Health service utilisation lags behind maternal diseases or illnesses during pregnancy in rural south Ethiopia: A prospective cohort study

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Abstract

Maternal survival has improved substantially in the last decades, but evidence on maternal morbidity and health service utilisation for various maternal diseases are scarce in low resource settings. We aimed to measure health service utilisation for maternal illnesses during pregnancy. A cohort study of 794 pregnant women in rural southern Ethiopia was carried-out from May 2017 to July 2018. Disease or illness identification criteria were: symptoms, signs, physical examination, and screening of anaemia. Follow-up was done every two weeks. Data on health service utilisation was obtained from women and confirmed by visiting the health facility. Multilevel, multiple responses, repeated measures, and generalized linear mixed model analysis were used. The cumulative incidence of women experiencing illness episodes was 91%, and there were 1.7 episodes of diseases or illnesses per woman. About 22% of pregnant women were anaemic and 8% hypertensive. Fourteen pregnant women experienced abortions, 6 had vaginal bleeding, 48% pain in the pelvic area, 4% oedema, and 72% tiredness. However, health service utilisation was only 7%. About 94% of anaemic women did not get iron-folic-acid tablet supplementation. Only two mothers with blurred vision and severe headache were referred for further treatment. The main reasons for not using the health services were: the perception that symptoms would heal by themselves (47%), illness to be minor (42%), financial constraints (10%), and lack of trust in health institutions (1%). Risk factors were being older women, poor, having a history of abortion, living far away from the health institution, travelled longer time to reach a health institution, and monthly household expenditure >=30 USD. In Conclusion, there was a high incidence of diseases or illnesses; however health service utilisation was low. Poor understanding of severe and non-severe symptoms was an important reason for low health

service utilisation. Therefore, community-based maternal diseases or illness survey could help for early detection. Ministry of Health should promote health education that encourages women to seek appropriate and timely care.

Keywords: Maternal, Illnesses, Health-service-utilisation, Cohort, Rural, Ethiopia

Introduction

Maternal survival has improved substantially in the last decades, but evidence on maternal morbidity and use of health services for various maternal diseases or illnesses are scarce in low resource settings. For each woman who dies of maternal causes, at least 20 women suffer from maternal diseases or illnesses [1]. Thus, it is important to get more precise estimates of maternal disease burden in low-income settings [2]. Maternal diseases or illnesses lack common measurement indicators, standardized and agreed tools and methods of assessment at community or primary health care level [3]. Most of the earlier researches were institutional-based studies, and there are few population-based cohort studies that integrate diagnosis and self-report [4].

Though ensuring healthy lives and promoting the well-being of women is one of the agenda in the Sustainable Development Goal Number 3 [5], the disease or illness burden in developing countries among pregnant and women who gave birth remained high [6]. Globally, 10 to 20 million women suffer from pregnancy and childbirth-related diseases or illnesses annually [7]. In developing countries, 25% of pregnant women reported at least one episode of disease or illness during pregnancy [8]. About 14% of pregnant women in Ethiopia reported in 2013 at least one disease or illness during pregnancy [9].

Appropriate and timely care seeking and health service utilisation are essential for healthy living. During pregnancy, the use of health services is dependent on the women's socioeconomic and demographic environment [10], like the mother's age, educational status, occupation, access, and travel time to health facility [11].

Diseases during pregnancy are associated with both increased maternal deaths and stillbirths [12, 13]. Of the severe diseases in 2017, 56 million pregnant women experienced spontaneous abortion globally, and 49 millions of these were in low-income countries [14]. In Ethiopia, in 2017, the rate of spontaneous abortion was 28 per 1000 women [14]. In 2015, the global number of stillbirths was estimated to be 2.6 million [15] and Ethiopia accounted for 4% of these (97,000 stillbirths) [15]. Around 42% of pregnant women in developing countries were estimated to suffer from anaemia in 2017 [16], and 25% of Ethiopian pregnant women had anaemia [17]. Although iron-folic-acid supplementation is recommended for prevention or treatment of anaemia to all pregnant and women who gave birth [18], there is limited data about the uptake of iron-folic-acid supplementation during the postpartum period from Ethiopia [17]. Hypertension is also common during pregnancy, and 10 % of pregnant women globally [19], and 6% in Ethiopia had hypertension [20]. Hypertension is a well-known risk factor for maternal death, preeclampsia/ eclampsia, and cardiac and renal complications during pregnancy and the postpartum period [21].

As the causes and burden of maternal diseases or illnesses and use of health services in Ethiopia were not been well described in the literature, we conducted a cohort study on women attending antenatal care in a rural area of south Ethiopia with the aim to measure the incidence of diseases

or illnesses during pregnancy, and simultaneously assess health service utilisation. Thus, our study presents new and important evidence for policies aiming at improving the health of mothers.

Methods and materials

Study design and period

We did a prospective cohort study on pregnant women attending antenatal care (ANC) in three local communities (kebeles) in south Ethiopia. The study lasted 15 months from May 2017 to July 2018.

Study area and setting

This study was conducted in three randomly selected rural kebeles of Wonago district, in southern Ethiopia. Wonago district (zone) is found 420 km far away from the capital, Addis Ababa. It has 14 rural and 4 urban kebeles. A kebele is part of a district (wereda) which is the lowest administrative unit in Ethiopia and is composed of about 1000-1500 households (average 5000-7500 people) [22]. In 2017, the total population of the district was estimated to be 145,000 people [23]. The major ethnic group was Gedeo people, and the population density was 980 persons per km^2. Agriculture is the dominant means of livelihood. The district has 6 health centres, 20 health posts, and 2 private clinics.

The three selected kebeles were Hase-Haro, Mekonisa, and Tumata-Chiricha in the Wonago district. The selected kebeles had 4 health posts, and 2 health centres and the total population was 28,822 people (9,420 in Hase-Haro, 13,304 in Mekonisa, and 6,098 in Tumata-Chiricha) [23].

The three kebeles were similar in socio-demographic and economic structure with most rural areas in Ethiopia. In 2013, more than 80% of the population lived in rural Ethiopia, and 26% of the rural residents lived on less than $1 per day, and 77% of rural mothers needed to travel more than 20 km to get to a hospital [24].

Study participants

Pregnant women attending ANC formed the study population. After their second ANC visit, we followed each woman by visiting their homes every second-week until the mother gave birth.

Inclusion and exclusion criteria

Pregnant women who were resident of the study area and had at least two ANC visits and were willing to participate in the study were included in the study. Those pregnant women who did not have any ANC visit, who did not reside in the study area and women who did not avail for examination at a scheduled visit were excluded after three attempts.

Sample size

The sample size was determined by Openepi software Version 3.03 (www.openepi.com). To get the maximum sample size, we used different socio-demographic factors as exposure variables and the incidence of different types of diseases or illnesses during pregnancy as outcome variables. The assumptions were 95% level of confidence, 80% power, 1:1 ratio of unexposed to exposed in a sample, 41% of unexposed with an illness, and 1.5 relative risk. We estimated the sample size to be 898 pregnant women after adding 10% for non-response.

Sampling procedure

First, we randomly selected 3 of 19 kebeles. Then, we recruited pregnant women attending the ANC in these kebeles until the required sample size was reached. We used house-to-house visits to follow-up the women until the women gave birth. There were 86 women with incomplete data, one withdrew from the study, and two women were excluded from the analysis as the women were confirmed as having cyst or mass rather than being pregnant which was decided in the nearest hospital (Fig. 1).

Fig 1: Flowchart of recruitment of pregnant women in rural southern Ethiopia, 2017/18

Case definitions

The concepts of disease, illness, and sickness have often been used to indicate medical, personal, and social aspects of human ailments [25]. A woman with the disease was identified using disease or illness category and/or by the recording of an associated disability S1 Table. Disease or illness identification criteria were based on general symptoms, signs, physical examination, and screening of anaemia. Symptoms of maternal diseases or illnesses were used as they would correlate the associated disability, and maybe the primary reason for women to seek care. Signs were based on findings on general physical examination, and screening of anaemia was done for all women [2]. The obstetric diseases or illnesses were grouped as pregnancy termination, hypertension, haemorrhage, infection, and other diseases or illnesses. Medical diseases or illnesses were classified as gastrointestinal, psychiatric, and other diseases or illnesses [26].

As symptoms of diseases or illnesses during pregnancy are characterised as non-severe or physiological, mild, potentially life-threatening, and maternal near miss or deaths, we grouped the symptoms into categories based on their use of health services and on knowledge of which symptoms need health care such as bleeding and hypertension. Our assumption was that pregnant women would seek health care primarily because of medical problems. We then assessed how they used the health services for each of these groups.

Operational definitions

Maternal diseases or illnesses: Any condition that complicates pregnancy and childbirth and which has a negative impact on a woman's health and activity [2].

Disease: a medical or health problem that consists of physiological malfunction.

Illness: a personal or subjective undesirable state of health.

Sickness: the social aspects of human ailment [25].

Disability: a term for impairments, activity limitations and participation restrictions.

Stillbirth: a baby born with no signs of life at or after 28 weeks' gestation [27].

Gravidity: all number of pregnancies in a lifetime (includes complete or incomplete).

Parity: number of children previously borne by a woman (excludes or abortions, but it includes stillbirths).

Exposure variables

The exposure variables were socioeconomic and demographic factors which could affect the outcomes (incidence of maternal diseases or illnesses, and health service utilisation). Individual-level socioeconomic factors were: women's age, marital status, women's educational status,

155 women's occupation (housewife=0, others=1), household wealth, and total monthly household
156 expenditure. Individual-level demographic factors were: women's age at first marriage, women's
157 age at first birth, gravidity, parity, birth interval, history of abortion, and history of stillbirth. The
158 community-level factors included their place of residence (Mekonisa=1, Hase-Haro=2, Tumata-
159 Chiricha=3), type of road to the nearest health facility (asphalt=0, others=1), walking distance to
160 the nearest health post or to the health centre or to hospital.

161 ## *Outcome variables*

162 We used two sources of data to assess health service utilisation and the reasons for not seeking
163 care. For each reported disease or illness episode, the women were asked whether they sought
164 care or not, and then confirmed by visiting the health institutions. We recorded the symptoms of
165 obstetric diseases or illnesses: hypertensive disorders, obstetric haemorrhage, pregnancy-related
166 infection, and other diseases or illnesses. We also recorded symptoms of medical diseases or
167 illnesses: gastrointestinal, psychiatric, and other symptoms.

168 The assessment for pregnancy-related disease or illness measurements were blood pressure and
169 pulse rate (by Riester ri-champion®N digital apparatus, www.riester.de), and haemoglobin
170 (HgB) (by HemoCue analyzer ®Hb 301 System, (www.hemocue.com). The validity and
171 reliability of the measurements were checked regularly before used in the study.

172 Hgb values for pregnant women (3rd Trimester, 27 weeks or more) was categorized into no
173 anaemia (>=11 g/dl), mild anaemia (10–10.9 g/dl), moderate anaemia (7–9.9 g/dl), and severe
174 anaemia (4–6.9 g/dl), very severe anaemia (<=3.9 g/dl) [28].

Hypertension during pregnancy

Systolic blood pressure (SBP) was classified as normotensive (<=119.9 mmHg), pre-hypertensive (120-139.9 mmHg), and hypertensive (>=140 mmHg). Diastolic blood pressure (DBP) was defined as normotensive (<=79.9 mmHg), pre-hypertensive (80-89.9 mmHg), and hypertensive (>=90 mmHg) [29]. Hypertension was classified as either a systolic blood pressure of 140 mmHg or greater, or a diastolic blood pressure of 90 mmHg or greater, or both [30].

Data collection

The data were collected prospectively using a pretested, structured, and an interviewer-administered questionnaire. The questionnaires were adopted from tools and indicators for maternal and newborn health [31], and from WHO maternal morbidity measurement working group [2]. The questionnaire was initially prepared in English and translated into local language, Gedeo language and Amharic, and back-translated into English. A pre-test was conducted among 82 mothers in a neighbouring kebele. The data collectors were trained women, residents of the selected kebeles who could speak the local language (Gedeo language) and Amharic and had completed grade 10. The field nurses and the supervisors were experienced in data collection and supervision. To ensure the data quality, double data entry and validation of data were employed using EpiData version 3.1 and analysed using SPSS version 25 software (SPSS Inc. Chicago, IL).

Quantitative variables

The data were assessed using frequency distribution to explore if the variables were normally distributed. We used cross tabulation for categorical variables to see the distribution of each

196 exposure variables on the outcome variables. Screening for missing values, outlier values, and
197 data entry errors was done using frequency distribution and observation of the data. Errors were
198 validated against the raw data and corrections were made before the analysis.

199 ## *Data analysis*

200 Principal components analysis (PCA) was used to construct a wealth index of households based
201 on 35 household assets and facilities (such as: type of houses' roof, wall and floor, drinking
202 water source, time, and safety, type and share of toilet facility, electricity/lighting, possessing
203 radio, TV, mobile, telephone, watch, table, chair, bed, refrigerator, electric stove, and lamp,
204 livestock, ox/milk cow, horse/donkey/mule, goat, sheep, chicken, beehives, place of cooking,
205 having separate cooking room, plough, land ownership and size, saving, employment, and
206 number of sleeping room). Before wealth index calculation was done, sample size adequacy was
207 checked by Kaiser-Mayer-Olkin (KMO) value that should be >=0.6, Eigenvalue should be larger
208 (>1) for factor 1 in order to rank the household by wealth status, and Bartlett's test of sphericity
209 should be significant, p-value <0.05 [32]. In this paper, the KMO value was 0.778, Eigenvalue
210 was 3.97, and Bartlett's test of sphericity p-value was 0.000. From the 35 questions used, 13
211 questions fulfilled this criterion. From 13 questions, 3 questions extracted with Eigenvalue above
212 1. By taking factor one, a ranking of cases was done. This wealth index was divided into two
213 indices, and each household assigned to one of these indices (poor and rich).

214 Multilevel, multiple responses, repeated measures, and generalized linear mixed (GLMM) model
215 analysis were used on the binary outcome variables to assess the individual and group processes
216 associated with disease or illnesses and assessed the relationships between individuals (women)

and their community (kebele). Four models were fitted using the GLMM in SPSS version 25. The model I (intercept-only model) was fitted without exposure variables to estimate the intraclass correlation coefficient (ICC) and to test the random variability of the intercept. Model II was examined for the effects of individual-level factors, Model III for community-level factors, and Model IV for both individual and community level factors sequentially [33].

ICC was calculated to evaluate whether the variation in disease or illnesses were primarily within or between individuals or communities. The Proportional Change in Variance (PCV) was obtained for each model against the null model to show the power of the factors in the model on disease or illnesses. It was calculated as PCV= (Ve-Vmi)/Ve; where Ve is variance in the null model and Vmi is variance in successive models. The study considered multilevel factors which might modify the effect of each other on disease or illness. The interaction effect of 20 exposure variables was checked and no significant interaction effects were seen. The Hosmer and Lemeshow recommendations were used in the selection of variables for a final model with a P-value 0.20 [34]. Statistical significance was considered at P-value <0.05. Multicollinearity and collinearity were checked among explanatory variables using mean-variance inflation factors (VIF).

Ethical consideration

This study was approved by the Institutional Ethical Review Board at Hawassa University, College of Medicine and Health Sciences (IRB/100/08), and from the Regional Committees for Medical and Health Research Ethics (REC) of western Norway (2016/1626/REK vest). Written permission letters were obtained from the Gedeo Zone Health Department and the Wonago

Wereda (district) health office. Written informed consent was obtained from each mother after she had received an explanation of the purpose of the study. The privacy, anonymity, and confidentiality of study participants were maintained. If a woman was found to have a disease or an illness, the nurses and data collectors linked the patient with the health extension workers in the kebele.

Results

Background characteristics

We obtained a response from 794 pregnant women (88.4%). The characteristics of the antenatal care population are listed in Table 1. From 794 pregnant women, 99.1% (787) were married, 63.7% (506) were illiterate, and 61.2% (486) was poor. The mean age was 25.3 years (range: 16, 45). The median walking distance to the nearest health post was 30 minutes (Inter Quartile Range, IQR: 20, 50), to the health centre it was 40 minutes (IQR: 25, 60), and to the hospital, it was 60 minutes (IQR: 40,180). The median monthly household total expenditure was 42.4 USD (IQR: 30.3, 60.1), of which 87% was spent on food. The mean age of pregnant women at their first marriage was 18.1 years (range: 14, 28), and the mean age at first birth was 19.4 years (range: 16, 28). About 23.3% (185) of mothers reported the current pregnancy was their first pregnancy, and 54.3% (431) had 2 or more children (Table 1). The proportion of observed to expected antenatal care visits was 71% from the three kebeles and varied from 49% to 96%.

Table 1: Characteristics of the antenatal care study population in Wonago district, rural south Ethiopia, May 2017 to July 2018 (=794)

Socioeconomic characteristics		N	%
Kebele/residence	Mekonisa	388	48.9
	Hase-Haro	178	22.4
	Tumata-Chiricha	228	28.7
Age of mother in years	<20	177	22.3
	>=20	617	77.7
Marital status	Married	787	99.1
	Others	7	0.9
Maternal educational status	Not educated	506	63.7
	Others	288	36.3
Maternal occupation	Housewife	734	92.4
	Others	60	7.6
Wealth Index	Poor	486	61.2
	Rich	308	38.8
Type of road to the nearest health facility	Asphalt	208	26.2
	Others	586	73.8
Walking distance to the nearest health post	<=14 minutes	114	14.4
	>=15minutes	680	85.6
Walking distance to the nearest health centre	<=29 minutes	265	33.4
	>=30 minutes	529	66.6
Walking distance to the nearest hospital	<=59 minutes	335	42.2
	>=60 minutes	459	57.8
Household total expenditure	<=30 USD/month	18	2.3
	>=30.1 USD/month	776	97.7
Demographic variables			
Age of mother at first marriage in years	<20	779	98.1
	>=20	15	1.9
Age of mother at first birth in years	<20	697	87.8
	>=20	97	12.2
Gravidity (No of pregnancy)	<=2	336	42.3
	>=3	458	57.7
Parity (No of birth)	1	334	42.1
	>=2	460	57.9
Birth interval in years	<2	387	48.7
	>=2	407	51.3
History of abortion	No	746	94.0
	Yes	48	6.0
History of stillbirth	No	756	95.2
	Yes	38	4.8

1USD=27.64 ETB on August 31, 2018

The incidence of diseases or illnesses and health service utilisation during pregnancy

The total disease or illness incidence was similar at all follow-up visits during pregnancy (46-53%), except during visit 1 where the incidence was highest (71.8%) (Table 2).

Birth outcomes

About 64% (509) of women delivered at home, and of these, 96.3% (490) was attended by family members. There were 781 singleton and 13 multiple births. Vaginal deliveries accounted for 98.6% (783). Fourteen women experienced abortions (17.6 per 1000 pregnant women), and 26 deliveries resulted in a stillbirth (stillbirth rate 33.2 per 1000 births), and we observed one maternal death. None of the women who experienced abortion used health services.

Table 2: Distribution of pregnant women during follow-up and diseases or illnesses starting two-weeks preceding the first interview in rural southern Ethiopia, May 2017 to July 2018 (n=794)

Follow-ups	Having at least one disease or illness				
	Yes		No		Total
	N	%	N	%	
1	570	71.8	224	28.2	794
2	422	53.1	372	46.9	794
3	344	47.9	374	52.1	718
4	263	46.5	303	53.5	566
5	213	47.1	239	52.9	452
6	159	46.6	182	53.4	341
7	127	48.7	134	51.3	261
Overall	**719**	**90.6**	**75**	**9.4**	**794**

The cumulative incidence of at least one type of disease or illness across all follow-up visits among 794 pregnant women was 90.6 (95% CI: 88.4, 92.4) per 100 pregnant-woman. There were 1.7 episodes of diseases or illnesses per woman, however, the overall rate of health service utilisation during disease or illness was only 6.7% (95%CI: 6, 7.4). The main reasons were symptoms that the women thought would heal by themselves in 46.4% (660 episodes), or that perceived illness was not important to seek health care that occurred among 42.2% (600), 10.3% (147 episodes) did not seek health care due to lack of money, and 1.1% (15) did not visit a health institution because they lacked confidence in the health institutions (Table 3).

Among those 719 pregnant women with the diseases or illnesses, the most common complaints were tiredness; 80% (95%CI: 77, 83). This was followed by heartburn, 69% (95%CI: 66, 72); pain at pelvic area, 52.4% (95%CI: 49, 56); and severe headache, 51.3% (95%CI: 48, 58). Others diseases were blurred vision with a headache, 14.9% (95%CI: 12, 18); fever, 14.6% (95%CI: 12, 17); 4.3% (95%CI: 3, 6) oedema; 0.8% (95%CI: 0.3, 1.7) vaginal bleeding; and foul smelling vaginal discharge, 1.4% (95%CI: 0.7, 2.5) (Table 3).

Among diseases that we regarded as severe and needed to be examined by health workers were six women with vaginal bleeding, of whom only one used the health service. Although 22% of pregnant women were anaemic, the uptake of Iron-folic-acid tablet supplementation was low (6%), and the reasons given were that 22 (15.3%) did not have money to visit a health institution, and 6 (4.2%) had no trust in the health institution. Their incidence of diastolic blood pressure was 26.3%; however, the rate of use of health service was only 3.2%. Among 31 (4.3%) women who had oedema, only 13% of them used the health service.

Among illnesses that we regarded as non-severe, there was low health service utilisation for tiredness, backache, and dizziness as many women with symptoms perceived their illness to be minor, and they thought they were not important, and some would heal by themselves (Table 3).

Only two of the mothers who had a severe headache and excessive tiredness or visual disturbance with a severe headache were referred for further treatment.

Table 3: Symptoms of diseases or illnesses and reasons for not using the service during pregnancy in rural southern Ethiopia, May 2017 to July 201 (n=794)

Symptoms	Number of women (disease at least once n=719)				Health service utilisation at least once		Number of episodes with disease or illness	Reason for not using the health service at least once								Total
								Waited for self-recovery		The disease was not serious		Lack of money		Lack of trust		
	Yes	%	No	Responses	Yes	%	N (95%CI)*	Yes	%	Yes	%	Yes	%	Yes	%	
Pain at the pelvic area	377	52.4	417	722	33	8.8	1.9 (1.5,2.3)	214	48.2	152	34.2	68	15.3	10	2.3	444
Severe headache	369	51.3	425	593	31	8.4	1.7 (1.3,2.0)	183	46.9	117	30	80	20.5	10	2.6	390
Severe nausea and vomiting	198	27.5	596	252	15	7.6	1.3 (1.0,1.6)	106	43.3	84	34.3	50	20.4	5	2	245
Blurred vision with a headache	107	14.9	687	143	17	15.9	1.3 (1.0,1.6)	47	37	33	26	39	30.7	8	6.3	127
Fever	105	14.6	689	139	8	7.6	1.3 (1.0,1.6)	64	42.7	52	34.7	30	20	4	2.7	150
Backache	85	11.8	709	105	10	11.8	1.2 (0.9,1.5)	34	33	27	26.2	34	33	8	7.8	103
Dysuria	80	11.1	714	91	5	6.3	1.1 (0.8,1.4)	36	46.8	21	27.3	16	20.8	4	5.2	77
Severe abdominal pain	17	2.4	777	17	3	17.6	1.0 (0.7,1.3)	8	33.3	4	16.7	8	33.3	4	16.7	24
Vaginal discharge or itching	10	1.4	784	12	4	40	1.2 (0.9,1.5)	7	41.2	3	17.6	5	29.4	2	11.8	17
Vaginal bleeding	6	0.8	788	6	1	16.7	1.0 (0.7,1.3)	3	25	2	16.7	6	50	1	8.3	12
Tiredness	575	80.0	219	1277	37	6.4	2.2(1.8,2.6)	253	44.2	214	37.3	93	16.2	13	2.3	573
Heartburn	496	69.0	298	1096	29	5.8	2.2 (1.8,2.6)	205	40.9	208	41.5	76	15.2	12	2.4	501
Dizziness	341	47.4	453	592	26	7.6	1.7 (1.3,2.1)	133	43.9	83	27.4	76	25.1	11	3.6	303
Cramp	292	40.6	502	417	24	8.2	1.4 (1.1,1.7)	134	45	93	31.2	63	21.1	8	2.7	298
Loss of appetite	238	33.1	556	335	19	8	1.4 (1.1,1.7)	105	42.7	83	33.7	49	19.9	9	3.7	246
Abdominal distension	227	31.6	567	330	18	7.9	1.5 (1.2,1.8)	123	41.4	98	33	65	21.9	11	3.7	297
Lack of sleep	135	18.8	659	180	14	10.4	1.3 (1.0,1.6)	71	44.9	48	30.4	35	22.2	4	2.5	158
Shortness of breath	37	5.1	757	42	5	13.5	1.1 (0.8,1.4)	19	42.2	7	15.6	16	35.6	3	6.7	45
Oedema of legs	25	3.5	769	63	3	12	2.5 (2.1,2.9)	17	44.7	14	36.8	6	15.8	1	2.6	38
Varicose vein	12	1.7	782	21	1	8.3	1.8 (1.4,2.2)	8	44.4	5	27.8	4	22.2	1	5.6	18
Oedema of face and hands	6	0.8	788	6	1	16.7	1.0 (0.7,1.3)	2	33.3	2	33.3	1	16.7	1	16.7	6
Anaemia	177	24.6	617	177	14	7.9	1.0	59	41	57	39.6	22	15.3	6	4.2	144
Systolic hypertension	105	14.6	689	915	8	7.6	1.8(1.4,2.2)	37	39.4	45	47.9	10	10.6	2	2.1	94
Diastolic hypertension	189	26.3	605	1150	6	3.2	2.0(1.6,2.4)	71	43	77	46.7	15	9.1	2	1.2	165
Total	**5003[1]**	**90.6[2]**		**8681[3]**	**332[4]**	**6.7[5]**	**1.7(1.3,2.1)[6]**	**660**	**46.4[7]**	**600**	**42.2**	**147**	**10.3**	**15**	**1.1**	**1422**

*Responses divided by number of cases per row; [1]Total cases. [2]Number of women with disease divided by all number of women; [3]Total responses; [4]Total health service use; [5]Total health service use divided by total cases; [6]Total responses divided by total cases; [7]Total number of reasons in column divided by overall number of reasons

Anaemia

Of 794 pregnant women, 22.3% (95%CI: 20, 25) were anaemic, of which, 13.9% (110) was mild, 7.9% (63) moderate, and 0.5% (4) was severe. However, 93.5% (95%CI: 92, 95) (742/794) of pregnant women did not get Iron-folic-acid tablet supplementation. But, the rate of use of health services during anaemia was only 7.9% (Table 3).

Hypertension during pregnancy

Of 794 pregnant women, 7.6% (60) (95%CI: 6, 10) experienced hypertension. About 13.3% (105) of pregnant women had systolic, and 23.8% (189) had diastolic hypertension.

Multilevel, mixed effect, repeated measures, and logistic regression analysis of maternal diseases or illnesses and health service utilisation

During disease or illness analysis, there was a model improvement and AIC increment from a model I to model IV. In the four models, the variability was significant between kebeles. The community-level variance (ICC) was 25.2% (95%CI: 19.4, 30.8 (Table 4). Risk factors for disease or illnesses include increasing age, poverty, history of abortion, time travel to a health facility, and if the pregnant mother lived far away from the health institution. The risk of disease or illness increases by 3.5% when the women's age increases by one year and by 45% for women who were daily labourer and farmer. The pregnant women from households with monthly household expenditure >=30.1 USD were 61% less likely to have a disease. The pregnant women who had a history of abortion in their lifetime were 82% more likely to have an illness. In addition, the place of residence was a possible predictor of diseases or illnesses. Pregnant women living in Hase-Haro kebele were 52% less likely to have a disease or illness (Table 4).

However, during health service utilisation analysis, there was no model improvement from the model I to model IV, but AIC was increasing. The pregnant women who walked more than 15 minutes to reach the nearest health post were 81.3% less likely to use of health services when compared to the women who walked less than 15 minutes (Table 4).

341
342
343
344
345 Table 4**:** Multilevel mixed effect repeated measures logistic regression analysis of individual
346 level and community level factors for diseases or illnesses and health service utilisation during
347 pregnancy in rural southern Ethiopia, May 2017 to July 2018 (n=794)
348

Exposure variables	p-value	Model IV during diseases or illnesses ARR (95.0% CI)	p-value	Model IV during health service utilisation ARR (95.0% CI)
Individual level factors				
Women's age in years	**0.049**	**1.035 (1.000, 1.071)**	0.702	1.030 (0.884, 1.201)
Women's age at first marriage in years	0.223	0.911 (0.784, 1.058)	0.917	0.974 (0.596, 1.593)
Women's age at first birth in years	0.814	0.984 (0.860, 1.126)	0.706	1.078 (0.730, 1.592)
Birth interval				
> =2 years	0.965	0.995 (0.785, 1.260)	0.227	0.595 (0.257, 1.381)
< =2 years		1		1
Women's occupation				
Daily labourer, farming, etc	**0.047**	**1.454 (1.005, 2.103)**	0.998	0.998 (0.259, 3.845)
Housewife		1		1
Household wealth Index				
Rich	0.234	1.137 (0.920, 1.405)	0.559	1.252 (0.589, 2.659)
Poor		1		1
Household monthly expenditure				
>=30.1 USD	**0.001**	**0.388 (0.198, 0.764)**	0.573	0.536 (0.061, 4.709)
<=30 USD		1		1
Gravidity				
>=3	0.802	0.895 (0.377, 2.125)	0.854	1.398 (0.039, 49.522)
<=2		1		1
Parity				
>=2	0.965	1.020 (0.421, 2.472)	0.920	1.196 (0.036, 40.167)
<=1		1		1
History of abortion				
Yes	**0.001**	**1.823 (1.181, 2.813)**	0.122	2.293 (0.750,11.388)
No		1		1
History of stillbirth				
Yes	0.152	1.443 (0.874, 2.383)	0.247	0.294 (0.037, 2.344)
No		1		1
Community level factors				
Kebele/place of residence				
Tumata-Chiricha	0.185	0.722 (0.445, 1.170)	0.089	0.180 (0.025, 1.298)
Hase-Haro	**0.013**	**0.481 (0.270, 0.856)**	0.109	3.008 (0.784, 11.544)
Mekonisa		1		1
Type of road to the nearest health facility				
No motrable road, etc	0.195	0.723 (0.443, 1.181)	0.168	1.897 (0.764, 4.712)
Asphalt		1		1
Walking distance to the nearest health post				
>=12.6 minutes	0.169	1.273 (0.902, 1.797)	**0.014**	**0.187 (0.050, 0.709)**
<=12.5 minutes		1		1
Walking distance to the nearest health centre				
>=22.6 minutes	0.999	1.000 (0.728, 1.373)	0.864	0.874 (0.188, 4.059)
<=22.5 minutes		1		1
Walking distance to the nearest hospital				
>=55 minutes	0.991	1.002 (0.669, 1.503)	0.340	2.398 (0.397, 14.474)
<=55.1 minutes		1		1
Random effect				
Individual variance (SE)		0.864* (0.146)		7.799* (0.702)
ICC (%)		25.2		-.108
PCV (%)		37.0		-0.07
Model fitness				

-2 Log likelihood		-16755.311		-31,289.723
AIC		16761.317		31,283.717

*Significant at P-value <0.05, the odds ratios were adjusted for all variables in the respective models, ICC=Intra class correlation coefficient, PCV= Proportional change in variance, ARR= adjusted relative risk

Discussion

In rural south Ethiopia, there was a high incidence of illness and disease among pregnant women and low health service utilisation. Over 90% of pregnant women experienced at least one symptom or disease during the period of observation. About 7.6% of pregnant women were hypertensive, and 22% were anaemic, and few of them received appropriate care. Risk factors for diseases or illnesses include increasing age, poverty, history of abortion, and if the pregnant mother lived far away from the health institution. Although many of these illness episodes were regarded and minor by the women, however, for potentially severe conditions such as hypertension, anaemia, and vaginal bleedings the rate of health service utilisation was low. The potential reasons for these results are discussed below:

In our study, the rate of diseases or illnesses was higher than previously conducted studies in Ethiopia [9], India [35], and in Pakistan [36]. This discrepancy could be explained by the fact that our study was a cohort study with multiple visits to pregnant women homes, and the other studies were cross-sectional. However, the incidence of diseases or illnesses was similar to 90.3% from population-based studies in Sri Lanka [37]. The Sri Lankan study showed that maternal illnesses considered as minor were judged not to be minor for women. Though, as shown by our study, the overall rate of use of health services during diseases or illnesses was low. The reasons for not seeking care during diseases or illnesses included a lack of money, or it could be due to longer time to travel to a health facility, or it could be that women who live in

371 hard to reach areas with limited access to health facilities experienced an increased risk of
372 diseases or illnesses than those who lived nearby to health facilities.

373 A 'severe' form of maternal diseases during pregnancy could include bleeding, anaemia,
374 hypertension, and fever [38]. Women with these symptoms did not get the necessary care at the
375 health posts and were not referred for treatment. Our study highlights that only 37 out of 582
376 women with bleeding, anaemia, hypertension, and fever used the health care service. However, a
377 study from Egypt indicted that all mother with such diseases used the health services [39]. This
378 difference could be due to the socioeconomic status of the women, some lacked trust in the
379 health institutions, and some were not able to seek health care because of financial
380 constraints(Table 3), and if the pregnant mother lived far away from the health institution. These
381 findings emphasize that the need to identify and address barriers to health service utilisation,
382 assess the quality of care, re-training of the health extension workers on disease or illness
383 identification and take necessary public health measures.

384 The burden of anaemia in our study was similar to other studies in Ethiopia [40, 41], and it was
385 most likely caused by iron deficiency [42]. However, our findings show that that the uptake of
386 Iron-folic-acid tablet supplementation and health service utilisation for anaemia was low. These
387 groups of pregnant women with anaemia were more likely to have an iron deficiency. This low
388 health service utilisation during anaemia may put the women at risk as they are 'severe' as
389 documented in our findings. The possible explanation could be poor women may prefer to
390 remain at home may be due to a longer time to travel to health institution or if the pregnant
391 mother lived far away from the health institution could avoid seeking care at all due to their

392 inability to pay for health services and transportation and some due to lack of trust on the health
393 institution.

394 In this study, the incidence of hypertension was high, however few of hypertensive women used
395 the health service, as has also been reported from Bangladesh [43]. This finding indicated that
396 the women who had hypertension could be at higher risk of complications of the mother and
397 child, pre-eclampsia and eclampsia. In addition, only two of the mothers with the disease were
398 referred for further treatment. This could be explained that women with these diseases were
399 supposed to incur cost in order to get health care services (Table 3). Although health care
400 services for pregnant women are free, however, if the women experience a disease or illness,
401 they have to pay for health care and transportation. Therefore, these institutions should discuss
402 how they could cover these costs.

403 A 'non-severe' form of maternal illnesses during pregnancy could include dizziness, abdominal
404 cramp, headache, dysuria, shortness of breath, abdominal distension, lack of sleep, pain in the
405 pelvic area and tiredness and it could affect the day-to-day life of pregnant women [37]. In this
406 study, many pregnant women experienced pain in the pelvic area and tiredness and they did not
407 use the health service. This finding was comparable with study in rural Bangladesh in which
408 87% of pregnant women had illnesses during their pregnancy, however, 73% of them did not
409 seek any care [11]. This finding was also similar with Australian longitudinal study in which
410 many women had non-severe illnesses, but 68% did not use health service [44], and in Sri Lanka,
411 90% did not use health service [37]. The use of health services is not primarily determined by a
412 woman's recognition of a problem. The possible explanation was that pregnant women with
413 illnesses were reluctant to seek, and delayed in seeking health care as pregnant women with

414 symptoms perceived their illness to be minor, and they thought they were not important, and
415 some would heal by themselves. Further delay in seeking care may result from the perception
416 that some women lack trusts in the health facilities and the underlying household poverty also
417 plays a role in determining health care utilization as the pregnant women who could not afford
418 for the use of health services.

419 In our study, we reported one of the study areas had higher risks than the other due to community
420 factors. The variability due to community-level factors was significant between kebeles, as has
421 been described from south-central Ethiopia [9]. This variability indicates that the presence of
422 other factors which was not addressed in this study. The unexplained community-level variance
423 remained significant and needs further study.
424

425 ***Study design:*** the World Health Organization designed a template on how to estimate the
426 incidence of diseases or illnesses during pregnancy based on a cross-sectional study design [2].
427 However, our results suggest that many diseases or illness episodes were not regarded as severe
428 by the patients and further work on how to improve the questionnaires may be needed and one
429 possibility is to ask about use of health services.
430

431 Our methods of registration of symptoms based on a recording of associated disability during
432 pregnancy revealed that high incidence of maternal diseases or illnesses, however, there was low
433 health service utilisation. Community-based disease or illness survey could be used for early
434 detection, to improve the health of mothers, and take necessary public measures. In this regard,
435 this study coincides with the World Health Organisation maternal morbidity matrix for assessing

maternal diseases or illnesses [2]. The need to measure and count 'severe' or 'non-severe' disabilities reported by the women could help to address the health needs of women and could serve as an indicator of access to health care, quality of the health care system, and the possibility of a survey of maternal diseases or illnesses for an informed decision.

Strengths of the study

To our knowledge, this study is the first of its kind in Ethiopia to study factors associated with diseases or illnesses during pregnancy and use of health services. It was an antenatal care based cohort study with multilevel, mixed effect, and repeated measures to identify the multilevel determinants of diseases or illnesses.

Limitations of the study

In this study, only those pregnant women who attended antenatal care were recruited: This might be a potential selection bias in this study as a random selection of women from the communities was not employed. The proportion of observed to expected antenatal care visits in the three kebeles was in agreement with birth registry studies in Southwest Ethiopia where the coverage of maternal health services was about 75% [45]. Thus, our study may be representative of women attending antenatal care but may not be fully representative of women not attending such services. Women not attending antenatal care could have higher maternal incidence rates of severe diseases, and lower use of health services. As there was a displacement of residents in the study area and its surrounding [46], the number of pregnant in the analysis was 88.4% due to incomplete data. Despite these limitations, this study provides useful insights about the incidence

456 of diseases or illnesses and use of health services and it would serve as a base for more detailed
457 investigation.
458

459 *The policy implication of the findings*

460 In conclusion, maternal disease or illnesses during pregnancy was high and health service
461 utilisation was low. Poor understanding of what severe and non-severe symptom was an
462 important reason for low health service utilisation. Therefore, community-based maternal disease
463 or illness survey could help for early detection. Ministry of health should promote health
464 education that encourages women to seek appropriate and timely care, which in turn could
465 improve the use of health services. We recommend further an interventional study should be
466 carried out to answer why health service utilisation was low and how it could be improved, and
467 how diseases or illnesses could be prevented and how the health of mothers could be improved.
468

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476

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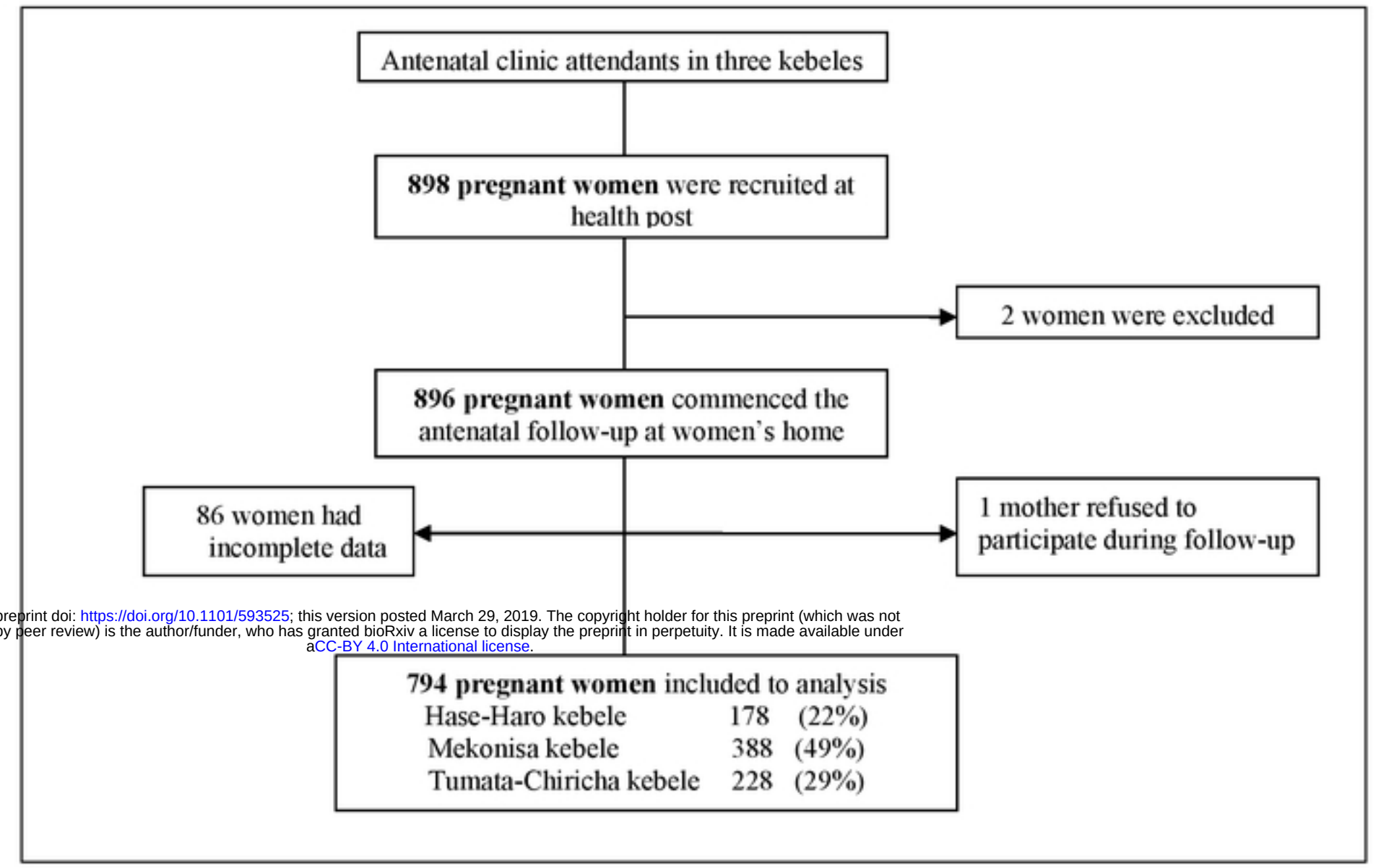
610 Supporting Information

611 ***S1 Table:*** Sign and/or symptoms of diseases or illnesses and case definition



Figure