



Effectiveness of a Nutrition Education Program in Improving Mothers' Knowledge and Feeding Practices of Infants and Young Children in Sudan

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Abstract

AIM: The aim of the study was to assess the effect of a designed Nutrition Education Program (NEP) on maternal knowledge and practices.

METHODS: A control two groups, quasi-experimental and pre-and post-experimental, were adopted. Data were collected through personal interviews of two groups using a validated questionnaire. The NEP was conducted in three phases. Phase one was the pre-evaluation, phase two was the program's implementation, and phase three entailed post-evaluation of the program.

RESULTS: The results supported the efficient role of the NEP intervention in raising mothers' knowledge and practices towards nutritional care of children under 2 years in Sennar locality. No statistically significant differences were found between the two groups with the controlled variable, mother age, mother education, mother occupation, husband occupation, number of children <5 years, family size, and infant age. This indicates that the two groups were homogenous. No significant difference between the two groups in mothers' knowledge and practices before applying the NEP. The results showed the effectiveness of the NEP in developing the experimental group mother's knowledge and practices, comparing post-test with pre-test in favor of post-test to be statistically significant.

CONCLUSIONS AND IMPLICATIONS: It can be concluded that nutrition education intervention demonstrated its effectiveness in maternal knowledge and practices. The study provided valuable baseline information to develop appropriate training courses and NEPs to raise maternal knowledge and practices toward infants and young children's nutrition.

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Introduction

The most critical time for good nutrition is during the first thousand days from pregnancy until a child's second birthday. Caregivers should prepare and feed well-balanced meals with clean hands and dishes and interact with their children to respond to their hunger signals [1].

Every infant and child has the right to good nutrition according to the "convention on the rights of the child." However, undernutrition is associated with 45% of child death [2].

Proper feeding of infants and young children can increase their chances of survival. It can also promote optimal growth and development, especially in the critical window from birth to 2 years of age [3]. Children are the nation's most important resources. Thus, they deserve the best possible nutrition care for their present and future health. Therefore, improving infants and young child feeding practices is of paramount importance to

improve the nutrition, health, development of children, and ultimately impacting child survival [4]. Undernutrition is associated with growth faltering, micronutrient deficiencies, delayed cognitive development, and morbidity [5]. The 65th World Health Assembly (WHA) endorsed the comprehensive implementation plan on maternal, infant, and young child nutrition (MIYCN) [6].

The WHA resolution urges member states to put the MIYCN plan into practice by including proven nutrition interventions relevant to the country in maternal, child, and adolescent health services and care. In addition, interventions should ensure universal access, establish, and engage policies in agriculture, trade, education, social support, environment, and other relevant sectors to improve nutrition.

Moreover, many researchers found that nutrition education played an important role in dealing with health problems and raising the level of nutrition knowledge and practices among women in terms of improving food recipes, increasing dietary adequacy and growth, and reducing morbidity [7], [8], [9], [10].

Nutrition education intervention programs include different categories of strategies that focus on nutritional awareness, such as individual counseling, interpersonal communication, and home visits [11], [12], [13], [14].

Many studies and the human capital theory showed that the educational level and socioeconomic status have more influence than the low attendance of antenatal care visits and therefore play an essential role in combating improper feeding habits and practices [15], [16]. Infants and young children in different remote areas in Sudan, including the Sennar locality where the current study was conducted, might be at risk of undernutrition and other related diseases due to a lack of the Nutrition Education Programs (NEPs) [17], [18].

Reviews of nutrition education provided evidence that children were not born with the innate ability to choose a nutritious diet; instead, their food habits are learned through experience and education, for example, children left to their own choices will not automatically select healthy foods. Their innate preference for sweet foods makes them particularly vulnerable to the highly sugared cereals, soda, and candy marketed to them virtually from birth [19], [20].

According to the Sudan Household Health Survey (2010) implemented by the Federal Ministry of Health (FMH) in the Northern States, the nutritional status of under-five children was reported as 32% underweight, 35% stunted, and 16% wasted. Based on survey results, Sennar State had a high percentage of poor nutrition among children under 5; 42.6% were underweight, 47.1% stunted, and 21.6% wasted [21], [22]. Therefore, Sennar State was identified as one of the most lacking states regarding awareness and practices interventions of NEPs for mothers to improve their children's health and nutritional status.

The findings of the knowledge, attitude, and practices (KAP) study conducted by the FMH Integrated Management of childhood illnesses (IMCI) in the Gabel Moya area in Sennar locality showed that 15.4% of the mothers did not know the advantage of breastfeeding to the infants and young children; 11.8% thought that exclusive breastfeeding should be continued until the 4 months of life; approximately 52.2% practiced breastfeeding till 4 months, whereas 8% continued breastfeeding until 6th months of age. Most mothers (82%) were not aware of the component of the adequate nutrient meal [23].

Mothers are the foremost providers of primary care for children. Their understanding of essential nutrition and health measures strongly influences the care they provide. The aspects of nutrition knowledge include the proper age for introducing solid foods and the type of solid foods, frequency of child feeding, diet during diarrhea, and the mother's perceptions of her child's nutritional status. Mothers' practical nutrition knowledge is essential for child health outcomes [24].

Poor infant feeding practices directly or indirectly contribute to undernutrition, morbidity, and mortality in infants [5]. Due to evidence that nutrition education empowers a mother to maximize her resources, the lack of awareness may cause a faulty diet that would affect the child's health [25], [26]. Therefore, the main goal of nutrition education is to create positive awareness of feeding practices. However, until now, most of the studies conducted on infants and young children feeding in Sudan have been confined to assessing the nutritional status of infants and young children, whereas in-depth studies for the evaluation of NEPs are limited, indicating a clear knowledge gap. As healthy eating habits are established early in childhood, assessing the NEPs is crucial. This study aimed to investigate the effect of a NEP that was implemented to raise mothers' attitudes toward nutritional care of children below the age of 2 in the Sennar locality.

Methods

Study design

A quasi-experimental pre/post design was conducted during July 2014–January 2015 in the Mayerno and El Salaam areas in Sudan's Sennar locality. Mothers of children below the age of 2 were enrolled in the study using a random systematic sampling technique. The participants were assigned into two groups of 136 mothers, the intervention area Mayerno (group A) and group B and the comparison area (El Salaam). A pre-tested structured questionnaire designed by the IMCI community component (KAP) survey questionnaire program was adopted and modified to collect the data related to the objectives of the current study. Ethical approval was obtained from the Ethical Committee, FMH, Sennar State. Additional clearance was obtained from the local health authorities and locality. Informed consent was obtained from the participants, and several measures were taken to ensure privacy and confidentiality throughout the study period by excluding personal identifiers during data collection.

Instruments, measures, and procedures

The questionnaire consisted of three sections:

- Section one: Included general characteristics and socioeconomic demographic information of respondents, for example, (mother age, educational level, occupational for mother and father, family size, and infant ages).
- Section two: Consisted of (30) items about mothers' knowledge about nutritional care of under 2-year-old children, for example,

(breastfeeding, complementary feeding, and feeding methods of children). A score of (zero–one) was given to the answers based on the validity of the answers.

- Section three: Consisted of (8) items each of them is a short answer question to assess mother practices regarding nutritional care of children under 2 years of age. Each correct answer was scored by (one), and each incorrect answer was scored by (zero).

Phases of the study: The study was composed of three phases:

1. Phase one (baseline data): Data were collected from the two groups (the experiment and the control groups) through the face-to-face interview method during the home visits to fill the pre-questionnaire
2. Phase two (implementation of the program; intervention phase): The program was implemented in the following steps:
 - 2.1: One day workshop was conducted in the Sennar locality health office to train four nutrition educators and two nutrition officers who helped later in all stages of the study, including the teaching sessions.
 - 2.2: The NEP targeted all mothers of children under 2 years of age in Mayerno units in Sennar locality. The sessions were taught in 4 days following a specific schedule for each group of mothers. Different teaching methods and tools, including training manuals, posters, and pamphlets, were used. At the end of each session, a group discussion was held, followed by the evaluation questions to measure the awareness, knowledge, practices progress, and benefits of the manual
 - 2.3: Seminars were conducted 3 months following the implementation of the program. These seminars summarized the four nutrition education sessions addressed to all mothers to maximize the benefits.
3. Phase three (evaluation phase): In this phase, the data related to the indicators of the study were collected using the same methods of data collection used in phase one about the mothers' knowledge and practices toward under 2-year-old children's nutritional care; the same mothers in the pre-evaluation phase were asked in the post-test and the same questionnaire. Secondary data were collected from updated references (books, journals, and the Internet) and relevant previous national and international studies.

Data analysis

Data analysis was conducted using the Statistical Package for the Social Science (IBM

SPSS Statistics for Windows, Version 20.0) [27]. Both descriptive and inferential statistics were applied to analyze the data. *t*-test and Chi-square tests were used to analyze continuous and categorical data, respectively. Alpha Cronbach and Spearman–Brown equations were applied for reliability. Pearson correlation coefficients, *t*-test for two groups, *t*-test by pairs, one-way ANOVA, and Chi-square test were also used.

Results

One hundred and thirty-six mothers, with the majority being below 30 years, were successfully interviewed and participated in the study. All mothers were housewives, and most of them had a moderate level of education. In addition, most of the husbands were engaged in free work (Table 1).

There was no significant difference between the two study groups regarding mothers' knowledge and practices before applying the NEP (Table 2).

To determine the significance of the effectiveness of NEP in developing mothers' knowledge and practices when applied at the Sennar locality (post-test measuring), the results of the *t*-test have shown that breastfeeding, children's feeding, foods and feeding gastrointestinal, attitudes, and practices were significant (Table 3).

Similarly, developing mothers' knowledge and practices in the experimental group (comparing post-test with pre-test) showed an efficient effect for the program (Table 4).

The results showed no significant difference in the effectiveness of the (NEP) in developing knowledge and practices among mothers in the experimental group; regarding some socioeconomic factors that may confound the outcomes (maternal education, husbands' occupations, number of children <5 years, and maternal age) (Table 5).

Discussion

To the best of the authors' knowledge, this is the first study that tackled assessing a NEP designed to enhance mothers' knowledge and practices on infants' feeding in Sennar, Sudan. The main findings of the current study were the significance of the NEP in developing mothers' knowledge and practices when applied at the Sennar locality (post-test measuring). Furthermore, the results illustrated a statistically significant effect for the NEP in developing experimental group mothers' knowledge and practices (comparing post-test with

Table 1: Sample demographic characteristics

Controlled variables	Levels	Groups		χ ²	Df	p	Statistical inference
		Control, n (%)	Experimental, n (%)				
Mother age (years)	< 20	17 (12.5)	13 (9.5)	0.841	2	0.657	The two groups are homogenous
	20–30	95 (69.8)	95 (69.8)				
	> 30	24 (17.6)	28 (20.5)				
Mother education	Illiterate	46 (33.8)	36 (33.8)	4.135	2	0.126	The two groups are homogenous
	Moderate	88 (64.7)	93 (68.3)				
	University	2 (1.4)	7 (5.1)				
Mother occupation	Housewife	136 (100)	136 (100)	0.000	1	1.000	The two groups are homogenous
Husband occupation	Laborers	49 (36.0)	49 (36.3)	0.267	3	0.966	The two groups are homogenous
	Officer	8 (5.8)	7 (5.1)				
	Free work	77 (56.6)	77 (56.6)				
	Others	2 (1.4)	3 (2.2)				
Number of children under 5 years of age	Only 1	43 (31.6)	52 (38.2)	1.427	3	0.699	The two groups are homogenous
	2	75 (55.1)	66 (48.5)				
	3	15 (11.0)	15 (11.0)				
	4	3 (2.2)	3 (2.2)				
Family size	< 9 members	114 (83.8)	114 (83.8)	0.000	2	1.000	The two groups are homogenous

Table 2: Mother’s knowledge and practices in the two study groups before applying nutrition educational program

Variables	Group	Mean	SD	Calculated T value	df	p	Statistical inference
Breastfeeding (K1)	B	1.49	2.54	-0.767	270	0.444	The differences are not significant
	A	1.74	2.98				
Children’s feeding (K2)	B	0.91	1.40	-1.535	254	0.126	The differences are not significant
	A	1.21	1.82				
Foods and feeding GI (K3)	B	1.96	2.38	0.703	270	0.483	The differences are not significant
	A	1.75	2.45				
Practices	B	44.3	4.45	1.494	270	0.136	The differences are not significant
	A	4.66	1.78				

SD: Standard deviation.

pre-test) and the post-test measuring. Furthermore, the results showed that NEP significantly affects developing mothers’ knowledge and practices when applied at the Sennar locality (Comparing post-test with pre-test).

Table 3: Mother’s knowledge and practices in the two study groups, when applied (post-test measuring)

Variables	Group	Mean	SD	Calculated T value	df	p	Statistical inference
Breastfeeding (K1)	B	2.02	2.89	-8.856	270	0.001	The NEP is efficient
	A	5.07	2.77				
Children’s feeding (K2)	B	0.79	1.31	-12.464	221	0.000	The NEP is efficient
	A	3.51	2.18				
Foods and feeding GI (K3)	B	2.50	3.45	-7.729	259	0.001	The NEP is efficient
	A	5.43	2.77				
Attitudes	B	45.4	4.09	-5.975	270	0.001	The NEP is efficient
	A	48.6	4.88				
Practices	B	4.91	1.43	-2.987	270	0.003	The NEP is efficient
	A	5.47	1.65				

NEP: Nutrition education program, SD: Standard deviation.

For successful intervention programs to be replicated, it is essential to have a complete set of necessary data on implementation. In developing country settings similar to the current study, where

Table 4: Mother’s knowledge and practices in the two study groups (t-test by pairs to determine the significance of effectiveness of nutrition education program in developing experimental group mother’s knowledge and practices)

Variables	Time	Mean	SD	Calculated T value	Df	p	Statistical Inference
Breastfeeding (K1)	Pre	1.74	2.98	-11.101	135	0.001	The NEP is efficient
	Post	5.07	2.77				
Children’s feeding (K2)	Pre	1.21	1.82	-10.303	135	0.001	The NEP is efficient
	Post	3.51	2.18				
Foods and feeding GI (K3)	Pre	1.75	2.45	-12.246	135	0.001	The NEP is efficient
	Post	5.43	2.77				
Practices	Pre	4.34	1.79	-5.283	135	0.001	The NEP is efficient
	Post	5.47	1.65				

NEP: Nutrition education program, SD: Standard deviation.

the resources are limited, and community public health problems are prevalent, the implementation

and evaluation are essential for promoting effective programs, replication, and expansion [28]. The current intervention study aligns with a global focus on infant and young child nutrition [3]. Furthermore, infant and young child feeding are among the prioritized areas specified in Sudan’s National Nutrition Strategy [29].

Similar to the current study, researchers found post-intervention increases in nutrition knowledge and good nutrition behavioral changes [30]. In addition, another study showed that the awareness level of pregnant women on healthy nutrition has significantly increased from 3% before the intervention to 31% after the nutritional education intervention ($p < 0.001$) [31]. Accordingly, sufficient evidence supports that nutritional education intervention positively affects respondents’ nutritional awareness.

Apropos of that, the validity of the results revealed no significant differences between the two groups before applying NEP regarding mothers’ knowledge and practices such as breastfeeding, complementary feeding, and general and child feeding, $t = -0.767, -1.535, \text{ and } 0.7031$, respectively.

As for the homogeneity of the two study groups, there were no significant differences with respect to the main variables; maternal age, mother’s education, mother’s occupation, husband’s occupation, number of children <5 years, family size, and infant age, $p < 0.657, 0.126, 1.000, 0.966, 0.699, 1.00, \text{ and } 0.220$, respectively. These results indicated that the two groups were homogenous.

The result showed no significant difference in NEP effectiveness in developing knowledge and practices among mothers in the experimental group according to maternal age, mother’s education, husband’s occupation, number of children <5 years, and age of infants and followed by two post-tests within 3-week interval. In line with the present study, no correlation was evident between mothers’ knowledge and practices of child health-related matters and the level of education, age, or the number of children [16].

The current study results revealed a correlation between the mothers’ awareness of nutritional care of children after the implementation of the program and their educational level. Similarly,

Table 5: Nutrition education program effectiveness in developing knowledge and practices among the experimental group

Factor	Variables	Source	Sum of squares	Df	Mean square	F	Significance	Statistical Inference
Mother's education	K1 improve	Between	7.129	2	3.565	0.289	0.749	The differences are not significant
		Within	1638.635	133	12.321			
		Total	1645.765	135				
	K2 improve	Between	13.879	2	6.939	1.030	0.360	The differences are not significant
		Within	896.357	133	6.740			
		Total	910.235	135				
	K3 improve	Between	9.256	2	4.628	0.373	0.690	The differences are not significant
		Within	1652.149	133	12.422			
		Total	1661.404	135				
	Practices improve	Between	7.788	2	3.894	0.620	0.540	The differences are not significant
		Within	835.829	133	6.284			
		Total	843.618	135				
Husband's occupations	K1 improve	Between	56.619	3	18.873	1.568	0.200	The differences are not significant
		Within	1589.145	132	12.039			
		Total	1645.765	135				
	K2 improve	Between	2.899	3	0.966	0.141	0.936	The differences are not significant
		Within	907.336	132	6.874			
		Total	910.235	135				
	K3 improve	Between	25.204	3	8.401	0.678	0.567	The differences are not significant
		Within	1636.200	132	12.395			
		Total	1661.404	135				
	Practices improve	Between	9.833	3	3.278	0.519	0.670	The differences are not significant
		Within	833.785	132	6.317			
		Total	843.618	135				
The number of children under 5 years of age	K1 improve	Between	88.275	3	29.425	1.950	0.122	The differences are not significant
		Within	4043.398	268	15.087			
		Total	4131.673	271				
	K2 improve	Between	3.247	3	1.082	0.161	0.923	The differences are not significant
		Within	1805.808	268	6.738			
		Total	1809.055	271				
	K3 improve	Between	32.376	3	10.792	0.629	0.597	The differences are not significant
		Within	4597.091	268	17.153			
		Total	4629.467	271				
	Practices improve	Between	6.657	3	2.219	0.523	0.667	The differences are not significant
		Within	1137.402	268	4.244			
		Total	1144.059	271				
Mother's ages	K1 improve	Between	8.181	2	4.091	0.332	0.718	The differences are not significant
		Within	1637.583	133	12.313			
		Total	1645.765	135				
	K2 improve	Between	17.139	2	8.569	1.276	0.283	The differences are not significant
		Within	893.096	133	6.715			
		Total	910.235	135				
	K3 improve	Between	19.005	2	9.503	0.770	0.465	The differences are not significant
		Within	1642.399	133	12.349			
		Total	1661.404	135				
	Practices improve	Between	5.169	2	2.584	0.410	0.665	The differences are significant
		Within	838.449	133	6.304			
		Total	843.618	135				

in Khartoum State, researchers reported a strong correlation between high illiteracy and low income with the knowledge and practices of the mother toward exclusive breastfeeding [32].

Strengths and limitations

The methodological strengths of this study include the use of a quasi-experimental pre/post design that allows a reliable assessment of the NEP. Ethical considerations were considered in not allowing the withholding of the NEP to cover all mothers who participated in the program.

However, some limitations should be noted. The sampling of the mothers participating in the study was based on home visits; 10 health workers were recruited during the data collection phase. (house visits). Furthermore, during program implementation, mothers were incentivized to participate. Potential risks may arise due to a lack of double blinding. Parents of the study children and the nutrition counselors allocated to the intervention group may be aware of the allocated arm, which may interfere with the reliability of the results. Another limitation is that self-reporting measurements such as maternal recall of recommended practices may

overestimate nutrition outcomes and behaviors due to recall bias.

It is highly recommended to focus on nutritional education programs to raise mothers' knowledge and practices about infants and young children feeding to be implemented in other states in Sudan. The government should support the NEP sector for integrated health packages and should ensure the proper functioning of nutritional health programs and health workers. Good nutrition educational programs which integrate government ministries (health and education) to introduce a section on infant feeding in the nutrition at the higher secondary level to promote knowledge and awareness in this aspect.

Conclusions

The results indicated the effectiveness of NEP in developing mothers' knowledge and practices improving their awareness. The intervention components can be feasibly integrated into existing health services in different areas in Sennar. If successful, the approach

used to deliver the nutrition education package could be quickly and inexpensively scaled and disseminated in other parts of Sudan.

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Author Contributions

E.M. designed the study and recruited the participants. E.M., S.S, and M.E. analyzed the data and wrote the manuscript. Z.T. and A.G. contributed to the design of the study, data collection, and manuscript writing. All contributive authors of this original manuscript authorized the final version of the manuscript. All authors have read and approved the final manuscript.

Ethical Approval

Ethical approval was obtained from the Ethical Committee, FMH, Sennar State. Additional clearance was obtained from the local health authorities and locality.

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