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Timely Initiation of Complementary Feeding and its Associated Factors among Children 6-23 Months in Ethiopia: A Systematic Review and Meta-analysis

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ABSTRACT

In Ethiopia, various studies have been done in order to determine the proportion of infants who had initiated complementary food timely and its associated factors. The results of these studies were not consistent and had a big variability. Hence, the aim of this systematic review and meta-analysis is to estimate the pooled prevalence of timely initiation of complementary feeding and its associated factors among children 6-23 months in Ethiopia. Different databases were systematically searched. Studies reporting the proportion and associated factors of timely initiation of complementary feeding in Ethiopia were considered. The Cochrane Q test statistic and I^2 test were used to assess the heterogeneity between the studies. A random effect model was computed to estimate the pooled prevalence of timely initiation of breastfeeding. In addition, the association between timely initiation of complementary feeding and Antenatal Care follow-up, place of delivery, postnatal checkup, women's education, mother's occupation, father's education, marital status, child sex, place of residence was determined. Eighteen studies were finally included in this meta-analysis. The findings of this meta-analysis revealed that, the pooled prevalence of timely initiation of complementary feeding in Ethiopia was 55.64% (95% Confidence interval: 50.35, 60.93%). In this study, timely initiation of complementary feeding in Ethiopia was significantly low compared to the current global recommendation on complementary feeding. Women from rural area were less likely to initiate complementary feeding at six months as compared with women from urban areas. Mothers who give birth at home were less likely to initiate complementary feeding timely.

Keywords: Associated factors, Children 6-23 months, Complementary feeding, Timely initiation, Ethiopia.

INTRODUCTION

Complementary feeding is defined as the process of starting when breast milk is no longer sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids are needed (WHO, 2000). Introduction of complementary feeding may be solid, semi-solid or soft foods to children in addition to breast milk (WHO, 2006), whereas timely initiation of complementary feeding is the introduction of complementary food other than breast milk at the age of six months of the infant's from birth(WHO, 2000, 2003). It is intended to meet the particular nutritional or physiologic needs of young children (Whitehead, 1991).

Therefore, it is universally recommended that mothers should start nutritionally adequate and safe complementary food at the infant's six months (WHO, 2000, 2008). A child should be fed only breast milk, which provides all the energy and nutrients needed for healthy growth until six months of age; this means that children should be given nothing but breast milk (WHO, 2000). From the age of six months, an infant's need for energy and nutrients starts to exceed what is provided by breast milk, and complementary feeding becomes necessary to fill the energy and nutrients gap. Besides, giving to breast milk only up to six months is crucial for the baby, mother, community and the nation at large (WHO, 2006).

Early initiation of complementary feeding is unnecessary and is discouraged because of the likelihood of contamination and resulting in high risk of diarrheal diseases (Hop et al., 2000).

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Complementing breast milk before the age of six months also reduces breast milk output because the production and release of breast milk is stimulated by the frequency and intensity of suckling (Hop et al., 2000). Besides, late initiation of complementary feeding to children in their life is a risk of under nutrition especially wasting, stunting and underweight.Adequate nutrition is essential to ensure optimal health, physical and mental growth of children (WHO, 2010). WHO supports the implementation of Infant and Young Child Feeding (IYCF) strategy for children aged 6–23 months as a critical element of efforts to address child malnutrition and mortality (WHO, 2008).

Timely initiation of complementary feeding is important to achieve a Sustainable Development Goal 3 (SDG3), which is directly related to health in order to decrease child mortality by improving child nutrition (Vella et al., 1992; Olofin et al., 2013; Wolfe et al., 1982). Despite this, a lot of women introduce complementary feeding early (Agedew et al., 2014; Deme & Ababa, 2015). As a result, suboptimal feeding rises up the risk of morbidity and mortality five times (Bartick et al., 2013; Hajeebhoy et al., 2014). The studies showed that 6% of infant mortality could be prevented if complementary feeding was initiated at the infant's six months (Sisay et al., 2016).

Accordingly, the World Health Organization (WHO) and United Nations Children's Fund (UNICEF), infant and young child feeding strategies have recommended that all infants should start at the age of six months (Federal Ministry of Health Ethiopia Infant and Young Child Feeding Programming Guide, 2011; Mosimah, 2015). Moreover, Ethiopia had designed consecutive national plans like health sector development plan I-IV (HSDP I-IV) and Health sector transformation plan I & II (HSTP I & II) to increase timely initiation of complementary feeding of children by 20% in 2019/20 (Federal Ministry of Health Ethiopia Health Sector Development Program IV, 2010).

In Ethiopia, about 60% of children 6-23 months were introduced of complementary feeding at 6-8 months as 2016 Ethiopian Demographic and Health Survey report (2016 EDHS) (Central Statistics EDHS, 2016).

In Ethiopia, the proportion of timely initiation of complementary feeding ranges from 10.75 to 72.5% in different studies conducted in Ethiopia (Kassa et al., 2016; Mekbib et al., 2014). Various studies have been conducted to estimate the timely initiation of complementary feeding and to identify the associated factors in different areas of Ethiopia and at national level (Yohannes et al., 2013; Ayana et al, 2017; Dangura & Gebremedhin, 2017; Deme et al., 2015; Kassa et al., 2016; Mekbib et al., 2014; Molla et al., 2017; Semahegn et al., 2014; Sisay et al., 2016; Yemane et al., 2014). The findings of these studies were inconsistent and characterized by great variability. Several factors associated with timely initiation of complementary feeding were also identified. Among these; having antenatal care follow up (Shumye et al., 2013; Sisay et al., 2016; Tafesse et al., 2018; Yeheyis et al., 2016; Yemane et al., 2014), women's education (Shumye et al., 2013; Yohannes et al., 2018; Chane et al., 2017; Hibstu et al., 2018; Sisay et al., 2016), women's occupation (Akalu et al., 2020; Shumye et al., 2013; Hibstu et al., 2018; Yeheyis et al., 2016), place of delivery (Sisay et al., 2016; Yeheyis et al., 2016; Yemane et al., 2014), father's education (Yohannes et al., 2018; Yemane et al., 2014), having postnatal checkup (Ayana et al., 2017; Yohannes et al., 2018) were the most frequently reported factors. Others factors include parity (Shumye et al., 2013), birth preparedness (Shumye et al., 2013), place of residence (Shumye et al., 2013), marital status (Yemane et al., 2014), sex of child (Semahegn et al., 2014), birth preparedness (Semahegn et al., 2014), household size (Yemane et al., 2014), skilled delivery (Tafesse et al., 2018) and family income (Chane et al., 2017) were less frequently reported.

These studies presented controversial findings concerning the association between having primary education and above, government employed women and timely initiation of complementary feeding. In some studies, having antenatal care follow up, having postnatal checkup, institutional delivery, having primary education and above, government employed women were positively associated with timely initiation of complementary feeding, while other studies showed no association. Such discrepancy is not well investigated. Therefore, the aim of this meta-analysis was to estimate the pooled prevalence of timely initiation of complementary feeding and its association with having antenatal care follows up, having postnatal checkup, institutional delivery, having primary education and above, government employed women in Ethiopia.

The findings of this study can give an input to policy makers and program planners in the design of appropriate interventions to improve complementary feeding initiation of the infants at six months. The study will have a paramount importance for clinicians and future researchers in related topics.

MATERIALS AND METHODS

Searching strategies:

To ensure scientific rigor, the Preferred Reporting of Systematic Reviews and Meta-Analysis (PRISMA) version-2009 guidelines were used

(Annexure 2) (Liberati et al., 2009). The current systematic review and meta-analysis was conducted based on the review of different literatures. The international databases, including Google Scholar, PubMed, WHO Global Health Library, CINAHL, HINARI and Cochrane Library were systematically searched. The search was carried out using the following keywords "magnitude", "prevalence", "proportion", "timely initiation" "appropriate initiation", "timely starting", "timely introduction", "complementary feeding", "additional feeding", "factor*", "predictor*", "determinant*", "risk", "factors associated", "associated factors", "risk factors", "predicting factors", and "Ethiopia". The search terms were used separately and in combination using Boolean operators like "OR" or "AND" (Annexure 1). The search was conducted from the 1st to the 10th of September, 2020. All manuscripts published until the 10th of September, 2020 were included in the review.

Inclusion criteria:

Study area: Only studies conducted in Ethiopia (Fig. 1).

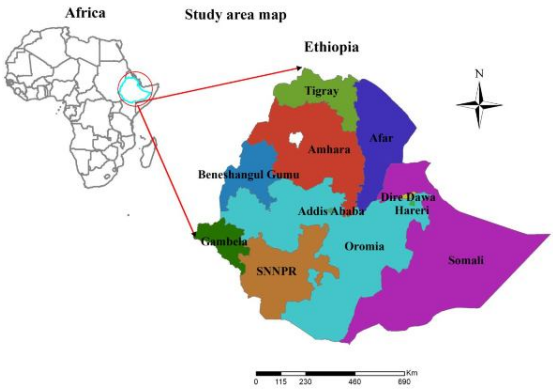

Fig. 1: Map of study area

Publication condition: Articles published in peer reviewed journals, articles published in local journals and Published books and reports by national and international organizations.

Study design: Observational studies that reported the proportion /prevalence/magnitude of timely initiation (initiation of complementary feeding at the infant's six months of birth) (WHO, 2000, 2003) of complementary feeding and its associated factors were considered.

Exclusion criteria:

We included open access journals to this study. But we excluded articles which were not fully accessed, in spite of contacting the primary author three times through email and we were unable to assess the quality of each article without accessing the full text.

Outcome measurement:

The primary outcome of this study was the timely initiation of complementary feeding. The proportion/prevalence/magnitude was calculated by dividing the number of women initiating complementary feeding at the infant's six months of age to the total number of women who have ever initiated complementary feeding. The second outcome of the study was to determine the association between timely initiation of complementary feeding and selected variables such as antenatal care follow up, place of delivery, postnatal checkup, women's education, mother's occupation, father's education, marital status, sex of child, and place of residence.

Data abstraction:

All authors independently extracted all necessary data using a standardized data extraction format. Data were extracted using Microsoft excel 2010 sheet. A standardized tool was used for data extraction. The data extraction format includes primary author's name, publication year, study year, region (study site in the country), study setting, study area, sample size, response rate and proportion/ prevalence/ magnitude of timely initiation of complementary feeding, Antenatal Care (ANC) follow up, place of delivery, Post Natal Care (PNC) checkup, women's education, mother's occupation, father's education, sex of child, place of residence, and marital status.

Quality assessment:

The quality of articles that met inclusion criteria was assessed using the Joanna Briggs Institute (JBI) critical appraisal checklist (Buccheri & Sharifi, 2017). All authors independently assessed articles before inclusion for review of the studies. Articles with quality scores of fifty percent and above were included in the final review.

Heterogeneity and publication bias:

The heterogeneity test of included studies was assessed by using the I^2 statistic. The presence of heterogeneity was declared using p-value 0.05 for I^2 statistic (Rücker et al., 2008). Whereas, the publication bias was assessed using the Egger regression asymmetry test (Deeks et al., 2005; Song et al., 2002). The presence of publication bias was declared with a p-value of less than 0.05.

Statistical analysis:

Data analysis was carried out by using STATA 14.0 version statistical software. The standard error for each original study was calculated using the binomial distribution formula. Heterogeneity among reported prevalence/proportion/magnitude was assessed by computing value for chi-square, I^2statistic and p-value (Rücker et al., 2008). As the

test statistic showed there is a significant heterogeneity among studies (I^2= 96.2%, p = 0.0001), as a result random effects model was used to estimate the Der Simonian and Laird's pooled effect. To minimize the random variations between the point estimates of the primary studies, subgroup analysis was done based on region (Addis Ababa, Tigray, Amhara, Oromia, SNNP and others), place of residence (urban and rural), study setting (institution and community), year of study (2011-2015 and 2016-2020) and sample size (203-422 samples and 476-806 samples). In addition, to identify possible source of heterogeneity, Univariate Meta regression was undertaken by taking the publication year, year of study, sample size, response rate, study quality score, study setting, residence and region, but none of them were statistically significant. Furthermore, Egger and Begg tests at 5% significant level were employed for assessing publication bias (Borenstein et al., 2010). Point proportion/ prevalence with their 95% confidence interval was presented in a forest plot. In this plot, the size of each box indicated the weight of the study, while each crossed line refers to 95% confidence interval. For the second outcome Log odds ratio was used to determine the association between timely initiation of complementary feeding and ANC follow up, place of delivery, PNC checkup, women's education, mother's occupation, father's education, sex of child, place of residence, and marital status

RESULTS

Study selection:

This systematic review and meta-analysis included both published studies done on timely initiation of complementary feeding among children aged 6-23 months in Ethiopia. In the first step of our search 6306 original articles were explored regarding to timely initiation of complementary feeding through Google Scholar, PubMed, WHO Global Health Library, CINAHL, HINARI and Cochrane Library. Of these articles, 313 were excluded because of duplication. From the rest 6000 articles, 5976 and 8 articles were excluded after reviewing of their titles and abstracts due to irrelevant of their titles and abstract. The rest 30 articles were screened for full text and 5 articles were excluded because of the outcome of interest. Hence, 25 full text articles were accessed and assessed for their eligibility based on the pre-defined criteria. At the end, 18 studies were satisfied the eligibility criteria and included in the meta-analysis (Fig. 2).

Characteristics of included studies:

As presented in table 1, these 18 included studies were published from 2013 to 2020. In the present meta-analysis, 8519 children aged 6-23 months were involved to estimate the pooled prevalence timely initiation of complementary feeding. All

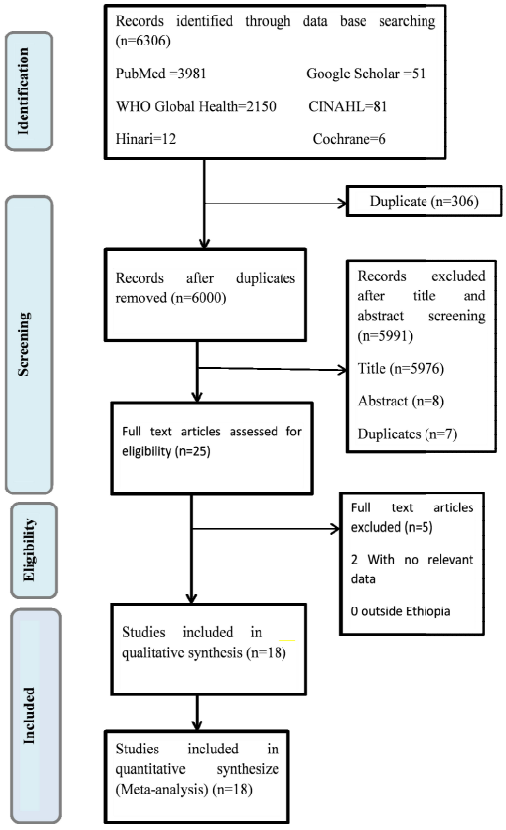

Fig. 2: PRISMA Flow diagram of the included studies for the systematic review and meta-analysis of the proportion of timely initiation of complementary feeding

included studies were conducted through community or institution based cross-sectional study designs. The highest proportion (72.5%) and the lowest proportion (34.3%) of timely initiation of complementary feeding were found in Arsi-Negele District of Oromia Regional State (Kassa et al., 2016) and Soro District of Southern Nations, Nationalities and People's Regional (SNNPR) State (yohannes et al., 2018). In this meta-analysis, seven regions of Ethiopia were represented. These studies were conducted five in Amhara regional state (Bazezew et al., 2020; Biks et al., 2018; Gessese et al., 2014; Molla et al., 2017; Sisay et al., 2016), five in SNNPR (Bereket et al., 2018; Chane et al., 2017; Epheson et al., 2018; Hibstu et al., 2018; Tafesse et al., 2018), two in Addis Ababa City Administration (Akalu et al., 2020; Toma et al., 2016), two in Tigray regional state (Ashenafi et al., 2013; Yemane et al., 2014), two in Oromia regional state (Kassa et al., 2016; Neme & Olika, 2017), one in Benishangul-Gumuz regional state (Ayana et al., 2017) and Harari regional state (Semahegn et al., 2014). More than half (10 studies) of the original studies were conducted in rural communities (Akalu et al., 2020; Ayana et al., 2017; Bereket et al., 2018; Biks et al., 2018; Epheson et al., 2018; Gessese et al., 2014; Kassa et al., 2016; Molla et al., 2017; Neme & Olika, 2017;

Sisay et al., 2016), while the rest (8 studies) original studies were done in urban communities (Ashenafi et al., 2013; Bazezew et al., 2020; Chane et al., 2017; Hibstu et al., 2018; Semahegn et al., 2014; Tafesse et al., 2018; Toma et al., 2016; Yemane et al., 2014). Whereas more than three-fourth (14 studies) original studies were performed in community based settings (Ayana et al., 2017; Bazezew et al., 2020; Bereket et al., 2018; Biks et al., 2018; Chane et al., 2017; Epheson et al., 2018; Gessese et al., 2014; Hibstu et al., 2018; Kassa et al., 2016; Molla et al., 2017; Neme & Olika, 2017; Sisay et al., 2016; Tafesse et al., 2018; Yemane et al., 2014) and the remaining (4) studies were institution based settings (Akalu et al., 2020; Ashenafi et al., 2013; Semahegn et al., 2014; Toma et al., 2016). Besides to this, the response rate of included studies were ranged from 94.1% to 100%, that almost all of the studies had a good response rate. This high response rate might be resulted from that the entire studies were used interviewer administered questionnaire to collect the data (Table 1).

Meta-analysis:

The findings of 18 studies showed that the pooled proportion of timely initiation of complementary feeding was 55.64% (CI: 50.35, 60.93%)in Ethiopia. Severe heterogeneity was observed across the studies (I^2 =96.2, p value = 0.000). Thus, a random effect model was employed to estimate the pooled proportion of timely initiation of complementary feeding (Fig. 3).

Table 1. Descriptive summary of 18 studies included in this meta-analysis of the proportion of timely initiation of complementary feeding among infants in Ethiopia, 2020

Region	Study area	Authors name and Publication year	Response rate (%)	Sample size	Proportion of TICF (95% CI)
Addis Ababa	Addis Ababa	Yeheyis et al., 2016	99.5	398	55.20 (51.31-60.30)
	Kolfe-Keranyo	Akalu et al., 2020	100	395	66.80 (63.32-70.72)
Tigray	Mekele town	Shumye et al., 2013	100	422	62.80 (58.10-67.31)
	Axum town	Yemane et al., 2014	100	421	52.80 (49.34-55.46)
Amhara	Enemay district	Gessese et al., 2014	98	543	56.4 (53.24-60.67)
	Lalibela district	Sisay et al., 2016	100	421	63 (58, 67)
	Lalibela district	Molla et al., 2017	98.7	470	57.7 (55.81-60.21)
	Dabat disrtrict	Biks et al., 2018	100	591	53.8 (45.90, 61.70)
	Gondar town	Bazezew et al., 2020	100	632	47.3 (43, 51.3)
Oromia	Arsi-Negele district	Kassa et al., 2016	96.7	611	72.5 (68.12-75.56)
	Horo Guduru district	Neme & Olika, 2017	100	260	40.0 (38.0-43.0)
SNNPR	Sodo town	Chane et al., 2017	98.1	611	71.2 (66.4, 75.3)
	Damot Weydie district	Epheson et al., 2018	99.3	401	50.6 (48.34-53.26)
	Sodo town	Tafesse et al., 2018	96.9	503	57.5 (55.23-60.25)
	Soro district	Yohannes et al., 2018	99.3	543	34.3 (30.3, 38.29)
	Halaba-Kulito	Hibstu et al., 2018	94.1	320	57.0 (54.0-60.56,)
Benishangul-Gumuz	Pawie district	Ayana et al., 2017	97.6	785	61.8 (58.2, 65.4)
Harari	Harar town	Semahegn et al., 2014	98.5	200	60.5 (57.60-64.32)

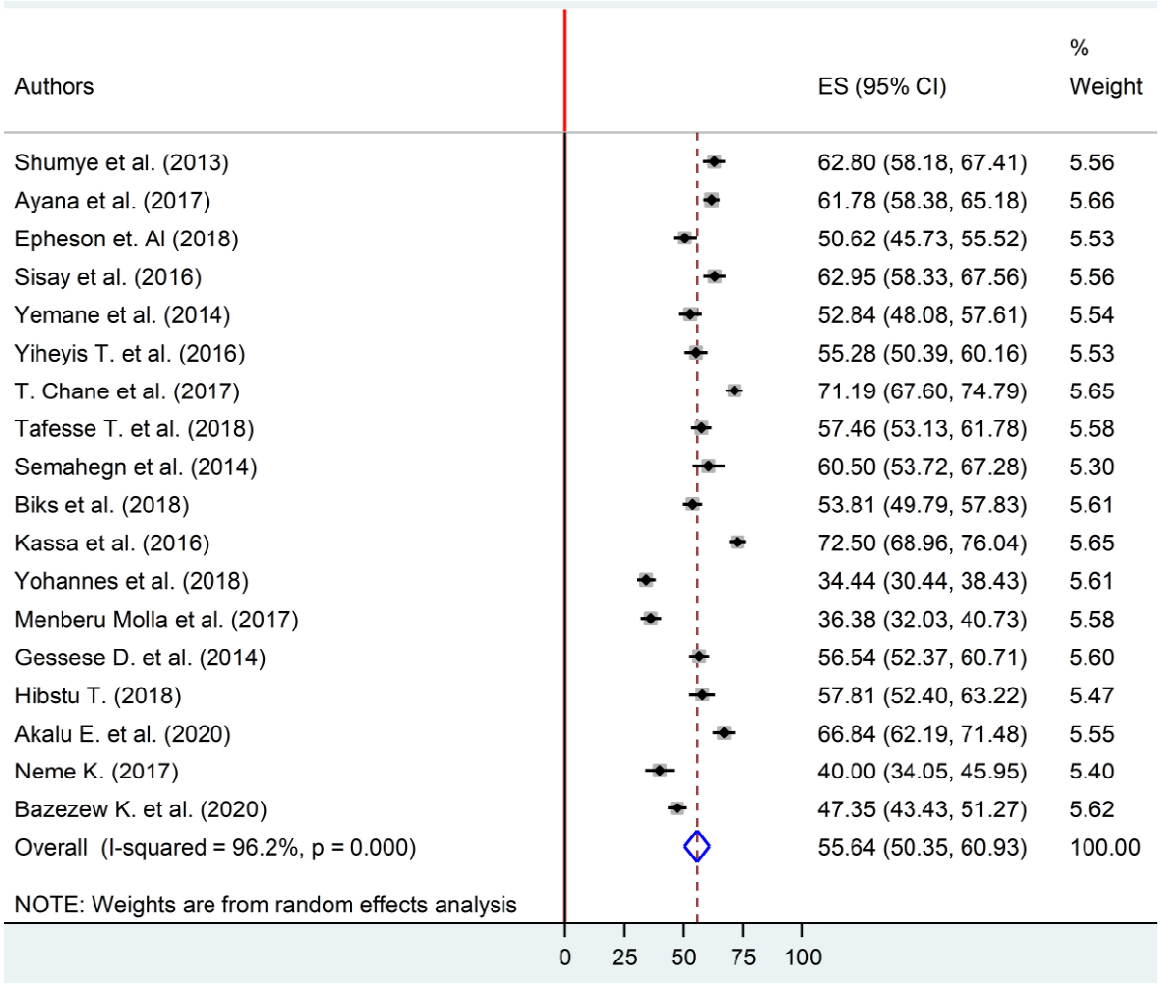

Fig 3: Proportion of timely initiation of complementary feeding among children 6-23 months in Ethiopia, 2011 to 2020

Various factors associated with the heterogeneity such as publication year, year of study, sample size, response rate, study setting, place of residence, study quality score, and region was investigated using Univariate meta-regression models, and none of these variables were statistically significant (Table 2).

Publication bias was also assessed through Egger and Begg regression asymmetry tests. The result of Egger and Begg tests showed non-significant publication bias for estimating the proportion of timely initiation of complementary feeding (p value = 0.296) and (p = 0.495) respectively. Similarly, the funnel plot assessment by visual inspection revealed that it is quite symmetrical and has not demonstrated publication bias (Fig. 4).

Subgroup analysis

Also, in this meta-analysis, subgroup analysis has been performed regarding to geopolitical settings (regions of Ethiopia), place of residence, study setting, study year and sample size of the studies. Accordingly, the highest proportion was observed in other regions (Harari and Benishangul-Gumuz) with proportion of 61.6 (95% CI: 58.5, 64.6)

Table 2: Related factors with heterogeneity of timely initiation of complementary feeding proportion in the current meta-analysis (based on Univariate meta-regression)

Variables	Coefficient	P-value
Publication year	-1.140249	0.406
Study year	-.5948972	0.754
Sample size	.0122523	0.523
Response rate	-2.629028	0.243
Study quality score	-.4839314	0.471
Rural residence	-6.923524	0.186
Community based study	-7.331231	0.250
Addis Ababa region	6.102289	0.472
Tigray region	2.456848	0.774
Amhara region	-5.904137	0.316
Oromia region	1.1161	0.896
SNNP	-1.838376	0.759
Others (Harari and Benishangul-Gumuz) region	6.200095	0.467

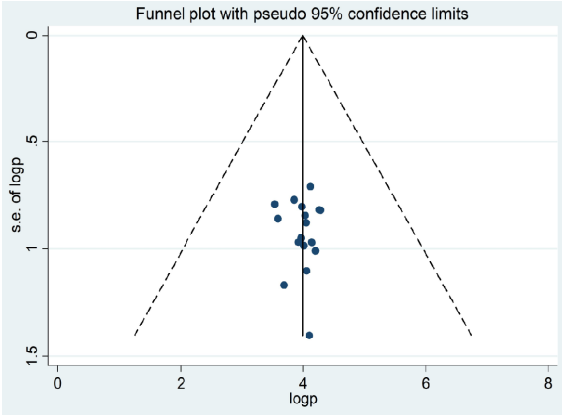

Fig. 4: Funnel plot with 95% CI limit of the pooled proportion of timely initiation of complementary feeding among children 6-23 months studies in Ethiopia, 2011 to 2020

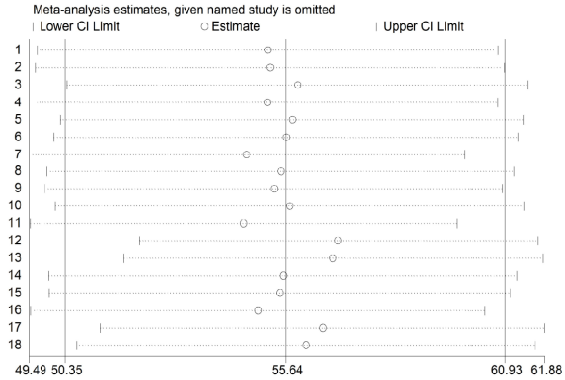

Fig. 5: Sensitivity analysis

followed by Addis Ababa City Administration with proportion of 61.1 (95% CI: 49.8, 72.4) and the lowest was seen in Amhara region with the proportion of 51.4 (95% CI: 42.9, 59.9) (Table 3). In addition to this, we also performed subgroup analysis based on place of residence (urban and rural) of the study participants. From the result of this subgroup analysis we found that urban women, 59.2 (95% CI: 53.7, 64.6) had a slightly higher proportion of timely initiation of complementary feeding than rural women, 52.2 (95% CI: 43.3, 61.0) (Table 3).

Sensitivity analysis:

A sensitivity analysis was done and statistically significant difference wasn't detected. The result of the sensitivity analysis demonstrated that the proportion of timely initiation of complementary feeding was 55.64 (95% CI: 50.35, 60.93, I^2 =92.7%) (Fig. 5).

Factors associated with timely initiation of complementary feeding:

A total of 11 studies which examined the association between timely initiations of complementary feeding and antenatal care (ANC) follow up, place of delivery, postnatal checkup, women's education and women's occupation, child sex, residence and marital status were included. The analysis of eleven studies revealed that having antenatal care follow up OR 4.19 (95% CI:2.03,8.65), home delivery OR 0.42 (95% CI: 0.26, 0.69), having postnatal (PNC) checkup OR 1.51 (95% CI: 1.07, 2.14), illiterate women 0.706 (95% CI: 0.584, 0.854),having primary education 0.578 (95% CI: 0.403, 0.829), illiterate father 0.374 (95% CI: 0.172, 0.812), having primary education of father 0.634 (95% CI: 0.367, 1.093), urban residence 1.763 (95% CI: 1.173, 2.650)and married women 2.069 (95% CI: 1.388, 3.085)were strongly associated with timely initiation of complementary feeding. The analysis of this meta-analysis showed that mothers who had ANC follow up were 4.19 times more likely to initiate complementary feeding at six months of the infant's age as compared to mothers who didn't have ANC follow up (Fig. 6).

Giving at home reduces the likelihood of timely initiation of complementary feeding of the infant's

Table 3: Subgroup analysis of the proportion of timely initiation of complementary feeding among children 6-23 months in Ethiopia, 2011-2020 (n=18).

Variables	Characteristics	Estimate (95% CI)	P-value
By region	Addis Ababa	61.1 (49.8, 72.4)	0.001
	Tigray	57.84 (48.1, 67.6)	0.003
	Amhara	51.4 (42.9, 59.9)	0.000
	Oromia	56.3 (24.5, 88.2)	0.000
	SNNPR	54.3 (41.1, 67.6)	0.000
	Others	61.6 (58.5, 64.6)	0.740
By place of residence	Urban	59.2 (53.7, 64.6)	0.000
	Rural	52.2 (43.3, 61.0)	0.000
By study settings	Institution based	61.4 (56.4, 66.5)	0.000
	Community based	54.0 (47.6, 60.4)	0.000
Sample size	203-422 samples	56.7 (51.6, 61.8)	0.000
	476-806 samples	54.6 (45.8, 63.5)	0.000
Year of study	2011- 2015	55.3 (49.3, 61.4)	0.000
	2016-2020	57.3 (45.3, 69.2)	0.000
	Overall	55.64 (50.4, 60.9)	

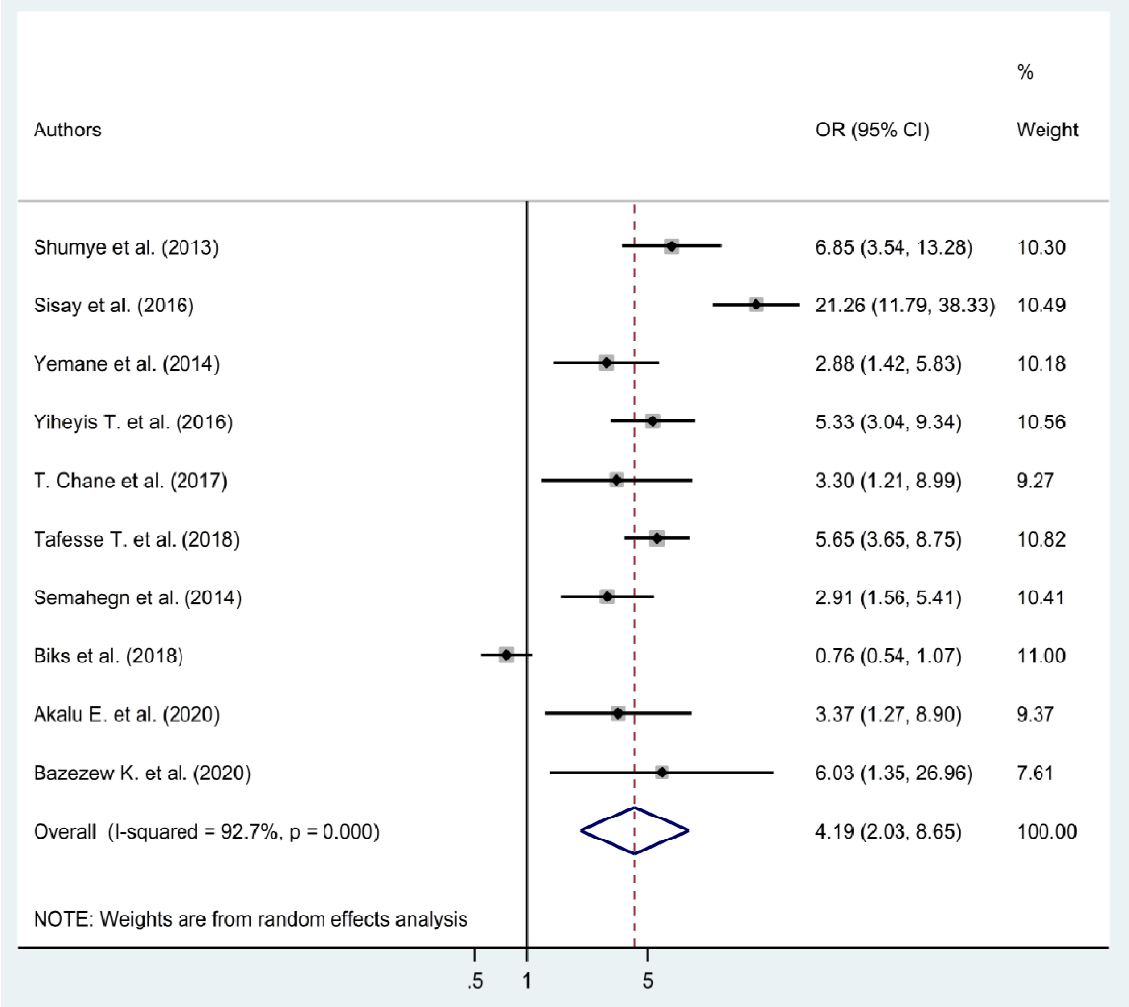

Fig. 6: Forest plot of odds ratio for the association of ANC and timely initiation of complementary feeding in Ethiopia

by 58% as compared to giving birth at health facility. Timely initiation of complementary feeding of the infant's among Mothers who had PNC was 51% higher than those mothers who didn't have PNC (Table 4).

In addition, timely initiation of complementary feeding of infants was reduced by 29.4% and 62.6% of being illiterate mother or father compared to secondary and above educational level of mothers and fathers respectively. The odds of mother and father having primary education were 0.578 and 0.634 times less likely to timely complementary feeding compared to mothers and fathers having secondary education and above respectively.

The likelihood of timely initiation of complementary feeding among mothers residing in urban was increased by 76.3% as compared to mothers residing in its counterpart. Whereas, married mothers were 4.19 times more likely to initiate complementary feeding at six months of the infant's age as compared to unmarried mothers.

DISCUSSION

This systematic review and meta-analysis was aimed to estimate the pooled proportion of timely initiation of complementary feeding and its associated factors. Although the WHO (Mosimah, 2015; WHO, 2003) UNICEF (IYCF programming guide, 2011) and Ethiopian national IYCF (national-strategy-for-infant-and-young-child-feeding-ethiopia, 2015) guidelines have recommended that all infants should start complementary feeding at six months of age, the present meta-analysis reported that only 55.64% (CI: 50.35, 60.93%) of infants were benefited from timely initiation of complementary feeding in Ethiopia. Also, the finding was lower than the EDHS 2016 report (EDHS, 2016), and Ethiopian HSDP IV target level that the target planned to increase the proportion of timely initiation of complementary feeding children from 54% in 2010/11 to 84% by the end of 2014/15(HSDP-IV, 2010) and the Ethiopian Health Sector Transformation Plan (EHSTP) target from 52% in 2015/16 to 72% in 2019/20(EHSTP2, 2015/16).

Table 4: Individual study data to calculate the odds ratio of timely initiation of complementary feeding and postnatal checkup in Ethiopia, 2011-20201

Sl. No.	Authors and Publication year	Post natal checkup	Timely initiation of complementary feeding (at 6 month)		OR (95% CI)
			Yes	No	
1	Ashenafi et al., 2013	Yes	67	61	0.533
		No	198	96	(0.349, 0.814)
2	D. Ayana et al., 2017	Yes	408	214	2.129
		No	77	86	(1.502, 3.019)
3	Sisay et al., 2016	Yes	80	25	2.215
		No	182	126	(1.339, 3.664)
4	Yemane et al., 2014	Yes	187	174	0.746
		No	36	25	(0.430, 1.294)
5	Toma et al., 2016	Yes	203	94	2.582
		No	46	55	(1.627, 4.097)
6	Chane et al., 2017	Yes	332	137	0.918
		No	103	39	(0.604, 1.395)
7	Semahegn et al., 2014	Yes	68	29	2.212
		No	53	50	(1.237, 3.957)
8	Biks et al., 2018	Yes	86	73	1.016
		No	232	200	(0.705, 1.463)
9	Bereket et al., 2018	Yes	53	53	2.286
		No	1333	304	(1.484, 3.520)
10	Akalu, 2020	Yes	146	61	1.420
		No	118	70	(0.933, 2.162)
11	Bazezew et al., 2020	Yes	295	311	5.217
		No	4	22	(1.777, 15.319)
Over all					1.514 (1.073, 2.136)

Even though the Ethiopian government has implemented different strategies to improve timely initiation of complementary feeding, the finding of this study indicated that a lot needed to accomplish target levels.

In addition, the proportion of timely initiation of complementary feeding noted in this study was in line with India (55%) (Kogade et al., 2019), Bangladesh (55.7%) (Saizuddin & Hasan, 2016), but lower than that of Kenya (80.6%)(Kimani-Murage et al., 2011), done in Sri Lanka (84%) and Nepal (70%) (Joshi et al., 2012; Upul et al., 2012), and higher thanthat reported in Pakistan (29%) and Nigeria (41%) (Khokhar et al., 2017; Ogunlesi et al., 2014). Similarly, the finding of this study was also higher than other sub-Saharan countries Demographic and Health survey (DHS based studies: Nigeria (47%) (Olatona et al., 2017) and Tanzania (52%). The possible explanation for the discrepancy of the proportion of timely initiation of complementary feeding in this study and other countries could be due to the fact that methodological difference, variation in infant and maternal socio-demographic characteristics, economical and health service utilization.

The subgroup analysis of this study revealed that there is a significant variation among Ethiopian regional states in the proportion of timely initiation of complementary feeding. Children who were from Benishangul-Gumuz and Harari regional states had higher rates of timely initiation of complementary feeding as compared to children from Addis Ababa City Administration, Tigray, Amhara, Oromia and SNNP regions. The possible source of variation in the regional proportion could be due to difference in the implementation of health extension programs. The proportion of timely initiation of complementary feeding in institution based study was higher than in community based studies. This might be due to mothers/caregivers exposure to timely breast feeding initiation messages during ANC, Delivery and PNC services.

Besides, it is also noted that rural children had lower rate of timely initiation of complementary feeding as compared to their urban counterparts. This finding is consistent with the 2016 Ethiopian Demographic and Health Survey report (60%). The Ethiopian DHS report indicated that rural women had lower proportion of timely initiation of complementary feeding than urban (EDHS, 2016). This might be due to the difference in traditional beliefs and cultural practices among mothers in Ethiopia. The introduction of prelacteal foods at birth is a common practice among rural Ethiopian

mothers. Mothers who introduce prelacteal foods at birth and therefore initiation of complementary feeding might be early (Ogunlesi et al., 2014). The other possible explanation could be due to mothers who live in urban places might have a good access to different information sources on complementary feeding including media. On the other hand, rural mothers might not have access to such information sources. Different earlier studies which have been conducted in Ethiopia reported that mothers who had access to mass media like radio or television were more likely to initiate complementary feeding at six months than their counterparts (Mashreky et al., 2015; Walters et al., 2019). Moreover, this variation might be resulting from due to lack of knowledge on the right time of complementary feeding initiation (Akalu et al., 2020; Biks et al., 2018; Semahegn et al., 2014).

The other aim of the study was to determine the association between timely initiations of complementary feeding and other factors. ANC follow up, place of delivery, PNC checkup, mother and father education, residence and marital status of the mother were factors significantly associated with timely initiation of complementary feeding.

Having ANC follow up had a significant positive association with timely initiation of complementary feeding. Women who had ANC follow up were about 4.2 times more likely to initiate complementary feeding at six months of the infant's age. This finding was similar to studies done in Nigeria (Ogbo et al., 2015) and Nepal (Acharya et al., 2019) . This could be due the effect of counseling at ANC visit on the importance of timely initiation of complementary feeding.

In this study home delivery was significantly negatively associated with timely initiation of complementary feeding. The odds of timely initiation of complementary feeding in infants were decreased by 58% among mothers who delivered at home as compared to mothers delivered at health facilities. This finding is in line with studies conducted in Kenya (Kimani-Murage et al., 2011), . The possible justification might bethe effect of postpartum counseling on the importance of timely initiation of complementary feeding for women who delivered at health facility.

In addition, post natal checkup had a significant positive associated with timely initiation of complementary feeding in infants. Women who had PNC were 1.51 times more likely to initiate complementary feeding timely. This finding was consistent to studies conducted in Sri Lanka (Senarath et al., 2012), Nepal (Acharya et al., 2019) and Malawi (Walters et al., 2019). This might be explained women who have visited health facilities for PNC service can get counseling on when to start complementary feeding for their children. Hence, women who have adequate knowledge on the proper time of complementary feeding initiation are more likely for practicing timely initiation of complementary feeding (Andualem et al., 2020; Foluke et al., 2017).

Being mother or father illiterate was negatively associated with timely initiation of complementary feeding among infants as compare to mothers or fathers having secondary and above education. Also, mother or father having primary education were less likely to initiate complementary feeding at the age of six months of the infants as compare to mothers or fathers having secondary and above education. The finding was the same to studies done in Ghana (Issaka et al., 2015), Nigeria (Ogbo et al., 2015), Pakistan (Liaqat et al., 2007) and Bangladesh (Kabir et al., 2012). This might be due to mothers or fathers being educated more, they can understand infant and child feeding messages and practice easily. Besides, educated mothers or fathers have the chance to read and acquire information regarding to their children appropriate introduction of complementary feeding time.

The odds of timely initiation of complementary feeding among children residing in urban were higher than its counterpart. This finding is in line with studies conducted in Sri Lanka (Senarath et al., 2012) and Ghana (Saaka et al., 2016). This might be explained by urban residents are more exposed for media and accessible for health facilities where much knowledge is obtained about the right time of complementary feeding initiation.

Children who were belonging to married women were more likely to timely initiation of complementary feeding as compared to children from unmarried women. This finding is also supported with a study conducted in Kenya (Kimani-Murage et al., 2011). This could be justified with couples could share new information, knowledge and skills which they get from different sources on the appropriate time of complementary feeding initiation of children.

In conclusion, the pooled proportion of timely initiation of complementary feeding was significantly low in Ethiopia as compared to the WHO recommendation and Ethiopian Health Sector Transformation Plan target on infant complementary feeding. Women who lived in urban area initiate complementary feeding timely as compared to women in rural area. Place of birth has a significant impact on timely initiation of complementary feeding. Therefore, health care workers (midwives and obstetricians) should focus on increasing timely initiation of complementary feeding by giving postnatal counseling regarding to the importance of timely initiation of complementary feeding. Moreover, a special

emphasis should be given for rural women and women who gave birth at home to increase timely initiation of complementary feeding.

Limitations of the study:

The first limitations of the study were only English articles or reports were considered to carry out the analysis. All included studies in this review were cross sectional in nature and therefore the outcome variable might be affected by other confounding variables. The limited sample size could affect the estimated report. Moreover, this meta-analysis represented only studies reported from seven regions of the country.

COMPETING INTERESTS:

The authors have declared that they have no competing interest.

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