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Influence of mothers' Obesity, Hypertension and Morbidity on Infant and Child Mortality among the Zou of Manipur, North East India

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KEYWORDS	ABSTRACT
BMI, blood pressure, morbidity, influence, infant and child mortality, Zou, Tribal	*The present study was conducted to find out the influence of obesity, hypertension and morbidity of the mothers on infant and child mortality among the Zou a tribal population of Manipur state. A cross-sectional study was conducted among 533 mothers of age 17- 49 years following house to house visits. The finding shows that BMI is negatively associated with infant and child mortality. There is a positive correlation with rising Blood Pressure categories. Although the magnitude of the correlation differed, there was a significant positive correlation with a higher frequency of major/chronic morbidity and the type of morbidity of the mothers. The present finding shows that undernutrition and the frequency, prevalence of morbidity of the mothers are the main influential factors of infant and child mortality in the study population. The considerable prevalence of underweight mothers indirectly highlighted their socio-economic status leading to poor health condition of the mother which indirectly may affects the development of child from the initial stage of conception.*

Introduction

The influence of socio-economical changes in societal elements could bring about certain variations in the health aspect within the native environment. By definition, the World Health Organization defined health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". These clearly rectify the importance of retrospections from various dimensions. Though health is a complex issue, education and awareness can pave the way to the minimization of the chances of getting infected. This can further enhance the longevity of the public and its considerable plan before-hand and minimized mortality rate especially during a tender age. Though there are considerable influential genetic roles at a certain degree, the prevalence of hypertension and undernutrition or morbidity, for instance, , is closely associated with the socio-economic status of the people reflecting the health status of the community.

Obesity which is one of the pertinent causes of hypertension is a condition that develops from a chronic quantitative imbalance between energy intake and energy expenditure which in turn leads to an excessive accumulation of adipose tissue within the body (Bray & Bellanger, 2006). The increasing pattern of obesity is differed by age and sex (Matijasevich et al., 2009). Obesity is more common in the middle-aged group, particularly people from higher socio-economic status and those living in urban areas. By the end of 2010, more than 1.4 billion cases of obesity are reported worldwide and about 400 million adults are overweight (WHO, 2011).

On the other hand, the existence of undernutrition is also another cause of concern. The double burden of malnutrition is characterized by the coexistence of undernutrition along with overweight and obesity, or diet-related non-communicable diseases, within individuals, households' population, and across all life courses. In the context of changing global nutrition landscape, impact by economic and income growth, urbanization, demographic transition along with globalization, the influence of diet-related epidemiology has seen substantial changes recently.

In 2014, the World Health Organization (WHO) reported that there are more than 1.9 billion of ages 18 years and older was overweight, while 462 million were underweight. More than 600 million were obese. In the same year, 42 million children under the age of five were overweight or obese but 156 million were affected by stunting (low height-for-age). About 50 million children were affected by wasting (low weight-for-height). Poor nutrition continues to cause nearly half of deaths in children under five, while low and middle-income countries now witness a simultaneous rise in childhood overweight and obesity increasing at a rate 30% faster than in richer nations.

Kabir et al., (1995) define infant mortality as "mortality or death during the first year of life" and child mortality as "mortality or death during the age of 1 to 4 years. UNICEF also define infant mortality rate as "the probability of dying between birth and exactly one year of age expressed per 1000 live births". On the other hand, child mortality is "the probability of dying between birth and below five years of age expressed per 1000 live births".

With the Geneva Declaration of the Rights of the Child in 1959, followed by the declaration of the year 1979 as "International Year of the Child" by United Nations, attention of the social scientists and other demographer focused more on the issue of family planning and the possible causes of child mortality. Since then, research on child mortality which is one of the ultimate demographic parameters to understand population growth and structure has gained tremendous momentum. Even today, India is no exception concerning the high rate of infant and child mortality.

Mortality is the permanent disappearance of all evidence of life at any time after birth has taken place. Infant and child mortality has received renewed attention as part of the United Nation's Millennium Development Goals. Approximately 10 million infants and children under five years of age die each year, with large variations in under-five mortality rates and trends, across regions and countries (Espo, 2002). Still, in 2013, about 4.6 million infant deaths accounting roughly 74% of Under Five year's mortality occurred within the first year of life. Globally, the infant mortality rate has decreased from an estimated rate of 63 deaths per 1000 live births in 1990 to 34 deaths per 1000 live births in 2013. There is also remarkable progress as annual infant deaths have declined from 8.9 million in 1990 to 4.6 million in 2013 (WHO, 2013). Outwardly, to terminate infant and child mortality appear futile efforts, however, to reduce at the minimum level is a pragmatic realization. Therefore, irrespective of various ethnic backgrounds, it is indispensable for any society to speculate the causes and effect from the grassroots level. Besides, to illustrate and retrospect the health status of women, particularly for the development of their children and their related family responsibilities themselves is also another cause for concern particularly for developing nations like India.

The present study was executed among the Zou, a hill people of the Manipur state of North East India. The Zou/Zo literally 'hilly' or 'Highlander' is a Mongoloid stock speaking Tibeto-Burman language. Its origin is believed to be from Indo-Chinese origin from a 'cave' known as 'Khul' in Zou or 'Chhinlung' or 'Sinlung' in Mizo and Hmar respectively referring to the same place. The

staple food of Zou is rice mostly cultivated on the hilly terrain of Manipur. The Zou mothers of Manipur are hardworking population practicing agrarian culture. Though there are few mothers who run small business apart from getting employment in private and government sectors, the majority of the participants engage in agricultural activities.

Objectives

The basic aim of this paper is to evaluate the influence of obesity, hypertension and morbidity of the mothers on infant and child mortality among the Zou of Manipur.

Materials and method

The present study was conducted among 533 married Zou women of Churachandpur District, Manipur. Data collection was conducted from January 2016 to February 2017. According to the 2011 census of India, the Zou population in Manipur is 30,567 persons and is the tenth largest Scheduled Tribe population in the state. A cross-sectional study was conducted among seven different Zou villages from the rural areas along with six urban locations where the Zou population is predominant.

Data on an anthropometric measurements such as height and body weight were collected using anthropometer and a portable weighing machine. An anthropometer rod was used to measure the height (in cm) with a precision of 1mm. Weight was recorded to the nearest 0.1 kilograms by weighing machine with minimum clothing. Body Mass Index (BMI) was calculated using the formula weight in kilograms / (height in meter2). To calculate the value of BMI, the value of height and weight were taken using standard protocols given by WHO for Asian population cut-off points (Normal BMI >18.5; overweight BMI>23; obese BMI>27.5) (WHO 2000). Physiological parameter like BP is measured using digital sphygmomanometer. The subject sat relaxed in a chair with his arm supported comfortably and the pressure cuff was applied close to the upper arm. The blood pressure of each participant was recorded after taking twice or thrice in about five-minute interval. For the classification of blood pressure, the 'Seventh Report of the Joint National Committee' (2003) on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (normal BP is <120/80 mmHg, Prehypertension is between 120-139/80-89 mmHg, Hypertension Stage I as 140-159/90-99 mmHg, and Hypertension Stage II as ≥160/100 mmHg) has been used as a standard protocol for the present study.

Statistical Analysis

For statistical analysis, correlation test, t-test, regression analysis, etc. have been employed. Besides calculating manually, most of the analyses were done in MS-excel software (Microsoft Company, 2010 version) and IBM developed software SPSS version 20.

Results

The influence of mothers' obesity, hypertension and morbidity on infant and child mortality among the Zou community can be described from the following tables.

Table 1: Infant and child mortality by BMI categories of the mothers

BMI Categories	No of mothers	Live birth	Mortality rate (per 100 live birth)		
			Infant (%)	Child (%)	Total (%)
Under weight	43	123	6 (4.87)	2 (1.63)	8(6.50)
Normal weight	292	920	29 (3.15)	19 (2.06)	48(5.22)
Over weight	142	418	11 (2.63)	4(0.95)	15(3.58)
Obese	56	192	5 (2.60)	4 (2.08)	9(4.68)
Coefficient correlation (r)			-.029	-.015	-.032

Table 1 shows the infant and child mortality rate by BMI categories of Zou mothers. In general, it shows that the infant and child mortality rate is inversely related to the increase in mothers BMI categories. There is a negative correlation in infant mortality rate with rising BMI though it is found to be statistically insignificant ($r = -.029$, $p > 0.05$). Interestingly, the infant mortality rate is found to be highest among the underweight category (4.87%) and least among obese category (2.60%). Besides, normal weight and overweight categories consist of 3.15% and 2.63% infant mortality rate respectively. On the other hand, the child mortality rate varies from 2.08% among obese category to 0.95% among the overweight category. It also shows that a considerable concentration of 2.06% and 1.63% child mortality rate is from normal weight and underweight category respectively. The correlation test shows that it is statically insignificant ($r=-.015$ $p > 0.05$). The overall infant and child mortality rate vary from 6.50% among the underweight category which is found to be the highest concentration to 3.52% among the overweight category. Normal weight shows about 5.22% infant and child mortality rate and about 4.68% is from the obese category. The overall infant and child mortality show that there is negative correlation which is not statically significant ($r = -.032$, $p>0.05$).

Table 2: Infant and child mortality by Blood pressure of the mothers

Blood Pressure Categories	No. of mothers	Live birth	Mortality rate (per 100 live birth)		
			Infant (%)	Child (%)	Total (%)
Systolic Blood pressure					
Normal (<120 mmHg)	407	1251	36 (2.87)	20 (1.59)	56 (4.47)
Prehypertension (120-139 mm Hg)	109	337	10 (2.96)	8 (2.37)	18 (5.34)
Hypertension stage I (140- 159 mmHg)	10	37	5 (13.51)	0 (0.00)	5 (13.51)
Hypertension stage II (≥160 mmHg)	7	28	0 (0.00)	1 (3.57)	1 (3.57)
Coefficient correlation (r)			.018	.029	.032
Diastolic Blood Pressure					
Normal (<80 mmHg)	367	1092	32 (2.93)	16 (1.46)	48 (4.39)
Prehypertension (80-89 mm Hg)	114	361	8 (2.22)	5 (1.38)	13 (3.60)
Hypertension stage I (90- 99 mmHg)	36	136	8 (5.88)	5 (3.67)	13 (9.56)
Hypertension stage II (≥100 mmHg)	16	64	3 (4.68)	3 (4.68)	6 (9.37)
Coefficient correlation (r)			.037	.067	.071

Table 2 shows the infant and child mortality rate by blood pressure of the mothers. It shows a positive correlation along with rising BP categories. In case of Systolic Blood Pressure (SBP), infant mortality rate ranges from nil among Hypertension stage II to 13.51% among Hypertension stage I. Hypertension constitute 2.96% infant mortality rate and Normal constitute 2.87%. Though the infant mortality rate shows a positive correlation with increasing SBP, it is found to be statistically

insignificant ($r= .018$, $p> 0.05$). The child mortality ranges from nil in Hypertension stage I to 3.57% among Hypertension stage II of the mothers. Normal categories constitute about 1.59% and Prehypertension consists of about 2.37% infant mortality rate. It also shows that child mortality is statically insignificant ($r=.029$, $p> 0.05$). The overall infant and child mortality range from 3.57% in Hypertension stage II to 13.51% among Hypertension stage I. Overall infant and child mortality rate in Normal SBP and Prehypertension category constitute 4.47% and 5.34% respectively. Total Infant and child mortality rate also show that there is positive correlation along with the BP categories which, however, is found to be statically insignificant ($r=.032$, $p>0.05$).

In the case of Diastolic Blood Pressure (DBP), infant mortality rate ranges from 2.22% in Prehypertension to 5.88% in Hypertension state I categories. Normal category constitutes 2.93% and Hypertension state II constitutes 4.68% of infant mortality rate. It also shows that there is a positive correlation between infant mortality with rising BP categories, the however statistical test shows that it is insignificant ($r=.037$, $p> 0.05$). The child mortality rate in case of DBP ranges from 1.38% in Prehypertension to 4.68% among Hypertension stage II. Normal category constitutes about 1.46% and Hypertension stage I constitutes a 3.67% child mortality rate. Statistical analysis shows that there is positive correlation though it is statically insignificant ($r=.067$, $P>0.05$). The overall infant and child mortality in case of DBP range from 3.60% among Prehypertension to 9.56% in Hypertension stage I. Normal category comprise 4.39% and Hypertension stage II constitute about 9.37% of the overall child mortality rate. Through there is positive correlation along with the DBP categories, it is found to be statically insignificant ($r=.071$, $p> 0.05$).

Table 3: Infant and child mortality based on mother self-reported morbidity

Health problems	No. of mothers	Live birth	Mortality rate (per 100 live birth)		
			Infant (%)	Child (%)	Total (%)
Cardiovascular diseases	118	430	15 (3.48)	7 (1.63)	22 (5.11)
Gastric disorder*	269	913	29 (3.17)	21 (2.30)	50 (5.47)
Diabetes	7	23	0 (0.00)	2 (8.69)	2 (8.69)
Tuberculosis	35	125	5 (4.00)	3 (2.4)	8 (6.4)
Blood issues	78	278	10 (3.59)	8 (2.87)	18 (6.47)
Malaria	32	138	5 (3.62)	2 (1.45)	7 (5.07)
Others**	6	27	1 (3.70)	0 (0.00)	1 (3.70)

*Gastric disorder- includes stomach-ache, chronic dysentery, etc.

**Others- include typhoid, chronic pelvic pain, and pneumonia

Table 3 shows the distribution of infant and child mortality rate against major self- reported health problem of the mothers. The infant mortality rate is found to be highest (4.00%) among those who suffer from Tuberculosis followed by Others (3.70%), Malaria (3.62%), Blood issues (3.59%), Cardiovascular diseases (3.48%), Gastric disorders (3.17%) and nil in Diabetes. The child mortality shows that the highest mortality is found among Diabetes (8.69%) which is opposite in case of infant mortality, followed by Blood issues (2.87%), Tuberculosis (2.40%), Gastric disorder (2.30%), Cardiovascular diseases (1.63%) and absent among Others diseases category. The overall infant and child mortality rate shows that it is found to be highest among Diabetic mothers (8.69%), followed by Blood issues (6.47%), Tuberculosis (6.40%), Gastric disorder (5.47%), Cardiovascular diseases (5.11%), Malaria (5.07%) and Others (3.70%).

Table 4: Infant and child mortality by major/chronic morbidity of the mothers

Morbidity frequency***	No. of mothers	Live birth	Mortality rate (per 100 live birth)		
			Infant (%)	Child (%)	Total (%)
0	182	468	15 (3.20)	5 (1.06)	20 (4.27)
1	210	665	15 (2.25)	8 (1.20)	23 (3.45)
2	96	344	12 (3.48)	14 (4.10)	26 (7.55)
3	36	131	8 (6.10)	1 (0.76)	9 (6.87)
4	9	45	1 (2.22)	1 (2.22)	2 (4.44)
Coefficient correlation (r)			.077	.086*	.113**

*P< 0.05, ** p< 0.01

*** includes cardiovascular disease, gastric disorder, malaria, tuberculosis, blood issue

Table 4 shows the infant and child mortality rate against the frequency of major/chronic morbidity of the mothers. It shows that infant mortality rate ranges from 2.25% among who suffer major ailment once to 6.10% among who suffer at least three major/chronic diseases. The infant mortality rate is found to be 2.22%, 3.20% and 3.48% among mothers who suffer four times, none and twice respectively in their married life. Though there is a positive correlation along with the increasing frequency of morbidity, the statistical test shows that it is insignificant (r=.077, P>0.05). The child mortality rate ranges from 0.76% among mothers who suffer at least three major diseases to 4.10% among who suffer at least twice major health problem. The lower child mortality rate is found among mothers who did not suffer (1.06%) from any major health problems in their married life and mothers who suffer only once (3.45%). Coefficient correlation shows that there is positive correlation which is found to be statistically significant (r=.086, p< 0.01). The overall infant and child mortality range from 3.45% among mothers who suffer only once to 7.55% among mothers who suffer at least twice major/chronic health problems. Mothers who never suffer from any major disease constitutes 4.27%, followed by 4.44% among mothers who suffer at least four major health problem and 6.87% from mothers who suffer at least thrice major/chronic health problems. Statistical correlation test shows that there is a strong positive correlation with the increasing frequency of health morbidity which is found to be highly significant (r=.113, p<0.01).Table 5: Infant and child mortality by obstetric morbidity during pregnancy (based on last child birth) of the mothers

Table 5: Infant and child mortality by obstetric morbidity during pregnancy (based on last child birth) of the mothers

Major ailment	No. of mothers	Live birth	Mortality rate (per 100 live birth)		
			Infant (%)	Child (%)	Total (%)
Swelling of feet/hand	118	413	15 (3.63)	5 (1.21)	20 (4.84)
Visual disturbances	20	67	9 (13.43)	0 (0.00)	9 (13.43)
Dizziness	50	102	10 (9.80)	3 (2.94)	13 (12.74)
Weakness/tiredness	35	131	2 (1.53)	0 (0.00)	2 (1.53)
Convulsion	13	61	2 (3.28)	1 (1.64)	3 (4.92)
Paleness	18	70	2 (2.86)	0 (0.00)	2 (2.85)
Cold/fever	12	37	1 (2.70)	1 (2.70)	2 (5.40)
Bleeding	6	17	1 (5.88)	2 (11.76)	3 (17.64)
Others*	44	147	6 (4.08)	3 (2.04)	9 (6.12)

*includes number of mothers who suffered from at least two of the mentioned categories of major ailment

Table 5 shows the prevalence of morbidity during pregnancy of the mother against the corresponding infant and child mortality. Infant mortality rate is found to be highest among the Visual disturbances (13.43%) followed by Dizziness (9.80%), Bleeding during pregnancy (5.88%), Others category (4.08 %), Swelling of feet/hands (3.63%), Convulsion (3.28%), Paleness (2.86%), Cold and fever (2.70%) and Weakness/tiredness (1.53%) during pregnancy. In case of child mortality, the highest frequency distribution is found among the Bleeding category during pregnancy (2.70%) followed by Dizziness (2.94%), Cold/fever (2.70%), Others category (2.04%), Convulsion (1.64%), Swelling of feet/hands (1.21%) and nil among the Visual disturbances. The overall infant and child mortality is found to be highest among the Bleeding category (17.64%) followed by Visual disturbances (13.43%), Dizziness (12.74%), Others category (6.12%), Cold/fever (5.40%), Convulsion (4.92%), Swelling of feet/hands (4.84%), Paleness (2.85%) and Weakness/tiredness (1.53%) at the least.

Table 6: Coefficients of the logistic regression of morbidity frequency of the Zou mothers on independent factors

Parameters	Coefficient of Regression (B) and its Standard Error	t- value	P- level
Morbidity	B ± SE		
Body Mass Index	-.050 ± .008	- 6.227	Significant at 1%
Systolic Blood Pressure	.004 ± .005	.766	Insignificant
Diastolic Blood Pressure	-.002 ± .006	-.350	Insignificant
Infant mortality	.177 ± .123	1.438	Insignificant
Child mortality	.328 ± .157	2.096	Significant at 5%
Constant	1.720 ± .413	4.168	Significant at 1%

Table 6 shows the logistic regression of the morbidity of Zou mothers. It shows that in some of the independent variables, the coefficient of regression (B) is negatively associated with BMI index (B=-6.227, p < 0.01), but there is a positive association with other independents factors like child mortality (B=.328±.157, p< 0.05) and constant (B= 1.720±.413, p< 0.01). In other words, the morbidity of the mother is likely to decrease with the decrease in BMI of the mothers. However, the mortality rate of the children is influenced by the morbidity of the mothers as highlighted in the table. These two independent factors appear to be the most important factors.

Summary and Conclusion

TThough the prevalence of obesity and its related cardiovascular diseases is influenced by genetic heredity in some cases, it is mostly due to the consumption of nutritious food substances and uncontrolled dietary habits. On the contrary, undernutrition can also influence a mother's well-being which can indirectly influence the child health from pregnancy to delivery and even thereafter. Several chronic diseases affecting women are also risk factors for poor pregnancy outcomes. These factors may have hereditary and environmental predispositions that affect women across generations. Barker et al. (1989) identified an inverse relationship between fetal/placental size and hypertension and ischemic heart disease. The influence of mother's obesity, hypertension and morbidity could be seen among the Zou children as well.

In general, the Zous are hilly inhabitants living across Indo-Myanmar border practicing mostly Jhum cultivation. The present finding seems to be consistent with the considerable occurrence of

underweight mothers. Accordingly, infant mortality seems to be highest among the underweight category and the least is found among the obese category. Though there is a negative association between BMI and infant mortality, statistical analysis shows that it is insignificant. The overall infant and child mortality also show that there is a negative correlation among the higher BMI categories. Rai et al. (2017) also reported that there is no significant association of infant mortality registered for obese mothers, but maternal underweight was the risk factor for neonatal mortality. The present study among the Zou mothers also shows a similar association with infant mortality. In other words, underweight mothers from the study population have a substantial influence on infant and child mortality.

Dadelszen et al. (2000) meta-analysis finding demonstrated that women with chronic hypertension have an increased risk of low birth weight, preterm birth; antihypertensive treatment was shown to exacerbate these risks, and for every 10 mmHg reduction in blood pressure due to treatment, an average reduction of 145 gram reduction in fetal growth was observed. A similar observation could be seen among the hypertension Taiwanese women who have a higher risk of delivering low birth weight infants giving rise to a higher rate of mortality. However, it appears that the observed decreased mortality in infants born to mothers with hypertension is not related to hypertension, but is due to an increased risk resulting from other causes of growth restriction and preterm birth (McBride, 2016). Chen's (2006) finding shows that pregnancy-induced hypertension appears to effectively reduce the infant mortality rate. In contrast, the present finding shows that the Blood Pressure of the mother could have a potential contribution to infant and child mortality. The highest number of infant mortality is found in the Hypertension category. However, statistical analysis shows that it is insignificant though there is a positive correlation between infant and child mortality with higher categories of BP classification.

The present study also shows that there is an association between the morbidity of the mother and infant and child mortality. It displays that the highest occurrence of infant and child mortality is found among the diabetic patients and the least among 'others category' consisting mostly typhoid, chronic pelvic pain and pneumonia. This further illustrates that there is less association with infant and child mortality with such health-related problems. Romagosa et al. (2007), shows that malaria infection during pregnancy has been said to cause infant mortality indirectly through its contribution to low birth weight and premature delivery. Similar cases could be found from the present study population. The correlation test shows that there is a positive association with infant and child mortality with mother's health which is found to be highly significant. The present study also demonstrates that there is a positive association between the frequency of major/chronic morbidity of the mother and infant and child mortality. The number of morbidity of a mother who suffers more than one major health issues appears to have a higher number of child mortality. This further illustrates that there is an association with the health condition of the mother and her children health related problems. The statistical test shows that there is a positive correlation between the frequency of a mother's major morbidity and the number of infant and child mortality which is found to be highly significant.

The present population study highlights a new dimension about the relationship of a Zou mother's nutritional status and the influence of infant and child mortality from a maternal health's perspective. Underweight mothers appear to have an indirect influence on their children health status as reflected in infant and child mortality rate. Though there are other findings of the ill effects of children of obese mothers during pregnancy and its consequences even at infancy stages to children in other population studies, the present finding shows a negative correlation with rising BMI categories of the mothers. As for mothers' morbidity, the frequency of a mother major/chronic morbidity and type of morbidity has a positive correlation on infant and child mortality rate. This finding may have significant impacts

on infant and child mortality in the study population. In general, the prevalence of infant and child mortality may be unavoidable but we can certainly minimize it. The considerable prevalence of underweight mothers indirectly highlighted the socio-economic status of the study population. This could lead to a poor health condition of the mother which indirectly may affect a child's development right from the stage of conception.

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