Original Article

Vitamin A-rich porridge for Boarding Khalwa students with night blindness

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ABSTRACT

Khalwa is a non-governmental boarding school specialized in teaching Quran to Sudanese children. Food supply to Khalwa is completely dependent on donations. Students are fed on low cost and low nutritional value diet made of sorghum flour porridge and a stew made of dry okra, onion and oil. The incidence of night blindness among these students is reported by the Nutrition Department of the Federal Ministry of Health, Sudan, in 2005 as 0.9%. In this study we interviewed and examined 453 Khalwa students in Umbada area, however blood sampling for assay of vitamin A level was not acceptable by the Khalwa authorities. Thirty four students (7.5%) showed clinical evidence of Vitamin A Deficiency (VAD), 67.6% of them for a period of less than 6 months which was consistent with their stay in Khalwa. Vitamin A fortified sugar is used in Kenya, Zambia, South Africa and Honduras but it is costly and sugar- containing foods and drinks are not in common use by Khalwa students. To supply students with a good amount of vitamin A, we prepared a new porridge formed of sorghum flour; peeled, chopped and boiled pumpkins in addition to their traditional stew. One meal per student contained 250 grams of sorghum flour and 125 grams of pumpkin which supplies 611µg (10891 I.U.) of vitamin A according to the USDA SR-25 composition tables (>100% Daily Value). Compared to the old porridge, there was significant differences (P <0.05) in vitamin A, carbohydrate, protein, fiber, fat, ash and moisture contents. All students accepted the taste of the new porridge and 91.2% agreed that it is not difficult to prepare. We conclude that adding pumpkins to Khalwa porridge is cost effective and may help preventing VAD and its deleterious effects on vision and health.

Key words:
Khalwa; Vitamin A deficiency; Pumpkin; Nutrition

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INTRODUCTION

Vitamin A deficiency (VAD) is a worldwide health problem second to protein energy malnutrition. Approximately 250,000–500,000 children in the developing countries become blind each year due to vitamin A deficiency, with highest prevalence in Africa and South East Asia. Sudan is classified as one of the 26 countries where VAD is considered a public health problem and the prevalence of night blindness is estimated to be 0.01 – 1% [1,2]. More recent surveys in Sudan indicate that there are 99 Boarding Khalwa with 10,725 students who are at risk of VAD and the reported incidence of night blindness is 0.9% [3]. The interrelation of VAD with childhood respiratory infections, diarrhea and measles is well documented in the literature [4]. It affects young children where it can cause xerophthalmia that leads to blindness, growth failure, depresses immunity, exacerbates infections and increases the risk of death. Night blindness is one of the earliest signs of vitamin A deficiency. Xerophthalmia and keratomalacia occur secondary to loss of goblet cells in the conjunctiva that is responsible for mucus secretion. Loss of mucus, death of epithelial cells and super infection can lead to complete blindness. VAD also affects vision by inhibiting the production of rhodopsin which is responsible for vision in dim light [5-7]. A high incidence of xerophthalmia has been seen after an outbreak of measles and it was observed that susceptibility to infection increases nine times when there is severe VAD [8]. This is attributed to the limited surplus of retinol that leads to reduction of the number of T-cells and lymphocytes that need retinol to proliferate and replicate. VAD is also common in children with severe malnutrition because of lack of retinol binding protein and thus reduced intestinal absorption of vitamin A. It is documented that vitamin A supplementation of children under five who are at risk of VAD can reduce all cause mortality by 23% [9]. Supplementation may be carried out with the immunization campaigns or in institutes, schools and Khalwa. This should be repeated every four to six months. Food fortification (oil, margarine, sugar, wheat, milk) is also effective though costly. Genetic engineering is another method of food fortification which has been achieved with golden rice and corn [10,11].

MATERIAL AND METHODS

This is a cross sectional observational study of children with night blindness among Boarding Khalwa students in Alsayem Deema Khalwa in Umbada area, Omdurman, Sudan. Out of 453 students interviewed and examined, 34 students showed evidence of VAD and were included in this study. Materials used in preparing the new recipe included sorghum floor and pumpkins which were available in Khalwa. The new recipe is formed of 250 gm sorghum flour, 125 gm of pumpkin and 750 ml water. Pumpkin is added to water, left to boil for 15 minutes. Sorghum flour is mixed with water and then added to the boiled pumpkin, left to cool, added to the okra stew which is usually used in Khalwa and then served. Acceptability test was performed by asking all students whether they like or dislike the new recipe. The USDA SR-25 composition tables were used to determine vitamin A level in pumpkin species available in the area [12]. Proximate analysis of the materials used was done by the AOAC method for moisture, ash and crude fibre contents [13-15]. Fat content was determined by using Soxhler extractor. Crude protein content was determined by using the micro-Kjeldahl method and carbohydrate was determined by using Pearson Equation where carbohydrate amount equals (100 – (moisture + fat + protein + ash)). Iron content was determined by an Atomic Absorption Spectrophotometer (Perkin Elmer 2380). For data analysis, we used SSPS computer program.

RESULTS

Thirty four male students were found to have night blindness, 29 of whom (85.3%) were in the age group 11-16 years and 5 were in the age group 9-10 years. Those who were staying in Khalwa for more than 6 months were 21 students (61.8%). Father death was reported in 11.8% of students. Illiteracy or poor education of father was reported in 23.6% and poor income (<400 SDG per month) was reported by 82.3%. Twenty three students (67.6%) have had night blindness for less than six months. Using chi square test, there was a significant correlation between the duration of stay in khalwa and the duration of the disease (P≤ 0.05). Xerophthalmia was observed in 22 students (64.7%), (Figure 1), hair change in 11 students (22.3%), Bitot spots in 10 students (29.4%), skin changes in 5 students (14.7%) (Figure 3), and corneal opacity in one student (2.9%). Among the affected students, 7 (20.6%) were seen in a health care centre prior to our study and were given treatment in the form of syrups and eye drops. One meal per student of both porridges weighed about 375 gm. All students liked the new recipe (Figure 3) and 3 students (8.8%) said that it is difficult to prepare. Physiochemical analysis showed significant difference between the new and old recipes (Table 1), and, similarly, in vitamin A content, iron content and cost (Table 2).

Table 1- Physiochemical analysis of the ingredients

	Moisture% ±SD	Ash% ± SD	Fat% ± SD	Fibre% ± SD	Protein% ± SD	CHO% ± SD
Flour	13.42 ±0.10	1.62 ±0.08	3.88 ±0.34	2.00 ±0.50	12.37 ±0.13	66.72 ±0.64
Pumpkin	25.77 ±0.59	7.30 ±0.61	2.49 ±0.02	14.15 ±0.19	18.11 ±0.62	31.71 ±0.91
New porridge	8.55 ±0.18	4.63 ±0.12	1.03 ±0.06	6.75 ±0.66	13.86 ±0.05	60.36 ±5.18
P value	0.002	0.001	0.004	0.001	0.003	0.002

CHO- Carbohydrate, SD- Standard deviation

Table 2- Contents and cost of the new and old porridges per meal (375 gm)

Porridge	Vitamin A (I.U.)	Iron (mg)	*Cost (SDG)
Old porridge	-	4.57	0.045
New porridge	**10892 I. U (611 µg)	8.07	0.06

SDG - Sudanese Pounds, **According to USDA- SR-25*

Figure 1 - Xerophthalmia

Figure 2 - Skin changes (Toad skin)

Figure 3 - The new porridge

DISCUSSION

Vitamin A deficiency is a common problem in developing countries and it is estimated to affect approximately one third of children under 5 years worldwide. The United Nation Special Session on Children in 2002 set a statement for elimination of VAD by 2010. VAD also contributes to maternal mortality and poor outcome in pregnancy and lactation [16]. The condition is usually secondary to dietary problems e. g. poor intake of fruits and vegetables rich in carotenoids. Breast milk of a lactating mother with VAD contains low amount of vitamin A which provides the breast fed baby with insufficient amount of vitamin A. Other causes of VAD include iron deficiency, alcohol consumption, malnutrition, fat malabsorption and infections. Global efforts to support national governments in addressing VAD are led by the Global Alliance for Vitamin A (GAVA). Vitamin Angles has committed itself to eradicate childhood blindness due to VAD by 2020 by supplementation of vitamin A and anti-parasitic drugs twice a year [17,18]. In Sudan, diet consumed by Boarding Khalwa students is deficient in vitamin A and the occurrence of VAD disorders as documented by this study and other similar studies is proportionately related the duration of stay in Khalwa. Risk factors for VAD, as seen in this study, include low dietary vitamin A intake, illiteracy or low level education of father, lack of safe water supply, lack of healthy disposal of human waste, poverty and lack of regular supplementation. Studies from India, Nepal and Bangladesh showed that the high incidence of VAD can be reduced by regular supplementation of vitamin A [19-21], though the mean age group of studied children was less than our group. The total number of students in Khalwa was 453 students and this hindered the preparation of stews with vegetables that contain high vitamin A level as it is costly and time consuming. Instead, we prepared the new porridge by adding pumpkin to the original flour porridge used by Khalwa students.

The process was simple, easy to do, not costly and showed a significant difference in vitamin A and iron content when compared to the original porridge. All students liked the taste of the new porridge, however, 3 students (8.8%) said that it is time consuming to prepare. According to the physiochemical analysis of the new porridge, the use of one meal for a student per day will cover the recommended daily allowance of vitamin A, and continuous use of this porridge will prevent the occurrence of VAD disorders.

CONCLUSION

Exclusive Sorghum flour porridge used by Boarding Khalwa students is deficient in vitamin A; consequently the incidence of VAD among these students is high. In Boarding Khalwa with high number of students, it is costly and time consuming to prepare stews containing vitamin A - rich vegetables. Fortification of food and proper distribution and monitoring is beyond the capability of most of the developing countries. Regular use of the new porridge made of sorghum flour and pumpkin (in addition to the original stew made of okra, onion and oil) supplies an amount of vitamin A that can prevent the occurrence of VAD disorders.

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