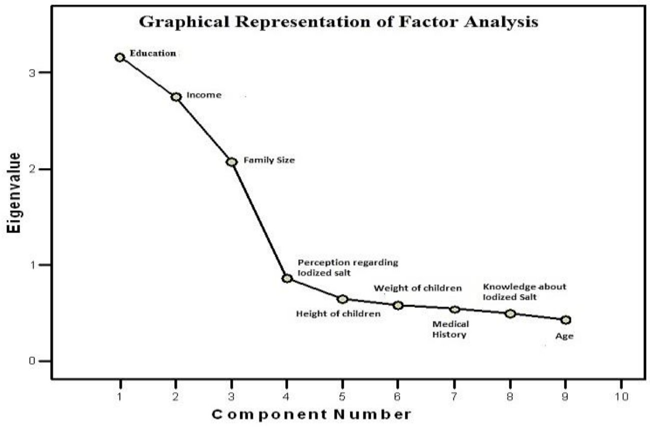

Figure 8: Factor Analysis

4. Discussion

Iodine deficiency is one of the most common, and is of international public health concern, particularly in developing countries (Hetzel, 2005). Inadequate iodine intake adversely affects physical and mental growth and development (Andersson et al., 2012). The social and economic impact of iodine deficiency is significant, resulting in lower IQ, productivity, and student achievement. Household survey on health implication of iodine in the three-union council of Abbottabad District revealed that, despite a national salt iodization programme, this community was unaware of the benefits of iodized salt, and most of the households used non-iodized salt in their food preparation.

The lower education level of the respondents revealed their less knowledge on awareness about iodine deficiency and its negative impacts. A group researchers defined health literacy as a concept which: "entails people's knowledge, motivation and competences to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course (Sørensen *et al.,* 2012)." Therefore, education level and associated general health literacy needs to be improved to ensure better health communication (Kickbusch et al., 2012). The integration of knowledge and communication on iodine deficiencies will empower and enable people to make sound health decisions (Khoja et al., 2000).

It was observed that the majority of respondents earn minimum income to meet their daily requirements. It could be one of the main reasons for their illiteracy and the poor health conditions. The respondents seemed less aware about the iodine deficiency due to less education level as well as poor nutrition level which might have raised their vulnerability to various disease including the effects of iodine deficiency. The other reasons include the high number of family members (above 12 in 37 % respondents) living in a household as shown in Figure 3.

Low income and poverty were main causes for iodine deficiency and the associated knowledge in study area. Our study revealed that most of the household were low in income, which significantly decrease their purchasing power. He inability to purchase healthy food results in iodine deficiency. The social setting observed in the areas also revealed that most household grow vegetables on their own. Soil analysis conducted in these areas showed deficiencies of iodine in soil (Bushra et al., 2019; Mohiuddin et al., 2019). Such situation also resulted less iodine intake by their homegrown food. The World Health Organization (WHO) reports that despite efforts at salt iodization, 2 billion people (approximately 29%) worldwide are iodine deficient (Fisher et al., 2011). The recommended daily allowance for iodine in adults is 150 mg (0.15 mg) per day, and it is 220 mg per day in pregnant women and 290 mg daily in lactating women. Although recent reports suggest that the United States population is iodine sufficient, other data indicate that subclinical deficiency could exist (Morris et al., 2012).

Controversy remains regarding the optimal daily iodine intake. This could be partly a result of the fear that iodine excess causes conditions such as hypothyroidism, goiter, and rashes. Other research suggests that iodine excess is associated with thyroid autoimmune disease leading to both hypothyroidism and hyperthyroidism, despite the fact that autoimmune disease has been increasing during the same time period that iodine intake has been decreasing in the United States.

Our study indicated that a fair percentage of respondents had iodine deficiency symptoms in their family and the measures should be taken to eradicate the disorders relating to iodine deficiency (Fig. 6). The results also revealed that girls suffered more with the lack of nutrition resulting in the regressed heights and it seems that girls are specifically not taken care in terms of proper nutrition. Similar to results on weight data, the results also indicate the vulnerability of the children, especially the girls toward the iodine deficiency disorders (Figure 4 and Figure 5). In Pakistan, the mean soil iodine concentration is found to be 0.66 ug/ g which is lower than global mean iodine concentration (3.0 ug/g) (Zia et al., 2014). Another study on rural households showed only 25% participants knew about iodized salt (Yamada et al., 1998). Another similar type of study showed in Ghana about knowledge levels of respondents as above average, and 72% of the respondents answered that each salt comprised iodine (Buxton and Baguune 2012). Therefore, the current study suggested that increasing education, trainings on health implications of iodine deficiencies and increasing the income level of people might be very effective to reduce vulnerabilities of women in children in the study area.

5. Conclusion

It can be concluded that people of District Abbottabad face the deficiencies of iodine in their diet resulting in disorder and diseases like endemic goiter and body among the population. Therefore, the main approaches to tackle the challenges include the use of iodized salt and oil commercially available in the local market at very low cost, fortification of food, water and distribution of iodine tablets. It is important to raise awareness and educate people regarding iodine deficiency disorders and use of commercial products containing iodine to save the public from diseases. Substantial work is required, especially in the hilly areas of Pakistan and other countries, where people are less educated and have low awareness. This study is important for scientists and policy makers to work more in the areas of Pakistan and similar areas of other Asian countries.

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