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ORIGINAL

Dietary intakes of Ethiopian Orthodox Tewahedo Christian lactating mothers during the fasting and non-fasting periods in rural Ethiopia: A prospective cohort study

Ingesta dietética de las madres lactantes cristianas ortodoxas tewahedo etíopes durante los periodos de ayuno y no ayuno en la Etiopía rural: Un estudio de cohorte prospectivo

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Abstract

Background: Even if Ethiopian Orthodox Tewahedo Christian lactating mothers are exempted from religious fasting, a significant proportion of these mothers are practicing it. However, there were little evidence generated on the effect of Orthodox fasting on the energy and nutrient intake of lactating mothers in Ethiopia. Therefore, this study was designed to evaluate the dietary nutrient intake of Ethiopian Orthodox Tewahedo Christian lactating women during Lent fasting and non-fasting periods in rural Ethiopia.

Materials and methods: A prospective study was conducted on 513 Ethiopian Orthodox Tewahedo Christian lactating mothers (157 fastings and 356 non-fastings) from rural Genta Afeshum district, during the lent fasting and non-fasting periods of 2017. Energy and nutrient intake was calculated from a 24-hr individual dietary recall using CIMI Ethiopia software. Nutrient intake below the estimated average requirement (EAR) was used to identify participants at high risk of inadequate intake.

Results: The median dietary intake of energy, zinc, magnesium, niacin, vitamin B12, and D for both study groups; and protein, iron, vitamin B1, and pantothenic acid for fasting mothers and vitamin A for non-fasting mothers were significantly ($p < 0.05$) higher in the non-fasting period compared to fasting period. Similarly, the prevalence of high risk for inadequate of protein, zinc and vitamin B1, both for the fasting and non-fasting mothers' group were significantly lower ($p < 0.05$) during the non-fasting compared to fasting period. Additionnaly, the prevalences for high risk of inadequate intake of dietary magnesium and niacin was significantly ($p < 0.05$) higher during fasting period than the non-fasting period, in the fasting mothers' group. However, there was a slight, but a significant ($p < 0.05$) increment in the prevalence of inadequate intake of vitamin A in the non-fasting period than the fasting period, in the non-fasting mothers' group.

Conclusion: The dietary energy and nutrient intake of fasting and non-fasting mothers were affected during lent fasting period, but they were substantially improved in the non-fasting period, thus the proportions of lactating mothers at higher risk of inadequate intake of nutrients were reduced during the non-fasting period. The results call for a strong integration and involvement of church leaders in the existing nutrition interventions, by preaching the exemption of the lactating mothers' group from fasting to improve the consumption of ASFs, both during fasting and non-fasting seasons. Therefore, this aims to improve the quality of diet consumed by the lactating mothers in general.

Key words: Ethiopian Orthodox Tewahedo Christian, lactating mothers, lent fasting period, dietary intake, CIMI Ethiopia.

Resumen

Antecedentes: Aunque las madres lactantes cristianas ortodoxas etíopes están exentas del ayuno religioso, una proporción significativa de estas madres lo practican. Sin embargo, se han generado pocas pruebas sobre el efecto del ayuno ortodoxo en la ingesta de energía y nutrientes de las madres lactantes en Etiopía. Por lo tanto, este estudio se diseñó para evaluar la ingesta de nutrientes en la dieta de las mujeres lactantes cristianas ortodoxas etíopes Tewahedo durante los períodos de ayuno y no ayuno de la Cuaresma en las zonas rurales de Etiopía.

Materiales y métodos: Se realizó un estudio prospectivo en 513 madres lactantes cristianas ortodoxas etíopes Tewahedo (157 ayunantes y 356 no ayunantes) del distrito rural de Genta Afeshum, durante los períodos de ayuno y no ayuno de Cuaresma de 2017. La ingesta de energía y nutrientes se calculó a partir de un recuerdo dietético individual de 24 horas utilizando el software CIMI Ethiopia. Se utilizó la ingesta de nutrientes por debajo del requerimiento medio estimado (EAR) para identificar a los participantes con alto riesgo de ingesta inadecuada.

Resultados: La mediana de la ingesta dietética de energía, zinc, magnesio, niacina, vitaminas B12 y D para ambos grupos de estudio; y de proteínas, hierro, vitamina B1 y ácido pantoténico para las madres en ayunas y de vitamina A para las madres sin ayuno fue significativamente ($p < 0,05$) mayor en el período sin ayuno en comparación con el período de ayuno. Del mismo modo, la prevalencia de alto riesgo de insuficiencia de proteínas, zinc y vitamina B1, tanto en el grupo de madres en ayunas como en el de madres sin ayuno, fue significativamente menor ($p < 0,05$) durante el período de no ayuno en comparación con el de ayuno. Además, la prevalencia de alto riesgo de ingesta inadecuada de magnesio y niacina en la dieta fue significativamente mayor ($p < 0,05$) durante el periodo de ayuno que durante el periodo sin ayuno, en el grupo de madres en ayunas. Sin embargo, hubo un ligero, pero significativo ($p < 0,05$) incremento en la prevalencia de ingesta inadecuada de vitamina A en el periodo de no ayuno que en el de ayuno, en el grupo de madres que no ayunan.

Conclusión: La ingesta de energía y nutrientes en la dieta de las madres en ayunas y sin ayuno se vio afectada durante el periodo de ayuno, pero mejoró sustancialmente en el periodo sin ayuno, por lo que las proporciones de madres lactantes con mayor riesgo de ingesta inadecuada de nutrientes se redujeron durante el periodo sin ayuno. Los resultados exigen una fuerte integración e implicación de los líderes eclesiásticos en las intervenciones nutricionales existentes, predicando la exención del grupo de madres lactantes del ayuno para mejorar el consumo de FAS, tanto en la época de ayuno como en la de no ayuno. De este modo, se mejorará la calidad de la dieta consumida por las madres lactantes en general.

Palabras clave: Cristiana ortodoxa etíope Tewahedo, madres lactantes, periodo de ayuno de cuaresma, ingesta dietética, CIMI Etiopía.

Introduction

Religious fasting plays a pivotal role in changing the dietary pattern of households. It affects the nutritional status of individuals living in the households, especially the nutritionally vulnerable groups such as pregnant and lactating women, and children[1-6]. In Ethiopia, more than two-thirds of the population are either followers of Ethiopian Orthodox or Islam religions. In these religions, fasting during their fasting period is a strict/mandatory religious practice[7]. However, the fasting traditions and the number of fasting days in the calendar year are prominently different between these two religions[8].

Unlike in Islam, the fasting practices in the Ethiopian Orthodox religion include avoiding any animal source foods for more than 180 days in a year. It is also coupled with abstaining from any foods and water until mid of the day or 3:00 pm afternoon by skipping breakfast during the fasting days, except Saturday and Sunday[4,9,10]. However, pregnant and lactating mothers are among the groups of people exempted and permitted to eat animal source foods during the fasting days, and any foods and water during the day or during fasting periods without any restriction[4,11-13]. However, this is not happening, as significant proportions of the Ethiopian Orthodox pregnant and lactating mothers are fasting in the seven official fasting periods of the religion throughout the year[2,4]. Studies in northern Ethiopia where the majority of the people are followers of the Orthodox religion reported that 28 - 77% of the pregnant or lactating women were fasting during the fasting periods[4,14]. A study in Oromia region was also revealed that 38% of pregnant women were also practing fasting in the Ethiopian Orthodox fasting period[2].

Our previous study in the Tigray region also found that the frequency of meals, diet diversity, and consumption of animal source foods (ASFs) was low in lactating women regardless of their fasting status during the Lent fasting season. However, the dietary pattern was improved during the following non-fasting period[4]. Yet, to the best of the authors' knowledge, less is known about the effect of Ethiopian Orthodox fasting on the dietary energy and nutrient intake of lactating mothers in Ethiopia. Therefore, this study was initiated to assess whether and to what extent the Ethiopian Orthodox fasting period affects the energy and nutrient intake of fasting and non-fasting Orthodox Christian lactating mothers.

Materials and methods

Study settings

The study was conducted in Genta Afeshum, which is one of the districts under the Misraqawi zone of Tigray regional state in Ethiopia. The district lies between 14° 20' N and 32° 29' E and resides in an altitude between 2045 and 3314 meters above sea level. The district is about 120 km far from the regional capital, Mekelle, and Addis Ababa (921 km), the capital city of the country. In the district, an estimated 99,112 people are living, and most of them are followers of the Ethiopian Orthodox religion[4,15,16].

Study design and period

This study is part of a larger longitudinal community-based study. In this study, two surveys were conducted during the Ethiopian Orthodox Tewahedo lent fasting (15 February – 15 April 2017) and non-fasting (1-30 May 2017) periods.

Sample size, sampling procedure, and study participants

Due to the larger study that included mother-child pairs, different sample sizes were calculated using the single population proportion formula and a finite population with a prevalence of underweight in lactating mothers, underweight, wasting, and stunting in children elsewhere in the Tigray region. Amongst this, the largest sample size was calculated using the assumption: prevalence of stunting in children (57.0%), 95% of confidence interval for true prevalence, and a relative precision (d) of 5% was high (n = 384) and selected for this study. Additionally, we also considered the 1.5 design effect in the calculated sample size, so that the final sample size was 576. The multi-stage systematic random sampling procedure was used to select the study participants.

Inclusion and exclusion criteria

Lactating mothers who had 6-23-months-old children, who were permanent inhabitants (lived > 6 months), were included, whereas those mothers who were not healthy or had even 6-23-months-old children but with an apparent health problem or gave birth to a twin with the indexed child were excluded from the study.

Data Collection

Before conducting the quantitative 24hr dietary survey, the principal investigator identified food items, recipes, cooking and serving materials, and how they were served commonly to women in the study area. Food items and prepared recipes were measured using a laboratory weight balance (2 kg maximum weight: Model CS 2000, Ohaus Corporation, New York, NJ, USA) to estimate the amount/weight of food consumed by the mothers. Pictures were also taken of the commonly consumed food items. Typical utensils for food preparation were used by the data collectors to support the estimation of quantities in the 24hr recall.

Ten experienced data collectors were recruited and trained before the survey. A pretested questionnaire which was translated to the local language (Tigrigna), was used to collect information on the socio-demographic and economic, and health-related characteristics of the mothers. Interactively, the mothers were asked to recall the dietary information for the last 24-hr using the multiple-pass technique[17].

Ethical Consideration

Ethical clearances were obtained from the Ethical Review Committees in Ethiopia (Hawassa University and Tigray Region Health Bureau) and Germany. Furthermore, the aim of the study and the confidentially of information to be collected during the study was told to the mothers. The partcipated mother was also informed about their right to withdraw with their children from the participation whenever they felt discomformed during the data collection time. Their agreement to participate with their indexed child in the study was documented by signing in the informed consent.

Data Management and Analysis

The amount of food items consumed by the mothers in the last 24-hr was estimated. The estimated amount of food items were sorted out into the 31 food groups of the CIMI Ethiopia software (Calculator for Inadequate Micronutrient Intake for Ethiopia)[18]. Then, food items that are categorized in the same food group were summed up together and the data were entered into CIMI Ethiopia, a nutritional assessment software. CIMI Ethiopia is recently developed and validated for calculating energy and nutrient intake and identifies the inadequacy of energy and nutrients in a person diet. Statistical analysis was performed using SPSS for Windows version 25 (IBM Corporation, Armonk, NY, USA). Nutrient intake data were not normally distributed (Kolmogorov-Smirnov test), therefore differences in energy and nutrient (n = 14) intake between the fasting and non-fasting mothers during the fasting period were determined using Mann Whitney U Test. Whereas, to determine the differences in the intake of fasting mothers between the fasting and non-fasting period, and similarly for the non-fasting mothers, Wilcoxon Signed Ranks Test was used. Average results were presented as mean (SD) and median with an interquartile range. To identify the prevalence of high risk for inadequate intake, the estimated average requirement (EAR) for each nutrient was used as a cutoff point[19,20]. Because there is no EAR for energy and pantothenic acid, inadequacy was not calculated for them. To calculate a potential risk of inadequacy for a protein, individual body weight was considered. Then, the difference in the proportion of mothers with a high risk for inadequate intake between the fasting and non-fasting periods was determined in both groups using McNemar's test.

Results

Socio-demographic, economic, and health-related characteristics

A total of 513 lactating mothers are included in this study. The mean age and height of the fasting and non-fasting mothers were comparable. While the average number of children of the fasting mothers was higher than those of mothers who were not fasting. However, the mean MUAC for the fasting mothers was lower than those of mothers in the non-fasting group. Details of the characteristics of lactating mothers are presented in **table I**.

Comparison of energy and nutrient intake of fasting and non-fasting mothers during the lent fasting period

The median intake of energy, protein and most micronutrients by the non-fasting mothers were higher than the fasting mother group during the fasting period. However, these differences were not statistically significant (p>0.05), except for niacin (p = 0.042) (data not shown).

Energy and nutrient intake of fasting mothers

The median intake of energy and 9 nutrients (including protein) were significantly higher (p<0.05) during the non-fasting than fasting period. Even though there was an increase in the median intake of calcium during the non-fasting period for fasting mothers, it was not significantly different (p=0.703) from the fasting period. However, there was no significant difference in the median take of vitamin B6 between fasting and non-fasting period. Similarly, the median intake of vitamin C by the fasting mothers was comparable in the fasting and non-fasting periods. Besides these, the median intakes of vitamin A, B6, B12, C, D and calcium were below the EARs (**Table II**).

Table I: Socio-demographic, economic, and health-related characteristics of mothers in northern Ethiopia.

	Fasting status of mothers		
	Fasting mothers (n = 157) Number (%)	Non-fasting mothers (n = 356) Number (%)	Total (n = 513) Number (%)
Marital status			
Married	139 (88.5)	296 (83.1)	435 (84.8)
Others	18 (11.5)	60 (16.9)	78 (15.2)
Maternal education			
No formal education attended	63 (40.1)	115 (32.5)	178 (34.7)
Completed primary school	57 (36.3)	125 (35.1)	182 (35.5)
Completed secondary school and above	37 (23.6)	116 (32.6)	153 (29.8)
Maternal occupation			
Housewives	131 (83.4)	276 (77.5)	407 (79.3)
Farmers	21 (13.4)	51 (14.3)	72 (14.0)
Daily /causal laborers	1 (0.6)	14 (3.9)	15 (2.9)
Petty traders	2 (1.3)	12 (3.4)	14 (2.7)
Employed	2 (1.3)	3 (0.8)	5 (1.0)
	Mean (SD)	**Mean (SD)**	**Mean (SD)**
Age of the mother (years)	30.36 (6.27)	29.53 (6.47)	29.78 (6.42)
Height of the mothers(cm)	156.51 (5.49)	156.66 (5.51)	156.62 (5.50)
MUAC of the mothers (cm)	22.75 (2.20)	23.57 (2.28)	23.32 (2.29)
Number of children of the mothers	3.59 (1.92)	3.24 (2.02)	3.35 (1.99)
Household monthly income (Birr)	1591 (965)*	2141 (1119)**	1974 (1103)***

*n=155 **n=354***n=509

Table II: Comparison of dietary energy and nutrients intake of fasting mothers during the Ethiopian Orthodox Lent fasting and non-fasting periods in northern Ethiopia.

Nutrients	Fasting mothers (n= 157)				Sign
	Lent fasting period		Non-fasting period		
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	
Energy (kcal)	1752 (725)	1769 (1147, 2248)b	2017 (462)	2059 (1665, 2363)a	<0.001*
Protein (g)	56 (27.9)	53.4 (32.9, 78.2)b	59.6 (15.6)	61.7 (49.3, 69.0)a	<0.001*
Iron (mg)	36.8 (18.3)	35.2 (22.6, 47)b	41.2 (10.9)	42.2 (34.0, 47.1)a	0.001*
Zinc (mg)	13.43 (6.1)	13.21 (8.65, 17.90)b	15.31 (3.7)	15.97 (12.60, 17.81)a	<0.001*
Vitamin A (µg RE)	219 (273)	155 (80, 248)a	236 (237)	187 (57.3, 362)a	0.102
Calcium (mg)	341 (184)	304 (194, 460)a	336 (102)	323 (268, 394)a	0.703
Magnesium (mg)	627 (273)	626 (407, 810)b	714 (167)	746 (586, 833)a	<0.001*
Vitamin B1 (mg)	1.69 (0.78)	1.61 (1.04, 2.26)b	1.86 (0.45)	1.93 (1.54, 2.19)a	0.006*
Niacin (mg)	13.2 (5.4)	13.8 (9.1, 16.1)b	15.6 (3.9)	15.8 (13.1, 18.1)a	<0.001*
Vitamin B6 (mg)	0.89 (0.58)	0.76 (0.45, 1.15)a	0.80 (0.52)	0.64 (0.42, 1.03)a	0.128
Vitamin B12 (µg)	0.008 (0.068)	0.000 (0.000, 0.000)b	0.065 (0.255)	0.000 (0.000, 0.000)a	<0.001*
Pantothenic acid (mg)	3.18 (1.43)	3.09 (2.03, 4.17)b	3.45 (0.84)	3.52 (2.84, 3.99)a	0.03*
Vitamin C (mg)	61.2 (28.9)	58.8 (39.6, 79.7)a	62.9 (30.9)	58.7 (41.8, 79.1)a	0.881
Vitamin D (µg)	0.04 (0.14)	0.02 (0.01, 0.03)b	0.07 (0.18)	0.03 (0.01, 0.06)a	<0.01*

Data analysis using Wilcoxon Signed Ranks Test (p < 0.05).

Energy and nutrient intake of non-fasting mothers

The median dietary intakes of energy, zinc, magnesium, vitamin A, B12, D, and niacin by the non-fasting mothers were significantly ($p<0.05$) higher during the non-fasting compared to the fasting period. Although the median intakes for majority of the rest of nutrients included in this study were not statistically significant ($p>0.05$) between the two periods; their intakes by the non-fasting mothers were increased during the non-fasting period. Despite, they were not statistically different ($p>0.05$), the median intakes of dietary vitamin B6 and C by non-fasting mothers were decreased during the non-fasting period. While the median intakes of iron, zinc, magnesium, vitamin B1, and niacin by non-fasting mothers were above the EARs, the median intakes of nutrients such as vitamin A, B6, B12, C and calcium were below the EARs, in both study periods (**Table III**).

Table III: Comparison of dietary energy and nutrients intake of non-fasting mothers during the Ethiopian Orthodox lent fasting and non-fasting periods in northern Ethiopia.

Nutrients	Non-fasting mothers (n = 356)				Sign
	Lent fasting period		Non-fasting period		
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	
Energy (kcal)	1878 (703)	1929 (1338, 2365) b	2075 (491)	2095 (1763, 2404) a	<0.001*
Protein (g)	60 (27.9)	59.7 (37, 78) a	60.9 (15.6)	60.5 (50.6, 70.6) a	0.302
Iron (mg)	39.2 (17.0)	39.4 (25.7, 49.7) a	41.5 (14.3)	41.6 (34.5, 47.5) a	0.058
Zinc (mg)	14.6 (6.8)	14.7 (9.7, 18.4) b	15.7 (4)	15.8 (13.2, 18.0) a	<0.01*
Vitamin A (µg RE)	242 (366)	154 (90, 243) b	244 (253)	202 (77.8, 345) a	0.004*
Calcium (mg)	366 (197)	323 (270, 386) a	341 (124)	324 (270, 387) a	0.106
Magnesium (mg)	676 (270)	688 (468, 869) b	726 (181)	741 (622, 843) a	<0.005*
Vitamin B1 (mg)	1.812 (0.78)	1.823 (1.174, 2.315) a	1.888 (0.47)	1.922 (1.601, 2.196) a	0.087
Niacin (mg)	14.2 (5.3)	14.2 (10.2, 17.9) b	16.3 (4.1)	16.3 (13.7, 18.4) a	<0.001*
Vitamin B6 (mg)	0.896 (0.64)	0.762 (0.442, 1.229) a	0.898 (0.64)	0.708 (0.459, 1.133) a	0.550
Vitamin B12 (µg)	0.005 (0.042)	0.000 (0.000, 0.000) b	0.077 (0.278)	0.000 (0.000, 0.000) a	<0.001*
Pantothenic acid (mg)	3.43 (1.58)	3.46 (2.31, 4.32) a	3.51 (0.94)	3.47 (2.93, 4.02) a	0.219
Vitamin C (mg)	68.5 (36.9)	64.9 (44.5, 85.6) a	64.6 (28.1)	62.7 (42.9, 82.4) a	0.122
Vitamin D (µg)	0.037 (0.09	0.023 (0.014, 0.037) b	0.067 (0.201)	0.034 (0.014, 0.057) a	<0.001*

Data analysis using Wilcoxon Signed Ranks Test ($p < 0.05$)

Comparison of the prevalence of energy and nutrients intake below EAR

The prevalence of high risk for inadequate intake of protein, zinc, magnesium, niacin, and vitamin B1 by fasting mothers were significantly ($p <0.05$) higher during the fasting than the non-fasting period. Similarly, for the non-fasting mothers, the prevalence for high risk of inadequate intake of protein, zinc, vitamin A and vitamin B1 were significantly ($p < 0.05$) higher during the fasting period compared to the non-fasting period. Furthermore, over 96% of the lactating mothers included in this study were at high risk of inadequate intakes of vitamin A, B12, D, and calcium. Moreover, the majority of fasting and non-fasting mothers showed a high risk for an inadequate intake of vitamin C (78.1% - 89.9%) and vitamin B6 (91.1 - 93%) regardless of the study period (**Table IV**).

Table IV: Comparison of the prevalence of energy and nutrient intake below the EAR by fasting and non-fasting mothers during Ethiopian Orthodox Lent fasting and non-fasting periods.

Nutrients	Lactating mothers					
	Fasting mothers (n= 157)			Non-fasting mothers (n= 356)		
	Intake <EAR			Intake <EAR		
	Fasting period n (%)	Non-fasting period n (%)	Sign.	Fasting period n (%)	Non-fasting period n (%)	Sign.
Protein (g)	83 (52.9)	56 (35.7)	0.003*	161 (45.2)	126 (35.4)	0.008*
Iron (mg)	0 (0.0)	0 (0.0)	NA	1 (0.3)	0 (0.0)	NA
Zinc (mg)	54 (34.4)	13 (8.3)	<0.001*	102 (28.7)	29 (8.1)	<0.001*
Vitamin A (µg RE)	152 (96.8)	154 (98.1)	0.727	342 (96.1)	351 (98.6)	0.049*
Calcium (mg)	153 (97.5)	157 (100.0)	NA	347 (97.5)	352 (98.9)	0.267
Magnesium (mg)	14 (8.9)	0 (0.0)	0.001*	28 (7.9)	28 (7.9)	NA
Vitamin B1 (mg)	50 (31.8)	11 (7.0)	<0.001*	93 (26.1)	30 (8.4)	<0.001*
Niacin (mg)	74 (47.1)	39 (24.8)	<0.001*	143 (40.2)	65 (18.3)	0.597
Vitamin B6 (mg)	143 (91.1)	146 (93.0)	0.678	328 (92.1)	326 (91.6)	0.888
Vitamin B12 (µg)	157 (100.0)	157 (100.0)	NA	356 (100.0)	356 (100.0)	NA
Pantothenic acid (mg)	-	-		-	-	
Vitamin C (mg)	141 (89.8)	138 (87.9)	0.701	307 (86.2)	278 (78.1)	0.275
Vitamin D (µg)	157 (100.0)	157 (100.0)	NA	356 (100.0)	356 (100.0)	NA

Data analysis using McNemar's test, significant level at $p < 0.05$; NA = Not appropriate for analysis; ns- not significantly different at $p < 0.05$; * = significantly different at $p < 0.05$. For the lactating mothers, the EARs were: calcium (800mg), iron (6.5mg), zinc (10.4mg), vitamin B1 (1.2mg), niacin (13mg), vitamin C (70mg), vitamin B6 (1.7mg), and magnesium (265mg). High risk for inadequacy of energy and pantothenic acid was not calculated using the EAR, due to the data inappropriateness and absence of cut points; for protein, 1.05 g/kg/day was considered for identifying the EAR cut point to declare inadequacy (FAO/WHO/UNU, 2001, 2002; FAO/WHO, 2001; Institute of Medicine (IOM), 2005, 2011).

Discussion

In the present study, the energy, protein, and most micronutrients intake between the fasting and non-fasting mothers during the Ethiopian Orthodox Lent fasting period were not significantly different, but their intakes were lower compared to the non-fasting period. This indicates that not only the energy and nutrient intake of fasting mothers, but also that of non-fasting mothers were also affected during the Lent fasting period. A study in Addis Ababa reported that the availability of meat was scarce due to the closure of most of the abattoirs during the Orthodox fasting period; otherwise it was also very expensive if available[20,21]. Our previous study also revealed a significant reduction in the intake of ASFs, DDS, and the number of meals by mothers during fasting than the non-fasting periods[4]. Thus, the involvement of the church leaders in preaching the exemption of lactating mother group from fasting is important. As a result,, the consumption of ASFs could be increased, both during the fasting and non-fasting seasons. Thus, the quality of diet consumed by the lactating mothers of Ethiopian Orthodox Tewahado mothers could be improved in general.

Unlike the other nutrients, the intake of niacin by the fasting mothers was significantly lower compared to the non-fasting mothers, which might be due to the high consumption of pulses majorly by the non-fasting group[4]. Furthermore, the median intakes of calcium, vitamin A, B6, B12, C, and D of the fasting and non-fasting mothers were below the EARs in both study periods. A study in Tigray region also reported lower intakes of calcium, vitamin A, and C by lactating mothers than the recommended nutrient intake[23]. Whereas, the present study demonstrated that the median intakes of iron, zinc, magnesium, vitamin B1, and niacin were above the EARs at the study population level. Similarly, studies in northern Ethiopia also reported that the intake of iron by children and adults was above the daily recommendations[23-26]. This could be mainly due to the consumed staples in the area, which are mainly cereals such as wheat, barley, and teff, and also include pulses such as chickpea and broad bean, and pepper, in which iron, zinc, magnesium, vitamin B1 and niacin contents are relatively high.

Energy intake of the mothers during the fasting and non-fasting periods was in the range of 1769-1929 kcal and 2059-2095 kcal/individual/day, respectively. However, these findings were higher than reported for the rural mothers in Ethiopia, Kenya and Tanzania[27-31]. In our study, the median intakes of protein were between 53.4-59.7g kcal/individual/day for fasting period and 60.5-61.7g kcal/individual/day for the non-fasting period. These results were higher than reported for the women at different physiological stages elsewhere in Ethiopia, Kenya and Nigeria[24,27,29-31]. The lower protein intake by the pregnant women could be related with restriction of the amount and type of food consumed due to a fear of obstetric complications associated with the delivery of a bigger baby, plastering on the fetal head, fear of abortion, evil eye and fetal abnormality[2,29,32-34].

The present study showed that the median intake of pantothenic acid was between 3.2-3.5 mg/individual/day in the study population level. It was higher than that reported for women of reproductive age (1.9-2.2 mg)/individual/day in southern Ethiopia[27]. However, it was lower than that found in South Africa[35]. The former inconsistency could be due to the consumption of higher amount of pulses in our case, but for the later, due to differences in the physiological stage of the participants and dietary habits in the two study areas[4,35,36].

In the present study, the median intakes of energy, protein, iron, zinc, magnesium, vitamin B1, and niacin were significantly increased during the non-fasting period for the fasting mothers. As a result, the prevalence of high risk due to inadequate intake of protein, zinc, magnesium, vitamin B1, and niacin was reduced significantly during the non-fasting period. Our findings on non-fasting mothers also showed significant improvements in energy, zinc, magnesium, and niacin intake and reductions in the prevalence of high risk due to inadequate intake of zinc and vitamin B1 after the fasting period. These increments were mainly due to an increased number of meals and a more diversified diet, specifically the consumption of ASFs and pulses[4]. Since cereals and pulses are the main staples of the study community, the intake of iron is not a problem; rather the quality of the diet is one of the challenges due to the presence of high amount of antinutrients, which may limit the absorption of minerals. Thus, activities which can improve the bioavailability of minerals such as consumption of vitamin C rich foods, ASFs, and processing techniques that can reduce the antinutrients content should be promoted.

Almost all lactating mothers (96.1-98.6%) didn't consume an adequate amount of vitamin A compared to the EAR cut method, regardless of the mothers fasting status and study period. This result was lower that what was found in women of the reproductive age of southern Ethiopia, in which the prevalence was between 23.7-47.5%. This disagreement could be due to the consumption of dark green leafy vegetables and fruits that are better available in southern Ethiopia than our study area[27]. Furthermore, a study conducted in Ethiopia using a national survey also reported that 83% of the participating households were consuming vitamin A below the EAR in the last 7 days prior the survey[38].

Highest prevalence of calcium intake below the EAR was found in studies conducted in Sidama (84.7-97.1%), Gondar (90.4%), Butajira (99%) districts, and at the national (89-96%) level in Ethiopia[23,27,31,37]. Our present study also reported a very high proportion (>97%) of fasting and non-fasting mothers who were at higher risk of

inadequate calcium intake, with no significant difference between the periods. Such a high level of risk for inadequate intake of dietary calcium in different areas of the country may demonstrate the need for implementation of the proposed universal calcium supplementation in Ethiopia after identifying the individual calcium intake level to reduce the risk related to high intake using validated testing tool[39]. Even if the intake of vitamin C was not significantly affected by the fasting period, more than two-thirds of the lactating mothers achieved less than the EAR. Therefore, considering the persistent and high prevalent risk of inadequate intake of calcium and vitamin C in both study periods, the consumption of vitamin C and calcium rich foods are expected to be chronically low in the study area.

Improvements in the intake of vitamin B12 and vitamin D were observed during the non-fasting period in both groups, even if the intake of these nutrients in general was close to zero. Thus, almost all the lactating mothers were at higher risk of inadequacy of vitamin B12 and vitamin D. In line with our results, studies in Sidama district reported the absolute (100%) risk for inadequate intake of dietary vitamin D in all women[28,40]. This problem is apparently observed in our study context due to poor consumption of vitamin D source foods like fish, milk, and eggs in both study periods for fasting and non-fasting mothers[4]. Similar to our findings for vitamin B12, the prevalence of vitamin B12 intake which was below the EAR was 100% in Sidama region and reported nationally in Ethiopia[28]. However, a previous national study in Ethiopia using a blood biomarkers identified only 15.1% of nonpregnant women was deficient in vitamin B12[41]. Therefore, further investigation of the vitamin B12 status should be done using a functional biomarker like methyl malonic acid or homocysteine and additionally valid biomarkers of B12-status like holotranscobalamin for a better understanding of the situation in the study area[42].

Despite the improvements in energy and nutrient intakes during the non-fasting period, our results also showed the co-existence of risk for multiple nutrient inadequacies in substantial proportions of fasting and non-fasting mothers diet. Thus, the risk to have or to develop different micronutrient deficiencies is expected to be high. Previous studies in Ethiopia also reported the co-existence of multiple micronutrient deficiencies in children and women at different physiological stages[43-47].

Although the current study has much strength, some drawbacks were also observed. Thus, the longitudinal nature of the study, following the fasting and non-fasting mothers during the longest fasting and the immediate non-fasting periods are among the strengths of this study. Studying in an area where almost all population are Ethiopian Orthodox Christians also helps in generating sound evidence on the effect of Orthodox fasting on dietary nutrient intake of lactating mothers. However, using a single 24-hr dietary recall data may not represent the usual intake of individuals. Because we did't take blood samples, the consequences of an inadequate intake cannot be correlated with specific clinical markers of the associated deficiency.

Conclusions

Based on our findings, we conclude that, during the fasting period, not only the energy and nutrient intakes of the fasting mothers, but also the non-fasting mothers were affected. Therefore, the prevalence for a higher risk of inadequate intake of most nutrients by the lactating mothers were high during the fasting period at the study population level. Regardless of the mothers' fasting status and fasting period, almost all lactating mothers (>96%) were at higher risk of inadequate intake of vitamin A, B12, and D, and calcium from their diet. Similarly, the majority of the lactating mothers were at risk of inadequacy of vitamin B6 (91.1-93%) and vitamin C (78.1-89.9%). Therefore, vitamin A, B6, B12, and D, and calcium can be considered as serious public health important micronutrients among lactating mothers in the district. Thus, the involvement of the church leaders by preaching the exemption of lactating mother group from fasting, thus consumption of ASFs should be encouraged, both during fasting and non-fasting seasons. Therefore, the quality of diet consumed by the lactating mothers of the Ethiopian Orthodox Tewahedo religion followers can be improved in general. Besides this, initiation of universal calcium with the support of using a valid individual screening tools to minimize the risk of excess intake should be implemented. Furthermore, as cereals and pulses are the staple food in the district, activities which can improve the bioavailability and absorption of protein and minerals such as consumption of vitamin C rich foods, ASFs and processing techniques like soaking, germination and fermentation should be promoted.

Author Contributions: B.B.D., C.L., S.R. and H.K.B were involved in the design of the study; B.B.D. conducted the research under the supervision of C.L., S.R., T.N. and H.K.B.; B.B.D. analyzed the data; B.B.D. wrote the paper; B.B.D., C.L., S.R., T.N, and H.K.B edited the draft manuscript; the final content was the primary responsibility of B.B. All authors read and approved the final manuscript. The funder has no any role in the content of this manuscript.

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