Original Article

De-worming during pregnancy in Nepal: an effect on neonatal mortality

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Abstract

Background: The Ministry of Health and Population, Nepal has been administering the de-worming medication (with tablet albendazole) to pregnant women aiming at reducing maternal anemia and neonatal death since 2001. The neonatal mortality has remained stagnant for the past decade. The effect of de-worming during pregnancy on neonatal mortality is not known yet.

Methods: This study is based on the database of Nepal Demographic and Health Surveys (NDHS) 2006 and 2011. This study includes the recent singleton live births within five years preceding the survey as the de-worming medication during the pregnancy was collected only in the recent live births (the last live birth) in the five years preceding the surveys. The newborn death of the pregnant women administered with de-worming medication was compared with those pregnant women who were not administered with de-worming medication during the pregnancy. An association has been established with the logistic regression model adjusting several potential confounding factors.

Results: In the pooled data, the recent singleton live births were 8,147. A total of 813 and 2,274 mothers were found to have taken de-worming medication during pregnancy in the NDHS 2006 and 2011, respectively. The use of de-worming during pregnancy increased from 20% to 56% between the surveys, but the newborn deaths in de-worming group rose from 1.2% to 1.4%. The adjusted OR of the neonatal death with the de-worming was {aOR 1.129 (95% CI 0.696-1.829), P = 0.623}.

Conclusion: The de-worming during pregnancy in Nepal was not found significantly associated with reduction on neonatal deaths, which suggests timely review of the program.

Keywords: De-worming, neonatal mortality, pregnancy, Nepal

Background

Nearly one-fourth of the global population is infected with soil-transmitted helminthes (STHs) (1). The World Health Organization (WHO) includes pregnant women as a high-risk group for the infection. Deworming during pregnancy has been recommended to control maternal morbidity and mortality, and adverse pregnancy outcome including newborn death caused by the helminthes(2).

The Ministry of Health in 2001 initiated de-worming (with tablet albendazole) during pregnancy after the 1st trimester aiming to reduce maternal anemia and newborn mortality in Nepal, as per the WHO recommendation (3). The coverage of de-worming medication during pregnancy among all live births has increased from 29% to 55% between two consecutive Nepal Demographic and Health Surveys (NDHS), 2006 and 2011 (4, 5). However, the neonatal mortality has remained stagnant (33 per 1,000

live births) at national level and has rather increased in some development regions between the periods. The STH contribution to neonatal deaths and effect of de-worming during pregnancy is not known yet.

The rational of the study is that the de-worming during pregnancy is still a controversy. In one hand, the helminthes are considered as a human parasite, a cause of anemia and malnutrition in the pregnancy (6, 7). On the other hand, various studies have suggested that helminthes are immune regulator (8-10). The growing understanding has suggested that they have bystander role on human host: protective as well as aggravating on various conditions (10-14). The role of mass de-worming during pregnancy on neonatal deaths from the epidemiological perspective has not been explored yet in Nepal. Thus, the study has aimed to evaluate the effect of de-worming during pregnancy on neonatal mortality using the nationally representative samples in Nepal.

Methods

Analysis framework

The primary outcome of the study was neonatal death; the exposure variable was the de-worming (with albendazole) medication during the pregnancy in the recent singleton live births.

Most of the information in the NDHS were collected for all live births within five years preceding the surveys among women aged between 15-49 years. But the de-worming medication during the pregnancy was collected only in the recent live births (the last live birth) in the five years preceding the surveys. For that reason, only recent live births were included in the study. The multiple pregnancies were not included in the study as they are clinically distinct from the singleton pregnancies (15).

Newborn deaths of the pregnant women administered with de-worming medication were compared with those pregnant women who were not administered with de-worming medication.

An association has been established with the logistic regression model, adjusting several potential confounding factors.

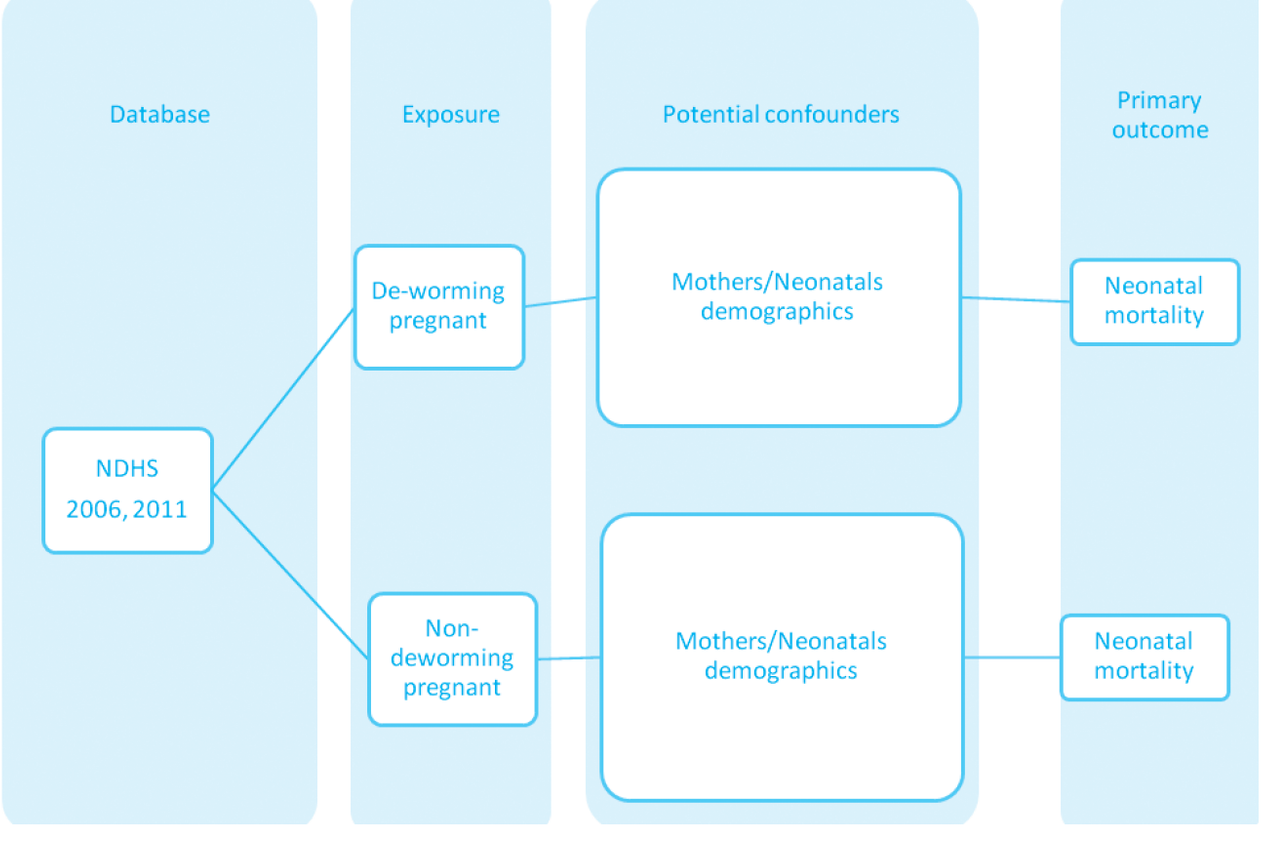

Figure 1: Analysis framework

Data generation

Nepal Demographic and Health Survey is a national representative survey. The survey was conducted under the aegis of the Ministry of Health of the Government of Nepal; USAID/ICF International had provided technical support and the surveys were implemented by a local research organization (4, 5).

The research question in the recent live births in the five years preceding the surveys was whether the respondent took any drugs for intestinal worms during pregnancy or not, and the response was either "yes" or "no".

In this study, the desired variables were selected and pooled from the kids file (NPKR) of the NDHS 2006 and 2011 only as the de-worming questionnaire was not included prior to the 2006 survey (4, 5). The NDHS 2006 covers information from 2001 to 2005, and the NDHS 2011 covers information from 2006 to 2010. Thus, the pooled data covers deworming information of the whole period from 2001 to 2010 (table 1).

Table 1: Sample details

Sample details	NDHS		Pooled data
	2006	2011	
Number of household	8707	10826	19533
Number of respondents (women age 15-49)	10793	12674	23467
Response rate	99.6%	99.4%	
Number of all births in preceding five years	5783	5306	11089
Number of recent singleton births	4028	4118	8147
Approximate time frame covered	2001-2005	2006-2010	

The databases (NDHS) provide the temporal relationship between exposure (de-worming) during the pregnancy and newborn outcome (death or survival). So, we assumed that the data from the survey can be treated as data generated from a retrospective cohort study (16) or retrospective case-control study. Besides, in recent years, so many studies analyzed the exposure/impact relationship from the NDHS-database to understand and support a program in various ways (17-19).

Data analysis

The data were analyzed at three levels; descriptive, bivariate, and multivariate. The Statistic Package for Social Sciences (SPSS) version 20 for windows was used to analyze the data. The multi-collinearity test was performed to decide whether to include the variables in the model. The Hosmer and Lemeshow Goodness of fit was applied to decide the final model.

Descriptive analysis

Based on the analysis frame (Figure 1), a group of potential confounding variables were identified from the previous study, i.e. NDHS further analysis on determinants of newborn health in Nepal (20). Distributions of variables were examined as numbers and percentages in the descriptive analysis with Chi-squared value at 5% level of significant.

Included variables were as follows: *residence, ecological zone, level of education, birth order, birth interval, tobacco use (any form), iron taken during the pregnancy, TT injection during the pregnancy, mother's body mass index (BMI), mother's height in centimeter (stature), place of delivery, skill birth-assisted (SBA) delivery, household solid fuel use, caste and ethnicity, newborn size at birth (mothers' perceived size at birth), sex of child, mother's level of anemia, women age in category, wealth index, and survey years (table 2)*. The BMI, the mother's height, the mother's level of anemia, and newborn size at birth (perceived) were taken as proxy indicators for these variables (21) as they were taken during the surveys period not during the period of pregnancy.

The demographic characteristics of women and neonates were described in numbers and percentage for each survey years and in pooled data. The variables were weighted using survey weights by the DHS. Associations of the variables were explained by the Chi-squared test.

Regression analysis

The multi-collinearity was seen between the two variables (*the SBA delivery and institutional delivery*). Thus, the variable "*SBA delivery*" wasnot included in

the logistic regression model because of greater R^2 while comparing. The final model was fit as the value of Hosmer and Lemeshow Goodness of Fit was more than 0.05.

All significant variables from the Chi-square test were considered for the further analysis. The unadjusted odds of neonatal death for each variable were calculated by the simple logistic regression model. The neonatal death was taken as a dependent variable, whereas the de-worming was taken as an exposure variable and categorized into de-worming: yes and no.

Fitting the simple logistic regression models:

Log odds=log(p/1-p)bo+b1X

P=probability of happening of neonatal death, where 1-p=q (probability of not happening of neonatal death), and

X=de-worming; de-worming X is categorical variable, X=0 implies without de-worming, and X=1 implies de-worming.

Finally, the significant variables from the simple logistic regression were adjusted for the multivariate analysis using the enter method by the SPSS. The variables in the model were as follows: *de-worming, mother's education, birth interval of child, intake of iron during pregnancy, TT injection during pregnancy, height of women (stature), mothers' perceived size at birth of the newborn, and mother's wealth quintile (table 3)*. The adjusted odds and corresponding CI at 5% level of significance were calculated through the final model to see the effect of de-worming on neonatal death.

Fitting the multiple logistic regression models:

Log Odds=log(p/1-p)= bo+b1X1+b2X2+……+bnXn,

X's are the independent variables.

b's are the coefficients associated with independent variables.

Results

Description of the characteristics

In the pooled data, the recent singleton live births were 8,147 (Table 1). A total of 813 (20.3%) and 2,274 (56.0%) mothers were found to have taken de-worming medication during the pregnancy in the NDHS 2006 and 2011, respectively**.** The newborn deaths have increased in both non-de-worming and de-worming groups. In non-de-worming group, the newborn death increased from 1.8% to 2.4% whereas in the de-worming group, it rose from 1.2% to 1.4%. The percentage of newborn deaths was significantly higher in the non-de-worming group in the NDHS 2011 and pooled data; however, it was not significant in the NDHS 2006 (table 2).

The percentage of newborn deaths was high among the mothers with: no education (2.1%), birth interval less than 24 months (2.6%), no iron intake during the pregnancy (2.5%), single dose TT injection during the pregnancy (2.9%), mother's height less than 145 cm (3.8%), newborn size at birth less than average (2.9%) and middle class (2.2%) that were significant in the Chi-squared test (Table 2).

The newborn deaths were high in rural residence (1.8%) and mountain zone (2.2%), first birth order (2.3%), mother's BMI less than 18.5 (2.1%), no health facility during delivery (1.9%), delivery by other than SBA (1.9%), Dalit/Janajati/Muslim (1.8%), female child (1.8%), mother's age less than 35 years (1.8%), and survey year 2011 (1.8%). However, the associations were statistically not significant through the Chi-squared test (Table 2).

Table 2: The neonatal deaths associated with the de-worming during the pregnancy including other various socio-demographic factor in Nepal, from the NDHS 2006, 2011 and pooled data by using the chi-squared test

Characteristics	NDHS 2006				NDHS 2011				Pooled data			
	Number	Newborn death			Number	Newborn death			Number	Newborn death		
	N	n	%	X^2	N	n	%	X^2	N	n	%	X^2
Deworming	4002				4064				8066			.027*
No	3189	56	1.8	.293	1790	43	2.4	.014	4979	99	2.0	
Yes	813	10	1.2		2274	31	1.4		3087	41	1.3	
Residence	4029				4119				8148			
Urban	533	6	1.1	.298	417	7	1.7	.790	950	13	1.4	.334
Rural	3496	61	1.7		3702	69	1.9		7198	130	1.8	
Ecozone	4029				4120			.781	8149			.681
Mountain	339	7	2.1	.646	303	7	2.3		642	14	2.2	
Hill	1663	24	1.4		1658	32	1.9		3321	56	1.7	
Terai	2027	35	1.7		2159	38	1.8		4186	73	1.7	
Education*	4028			.004	4119			.068	8147			.001*
No	2332	51	2.2		1810	43	2.4		4142	94	2.3	
Primary	736	9	1.2		827	10	1.2		1563	19	1.2	
Secondary and above	960	6	0.6		1482	23	1.6		2442	29	1.2	
Birth order	4029			.155	4118			.308	8147			.057
First	1094	25	2.3		1302	30	2.3		2396	55	2.3	
2nd and 3rd	1776	24	1.4		1881	32	1.7		3657	56	1.5	
≥ 4th	1159	18	1.6		935	14	1.5		2094	32	1.5	
Birth interval*	4029			.015	4118			.032	8147			.001*
First birth	1094	25	2.3		1302	30	2.3		2396	55	2.3	
< 24 months	615	15	2.4		545	15	2.8		1160	30	2.6	
≥24 months	2320	27	1.2		2271	31	1.4		4591	58	1.3	
Tobacco use	4029			.869	4118			.539	8147			.820
Yes	3276	55	1.7		3616	65	1.8		6892	120	1.7	
No	753	12	1.6		502	11	2.2		1255	23	1.8	
Iron	4029			.045	4118			.001	8147			.000*
No	1682	36	2.1		892	28	3.1		2574	64	2.5	
Yes	2347	31	1.3		3226	47	1.5		5573	78	1.4	
TT number*	4029			.000	4118			.000	8147			.000*
Single dose	1484	41	2.8		1248	38	3.0		2735	79	2.9	
≥TT doses	2545	26	1.0		2870	38	1.3		5415	64	1.2	
BMI	4004			.991	1990			.700	5994			.888
<18.5	991	17	1.7		385	12	3.1		1376	29	2.1	
18.5-24.99	2764	46	1.7		1397	33	2.4		4161	79	1.9	
≥ 25	249	4	1.6		208	5	2.4		457	9	2.0	
Height of women*	4005			.307	1991			.000	5996			.000*
<145 cm	547	12	2.2		241	18	7.5		788	30	3.8	
≥ 145 cm	3458	55	1.6		1750	31	1.8		5208	86	1.7	
Institutional delivery	4028			.388	4119			.218	8147			.184
Elsewhere	3250	56	1.7		2538	52	2.0		5788	108	1.9	
Health facility	778	10	1.3		1581	24	1.5		2359	34	1.4	
SBA delivery	4029			.600	4118			.177	8147			.215
Delivery by others	3204	55	1.7		2509	52	2.1		5713	107	1.9	
Delivery by SBA	825	12	1.5		1609	24	1.5		2434	36	1.5	
Solid fuel	4029			.427	4119			.438	8148			.901
Other than solid fuel	687	9	1.3		932	20	2.1		1619	29	1.8	
Solid fuel	3342	58	1.7		3187	56	1.8		6529	114	1.7	

Caste/ ethnicities	4029			.975	4119			.700	8148			.745
Other	1932	32	1.7		1824	32	1.8		3756	64	1.7	
Dalit/Janajati/Muslim	2097	35	1.7		2295	44	1.9		4392	79	1.8	
Mothers' perceived size at	4026			.001	4113			.007	8139			.000*
birth of the newborn *	945	15	1.6		776	22	2.8		1721	37	2.1	
> average	2344	27	1.2		2697	37	1.4		5041	64	1.3	
Average	737	23	3.1		640	17	2.7		1377	40	2.9	
< average												
Sex of child	4029			.115	4119			.511	8148			.548
Male	2128	29	1.4		2177	43	2.0		4305	72	1.7	
Female	1901	38	2.0		1942	33	1.7		3843	71	1.8	
Anemia level	3979			.256	1966			.068	5945			.106
Severe<7.0	15	0	0.0		6	1	16.7		21	1	4.8	
Moderate 7.0-9.9	309	9	2.9		125	5	4.0		434	14	3.2	
Mild 10.0-10.9	1238	19	1.5		613	13	2.1		1851	32	1.7	
No anemia>11.0	2417	35	1.4		1222	27	2.2		3639	62	1.7	
Women age	4029			.935	4118			.135	8147			.258
Less than 35 Years	3474	58	1.7		3619	71	2.0		7093	129	1.8	
35 and plus years	555	9	1.6		4999	5	1.0		1054	14	1.3	
Wealth index*	4029			.374	4118			.088	8147			.039*
Poorest	952	12	1.3		973	13	1.3		1925	25	1.3	
Poorer	846	19	2.2		889	18	2.0		1735	37	2.1	
Middle	799	13	1.6		866	23	2.7		1665	36	2.2	
Richer	749	15	2.0		743	16	2.2		1492	31	2.1	
Richest	683	8	1.2		647	6	0.9		1330	14	1.1	
Survey year 2006 and 2011	4029	67	1.7	-	4119	76	1.8	-	8148	143	1.8	.531

Association between explanatory and outcome variable

The unadjusted OR of the neonatal death with the de-worming variable was 0.674, 95%CI (.468- .971), p=0.034. The baby born to the pregnant mother administered with de-worming medication was 32.6% less likely to die than pregnant mothers who did not receive de-worming medication, with the true population effect between 2.9% to 53.2 %. The explained variance was 0.003 (Negelkerke R Square) (Table 3).

The simple logistic regression has revealed that many variables were significant to reduce the neonatal death in Nepal, such as, the de-worming (yes), educational level of mother (secondary and above), birth interval of child (equal or greater than 2 years), any iron intake during the pregnancy, TT injection during the pregnancy (two or more), mother's height (equal or greater than 145 cm), and mothers' perceived size at birth of the newborn (greater than average) (Table 3).

Some variables were protective for the newborn survival, such as, hill zone, secondary and higher education, 2nd and 3rd birth orders, BMI (equal or greater than 25), delivery at health facility, delivery by the SBA, use of solid fuel, women's age (35 years and above) and the richest wealth quintile, but they were not statistically significant.

Similarly, other variables, such as, rural residence, use of tobacco (any form), Dalit/Janajati/Muslim, female child, and mother's anemia were risk factors for the survival of the neonates in Nepal, though they were not statistically significant.

The multivariate logistic regression

The multivariate logistic regression revealed that the mother's educational level (secondary and above), birth interval (equal or greater than 24 months), any intake of iron during the pregnancy, TT injection during the pregnancy (two or more), and height of mother (equal or greater than 145 cm) had a significant role to reduce the neonatal deaths in Nepal (Table 3). However, the final model disclosed that the de-worming during pregnancy had no significant effect to reduce the neonatal deaths in Nepal [aOR0 1.129 (95%CI 0.696-1.829), P = 0.623] (Table 3).

Table 3: Neonatal deaths associated with the de-worming during pregnancy including other various socio-demographic factors in Nepal, from the NDHS 2006, 2011 and pooled data by using the logistic regression analysis

Variables	Simple logistic regression					Multiple logistic regression ¥			
	uOR	95% CI		P	R^{2*}	aOR	95%CI		P
De-worming during pregnancy									
No (ref)					.003				
Yes	.674	.468	.971	.034		1.129	.696	1.829	.623
Mother's level of education									
No (ref)					.010				
Primary	.540	.330	.883	.014		.467	.262	.834	.01
Secondary and higher	.517	.340	.785	.002		.544	.311	.954	.034
Birth interval									
First birth (ref)					.011				
< 24 months	1.136	.723	1.784	.581		.811	.480	1.368	.432
≥24 months	.553	.381	.803	.002		.360	.229	.567	.000
Iron intake during pregnancy									
No (ref)					.009				
Yes	.557	.399	.777	.001		.877	1.412	.544	.589
TT injection during pregnancy									
Single dose(ref)					.021				
≥ 2 TT doses	.407	.292	.568	.000		.367	.237	.570	.000
Height of mother									
<145 cm(ref)					.012				
≥ 145 cm	.436	.285	.668	.000		.457	.295	.708	.000
Mothers' perceived size at birth									
> average(ref)					.014				
Average	.591	.392	.890	.012		.679	.420	1.098	.114
< average	1.377	.875	2.168	.167		1.382	.817	2.338	.227
Wealth index									
Poorest(ref)					.008				
Poorer	1.669	.999	2.787	.050		2.295	1.260	4.180	.007
Middle	1.702	1.016	2.849	.043		3.009	1.649	5.488	.000
Richer	1.604	.940	2.736	.083		2.921	1.517	5.625	.001
Richest	.831	.432	1.601	.581		1.814	.792	4.155	.159

uOR-unadjusted odds ratio, aOR-adjusted odds ratio, *Negelkerke R Square (Simple logistic regression) , ¥ Negelkerke R Square (Multiple logistic regression) = .087, and Hosmer and Lemeshow goodness of fit = .501 (p > .05)

Discussion

The de-worming is an important intervention to prevent the pathological effects of the helminthes. This article, however, tries to identify the relationship of mass de-worming intervention during the pregnancy and its impact on neonatal morality in Nepal, and the discussion would be based on the theoretical underpinning, program perspectives, and the findings of the study.

The growing concern is that the helminthes are not only parasites: they are immune-regulators also; they have bystander roles- protective as well as aggravating for various infections and conditions (10, 22-24). The helminthes exert their immune regulatory actions by modulating cells of both innate and adaptive immune systems, and they create a tolerant environment, ensuring their own survival, but also protecting the host from immune-mediated conditions by limiting excessive inflammatory and autoimmune phenomena (25). The helminthic infections were shown to have a protective effect on allergic diseases, the anti-helminthic treatment of chronically infected children resulted in increased atopic diseases (25). In contrast, the suppressed immunity due to helminthes reduce the vaccine efficacy, increase susceptibility of viral, bacterial and protozoa infections; and reduce immunopathology of

asthma, autoimmune diseases, and inflammatory bowel diseases (10). Thus, the helminthes have a bystander role on human health.

Nepal has introduced the de-worming intervention since 2001 during the second trimester of the pregnancy aiming to reduce maternal anemia, death and neonatal mortality based on the fragmented information from the country level and the WHO global recommendation(2). Since the implementation of the program, the rate of de-worming increased rapidly, but its effect has not been reflected in the neonatal deaths. The coverage of the de-worming has increased rapidly; in contrast, the anemia in pregnant women has increased from 42 to 48% during the period (5). Furthermore, the neonatal mortality has remained stagnant at national level and increased in some development regions (4, 5)

A recent study has revealed that the overall prevalence of any STH in grade three student was 21% whereas the prevalence of Ascaris was the highest (14.6%) followed by Trichuris (5.0%) and hookworm infection (4.7%) in Nepal (26). However, there is lacking of nationally representative data on the STH infection that could represent the pregnant or adult population. Presumably, the prevalence of the hookworm in the pregnancy could be higher than the children as the hookworm infection increases with age(27). More importantly, various studies have shown that the common pattern of hookworm's infection prevalence remain high, most of the hookworm infections (about 80%) possess the low intensity of the infection, and only moderate to severe anemia of hookworm infection is improved by the de-worming during the pregnancy (28-30). Considering these facts, we can say that a small proportion of pregnant women may require de-worming during pregnancy in Nepal.

This study has revealed that the effect of de-worming during pregnancy has no effect [aOR0 1.129 (95%CI 0.696-1.829), P = 0.623] to reduce the neonatal deaths in Nepal. The findings of the study are similar to many other cross-sectional and prospective studies with a few exceptions. A randomized controlled trial in Sarlahi district of Nepal, primarily designed to evaluate the impact of multiple micronutrient supplementations, where the expectant mothers were given a dose of albendazole in the second trimester and another dose in the third trimester, most of them also received micronutrient supplements. The study which was published in the Lancet had shown that an infant mortality at 6 months fell by 41% (RR 0·59; 95% CI 0·43–0·82)among mothers who received two doses of albendazole, however, a single dose failed to show an impact on the mortality (31).The Cochrane Database of Systematic Review also revealed that a single dose of anthelminthics in the second trimester of pregnancy was not associated with any impact on low birth weight (RR 0.94; 95% CI 0.61 to 1.42 (1 study, n = 950), perinatal mortality (RR 1.10; 95% CI 0.55 to 2.22 (2, studies, n = 1089) and preterm births (RR 0.85; 95% CI 0.38 to 1.87 (1 study, n = 984)) (32).

Most of the other studies have revealed that there was no significant effect of the de-worming to reduce neonatal mortality. A study conducted in Uganda showed that albendazole treatment during pregnancy had no overall benefit for birth weight (difference in mean associated with albendazole: −0.00 kg (95% CI −0.05 to 0.04 kg); perinatal mortality 0.78 (95% CI 0.42-1.46), and early neonatal mortality 0.93 (95% CI 0.61-1.44) (33). Moreover, maternal albendazole treatment was associated with a significantly increased risk of (doctor-diagnosed) infantile eczema [Cox HR (95% CI), 1.82 (1.26–2.64), 0.002] and strongly associated with (reported) recurrent infantile wheeze [1.58 (1.13–2.22), 0.008] (29, 34). Likewise, de-worming with mebendazole had no statistically significant effect on maternal anemia and perinatal mortality in pregnant women living in Iquitos, Peru (35, 36).

Finally, this study has shown that the use of de-worming during pregnancy has increased, in contrast the newborn deaths in the de-worming group also rose between the surveys. The unadjusted OR of the neonatal death with the de-worming has shown the significant effect {0.674, 95%CI (.468- .971), p=0.034}, however, the adjusted OR of the neonatal death with the de-worming has not shown the effect to reduce the neonatal death in Nepal {aOR 1.129 (95% CI 0.696-1.829), P = 0.623}.This may be attributed due to low prevalence of hookworm and trichurisinfection in Nepal (26)which require treatment for only a few moderate and sever infection or there may be adverse effects of de-worming during pregnancy as other studies have shown (29, 34).

Strengths and limitations

The data were taken from nationally representative sample surveys' database. In addition to this, the study is based on only recent singleton live births, which has reduced the recall biases to a great extent as compared to all live births. The study preferred singleton pregnancies to multiple ones as the multiple pregnancies are clinically

distinct from common singleton pregnancies; they have lower average gestational age at delivery, intrauterine growth restriction, and some complications occur only among multiples, including twin-to-twin transfusion syndrome (15).

The information on neonatal deaths and de-worming were based on maternal recall and it is accepted that the information from the past events could be subjected to recall bias to some extent in the survey data. There are many other variables which could be associated with newborn death such as preterm birth, pneumonia, intrapartum-related complication, diarrhea and congenital anomalies; as well as other mother related condition such as eclampsia, diabetes of mother, hypertension and so on. The causes of newborn death were surveyed in 2006 with the verbal autopsy questionnaire for the neonatal deaths related to preterm birth, pneumonia, intrapartum-related complications, diarrhea and congenital abnormalities among others. But the autopsy questionnaire was not included in the 2011 survey. So, it is not possible to include these variables in the study.

The diarrhea and ARI (as proxy pneumonia) were included in both surveys, but this information was collected only for two weeks before in both the surveys, whereas, newborn deaths were taken for 5-years preceding the survey. That's why it was not appropriate to include those variables in this study. The blood pressure and diabetes data were not collected in both surveys. These are the limitation of the study. However, a maximum effort has been made to identify the relationship of the variables adjusting various potential confounders with the available database.

Conclusions

The de-worming medication is an important intervention to prevent the pathological effects of the helminthes but the de-worming during pregnancy has found no effect to reduce neonatal deaths in Nepal, which suggests a further review of deworming programme for the pregnant women in Nepal.

List of abbreviations

BMI: Body Mass Index; DCMPH: Department of Community Medicine and Public Health; IOM/TU: Institute of Medicine/Tribhuvan University; NDHS: Nepal Demographic and Health Survey; NHRC: Nepal Health Research Council; NMR: Neonatal Mortality Rate; OR: Odds Ratio; SBA: Skill Birth Attendant; SPSS: Statistical Package for the Social Sciences; STH: Soil-transmitted helminthes; TT: Tetanus Toxoid

Declarations

Ethical approval and consent to participate

Ethical approval was taken from the Institutional Review Board, Institute of Medicine/Tribhuvan University (IOM/TU) [(REF: 295 (6-11-E) 2 070/071] to conduct the study. Permission was obtained from the ICF Macro International, the research agency, to use the data sets for the analysis.

Consent for publication

Not applicable

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author at reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

PRS, MDD and RP conceptualized framework and designed the study. RRWand SK provided critical feedback on the framework. PRS and YS analyzed the data. RP, SK, RS and YS revised the analysis. PRS drafted the paper, all other contributors revised it. All have agreed to be accountable.

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