Anthropological Review • Vol. 84(1), 73–83 (2021)

Anthropological Review
Available online at: https://doi.org/10.2478/anre-2021-0004

Obstetric history and its association with cardiometabolic risk factors: a case-control study among Bhil Women of Rajasthan, India

Savitesh Kushwaha[1], Jyoti Mishra[2], Prakash Ranjan Mondal[3]

[1]Department of Community Medicine and School of Public Health, Post Graduate Institute of Medical Education and Research, Chandigarh, India
[2]Lady Hardinge Medical College & Smt. Sucheta Kriplani Hospital, New Delhi, India
[3]Department of Anthropology, University of Delhi, New Delhi, India

Abstract: Pregnancy and childbearing are special reproductive events having an impact on women's health and demographic trends. Reproductive health is not only linked to biological events of gestation and birth, but also are intricately linked to women`s status and their role in society. The current study focuses on the impact of bad obstetric history in the development of cardiometabolic risk factors. The present retrospective case-control study was conducted among Bhil tribal women of Rajasthan, India. A total of 287 women participated in this study which included 125 cases and 162 controls. Data on somatometric measurements, physiological measurements and lipid profile were recorded and analysed using SPSS version 25.0. The mean number of conceptions differed significantly between pregnancy in cases (5.06±1.85) and pregnancy in controls (3.19±1.56). Cases were characterised with significantly increased mean SBP (p=0.010), although the values (116.68±23.04) fell within the normal range. Bad obstetric history was found to be a risk factor for central obesity, hypertension and dyslipidemia among the Bhil women. It was also found to be relatively associated with adverse demographic/lifestyle variables which could enhance the effect of cardiometabolic risk factors. Women with bad obstetric history need special care and lifestyle variables need to be adjusted for better health outputs.

Key words: cardiometabolic diseases, obstetric history, reproductive health, women health.

Introduction

Reproductive health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (WHO 2008). Reproductive health addresses the reproductive processes, functions and system at all stages

Original Research Article Received: January 18, 2021; Revised: February 11, 2021; Accepted: February 11, 2021
DOI: 10.2478/anre-2021-0004

of life (Tobergte and Curtis 2004). Additionally, it focuses on the reproductive behaviour of men and women and provides means for addressing health and population issues. Therefore, reproductive health implies that people can have a safe and satisfying sex life; the ability to reproduce; and the right to decide if, when, and how frequently to reproduce. Pregnancy and childbearing are special reproductive events having an impact on women's health and demographic trends. Reproductive health is not only linked to biological events of gestation and birth but also are intricately linked to women`s status and their role in society (Dawoodani 2013). Womens' general well-being is optimised when all the elements of reproductive health improve in tandem. The five main components of sexual and reproductive health care are the development of antenatal, perinatal, postpartum, and new-born care; provision of high-quality facilities for family planning, including infertility services; removal of unsafe abortions; prevention and treatment of sexually transmitted diseases, including HIV (human immunodeficiency virus), reproductive tract infections cervical cancer, and other gynaecological morbidities; and promotion of health and sexuality (Glasier et al. 2006). Nearly 3 hundred thousand women die every year globally due to pregnancy-related complications like severe bleeding, sepsis, eclampsia, obstructed labour and unsafe abortions ("Trends in maternal mortality: 1990 to 2015: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. Geneva: World Health Organization; 2015." 2015). Also, obesity is the most common disorder associated with the menopausal transition (Karvonen-Gutierrez and Kim 2016). Furthermore, children born to obese mothers are at increased risk of long-term morbidity (Fitzsimons et al. 2009). Critical care is required to manage hypertension during pregnancy (Vincent and Frise 2018). Dyslipidemia during pregnancy is found to be associated with the onset of gestational diabetes mellitus, pre-eclampsia, preterm birth, growth retardation and hormonal imbalance (Edison et al. 2007; Hollingsworth and Grundy 1982; Hubel et al. 1996; Sanchez-Vera et al. 2007; Vrijkotte et al. 2011; Wiznitzer et al. 2009). Women who have increased lipid levels including those of LDL-C (low density lipoprotein) and apolipoprotein B, have an a higher risk of having a child with CHD (congenital heart defects) (Ba et al. 2017).

The reproductive health of women in some states of India has considerably improved in the past two decades ("Why are women's health outcomes in India so poor? – The Hindu BusinessLine"). Data from the various sources validate this statement. In India, the reproductive health status of men and women is deeply bound to social, cultural, and economic factors that influence several aspects of life. As per the data of NITI (National Institute for Transforming India) aayog, the MMR (maternal mortality Ratio) was reduced up to 130 in the year 2014–2016 from 167 in the year 2011–2013 ("Maternal Mortality Ratio (MMR) (per 100000 live births) | NITI Aayog"). Several studies have shown that Indian tribal women lack educational resources and knowledge regarding their reproductive health (Chandraker et al. 2017; Geetha et al. 2017; Jejeebhoy 2007; Saha et al. 2007). Indian women are generally vulnerable to poor nutrition and lactation. It has been reported that the effect of maternal nutritional status on birth weight is more predominant than other factors (Dharmalingam et al. 2010). Womens' poverty, low socioeconomic status, gender discrimination, reproductive role and behaviour not only subjects women to various diseases but also limits their access to health services and developmental programs (Sanneving et al. 2013).

The present study was conducted in order to examine the association between obstetric history and cardiometabolic risk factors among Bhil women of Rajasthan, India. This study has also shown the influence of demographic/lifestyle variables in modifying cardiometabolic risk factors in women with bad obstetric history. The Bhils (tribe) have an agriculture-based economy and Bhil women mainly work in the fields and their homes. Due to below-average socioeconomic status, Bhil women are more exposed to cardiometabolic diseases.

Materials and Methods

The present retrospective case-control study, was conducted in two districts (Sirohi and Udaipur) of Rajasthan, India for a period of 4 months (December 2014 to March 2015). The sample size was n=480, using G-Power software with effect size, d=0.33. The initial screening was organised for 600 randomly selected participants/women, while 480 of them provided consent for participation in this study. The collected sample was categorised into case and control group. After excluding participants, who left the

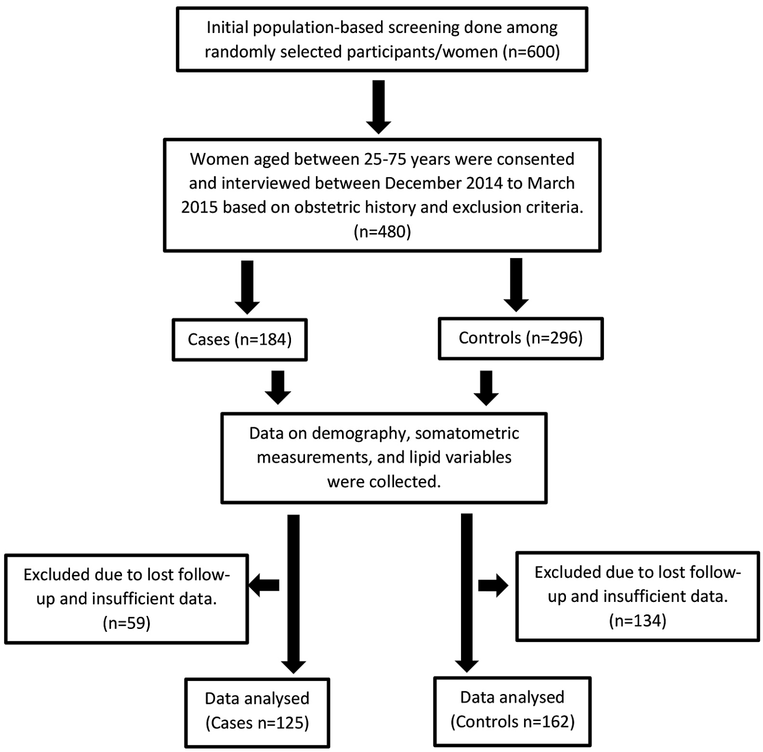

Fig. 1. STROBE Flowchart of study methodology

study, the data were obtained from 287 women aged 25–75 years who were unrelated up to their first cousin (cases=125, controls=167) (Fig. 1). Women having a bad obstetric history (still birth, miscarriage, fetal death, pre-term delivery, neonatal deaths, and neonatal anomalies) or whose child had died within 5 years of birth, irrespective of the pregnancy order were placed in the case group. The control group consisted of women who had successful pregnancy outcomes (i.e., no bad obstetric history). Pregnant women and women suffering from chronic diseases or those from cardiometabolic diseases such as chronic arterial diseases, myocardial infarction, arteriosclerosis, heart attack, angina, and ischemic heart diseases were excluded from the present study. Details on lifestyle/demographic variables were obtained. Those women having history of smoking (any tobacco products) and alcohol consumption were considered as smokers and alcoholics respectively. A women was considered as being literate if she had attended any educational institution, was employed or if she had any source of income. The Somatometric measurements like height, weight, hip circumference, and waist circumference were taken. Physiological variables were also included like blood pressure (systolic blood pressure (SBP) and diastolic blood pressure (DBP)) and pulse rate. Intravenous blood sample (2ml) was taken for lipid profiling. Ethical clearance was obtained from the Ethical Committee of the Department of Anthropology, University of Delhi, India.

Statistical analysis

The descriptive statistics were used to determine the distribution of data. Chi-square test was conducted for categorical variables. Two-tailed t-test was conducted on normally distributed data between cases and control group. The odds ratio (O.R.) was determined for risk estimation among the distribution of various parameters between cases and controls. The probability (p) value for alpha (α)<0.05 is considered as statistically significant for all statistical tests. Statistical analysis was done using SPSS 25.0 version.

Guidelines followed: – BMI (Body Mass Index), WHR (Waist Hip Ratio) and WC (Waist Circumference) (Committee 2000) – World Health Organisation; SBP/DBP (Hypertension) (Chobanian et al. 2003) – JNC 7; Lipid Variables – TC, (Total Cholesterol, Triglyceride, HDL-C (High density lipoprotein cholesterol), LDL-C (Low density lipoprotein Cholesterol), VLDL (Very Low-Density Lipoprotein), Non-HDLC (non-HDL cholesterol) (Pasternak 2002) – NCEP-ATP III

Results

A total of 287 samples were collected which varied within the variables. The samples details were tabulated according to the demographic, somatometric (anthropometric) and biochemical variables. A higher number of women were educated (24.7%) and a smaller number of women were consuming alcohol (alcoholic) (2.5%) in the control group. The smokers (19.2%) and unemployed (52.8%) were more prevalent among cases (Table 1).

These differences however, were not found to be significant. However, the relative differences indicated the influence of negative variables (alcoholic, unemployed, smoking, and illiteracy) in the case group. The total mean age of the present population was 43.43±12.26 years, whereas the mean age of cases and controls was 47.10±11.86 years and 40.60±11.84 years respectively. Women in the case group were younger at 1st conception (17.89±2.88 years) as compared to the control group. (18.77±4.01 years). However, this difference was not statistically significant. The mean value of the number of pregnancies was high in the case group and was a statistically significant difference when compared with the control group. The mean BMI, WHR and WC were 22.64±4.84, 0.90±0.13 and 82.65±15.42 cm in the case group and 22.93±5.19, 0.89±0.13 and 81.16±12.96 cm in the control group respectively. The mean value for SBP in the case and control groups was 116.68±23.04 mmHg and 110.05±19.12 mmHg respectively. This difference was statistically significant. The mean DBP value was higher in the case group (78.37±13.70 mmHg) when compared with the control group (75.47±12.25 mmHg). However, this difference was not statistically significant. The socio-demographic variables seemed to influence SBP and DBP in the present study. Both SBP and DBP values fell within the normal range in both case and control groups. The mean TC was 151.41±44.42 mg/dl and 154.18±45.95 mg/dl among case group and control group respectively. The mean TG levels were 138.87±49.27 mg/dl in case group and 129.36±42.52 mg/dl in the control group. HDL-C was approximately equal among both case (46.61±13.36 mg/dl) and control groups (46.56±12.49 mg/dl) and falls in the abnormal range. The mean LDL was found to be higher in the control group (81.73±48.30 mg/dl) than cases (77.28±44.08 mg/dl). The mean VLDL was higher in the case group (27.77±9.85 mg/dl) than the control group (25.87±8.50 mg/dl). The mean Non-HDLC values were higher in control group (107.61±46.72 mg/dl) as compared to the case group (104.80±44.24 mg/dl). Both case and control groups were not found to differ statistically w.r.t. TG, TC, HDL-C, LDL, VLDL and Non-HDLC.

The mean levels of HDL-C and VLDL were found to be abnormal among both case and control groups (Table 2).

Those women who had a poor obstetric history were more likely to have had higher WC (OR=1.00, *p*=0.99), WHR (OR=1.46, *p*=0.25), and Hypertension (OR=1.94, *p*=0.10), except for BMI (Body Mass Index), where odds for having underweight (OR=0.92, *p*=0.0.78), overweight (OR=0.87, *p*=0.73), and

Table 1. The demographic and lifestyle characteristics of Bhil women of Rajasthan

Variables		Cases (n=125)	Controls (n=162)	Total (n=287)	Chi-Square *p*–value
Literacy	Literate	29 (23.2)	40 (24.7)	69 (24.1)	0.717
	Illiterate	96 (76.8)	122 (75.3)	218 (75.9)	
Alcohol	Alcoholic	7 (5.6)	4 (2.5)	11 (4.1)	0.289[a]
	Non- Alcoholic	118 (94.4)	158 (97.5)	276 (95.9)	
Smoking	Smoker	24 (19.2)	24 (14.8)	48 (17.0)	0.324
	Non-Smokers	101 (80.0)	138 (85.2)	239 (83.0)	
Occupation	Employed	59 (47.2)	83 (51.2)	142 (49.2)	0.498
	Unemployed	66 (52.8)	79 (48.8)	145 (50.8)	

Statistically significant at $p<0.05$; [a] = Yate's correction; Values in parentheses depict percentages.

Table 2. Somatometric (anthropometric), physiological and biochemical variables among Bhil women of Rajasthan

Variables	Total Mean±SD	Cases Mean±SD	Controls Mean±SD	*t*-test *p*-value
Age (years)	43.43±12.26	47.10±11.86	40.60±11.84	<0.0001
Age at 1st conception	18.39±3.60	17.89±2.88	18.77±4.01	0.067
No. of pregnancies	4.01±1.93	5.06±1.85	3.19±1.56	<0.0001
BMI[a] (Kg/m)	22.80±5.03	22.64±4.84	22.93±5.19	0.626
WHR[b]	0.89±0.12	0.90±0.13	0.89±0.13	0.817
WC[c] (cm)	81.81±14.08	82.65±15.42	81.16±12.96	0.381
SBP[d] (mmHg)	112.95±21.14	116.68±23.04	110.05±19.12	0.010
DBP[e] (mmHg)	76.73±12.96	78.37±13.70	75.47±12.25	0.067
TC[f] (mg/dl)	153±45.21	151.41±44.42	154.18±45.95	0.671
TGg (mg/dl)	133.37±45.61	138.87±49.27	129.36±42.52	0.147
HDL-C (mg/dl)	46.58±12.82	46.61±13.36	46.56±12.49	0.980
LDL (mg/dl)	79.88±46.50	77.28±44.08	81.73±48.30	0.501
VLDL (mg/dl)	26.67±9.12	27.77±9.85	25.87±8.50	0.147
Non-HDLC (mg/dl)	106.42±45.60	104.80±44.24	107.61±46.72	0.668

Reference values: [a]BMI 18.5-22.9 kg/m^2, [b]WHR <0.80, [c]WC <80, [d]SBP <120, [e]DBP <80, [f]TC <200, [g]TGg<150, [h]HDL-C>50, [i]LDL<130, [j]VLDL<30, [k]Non-HDLC<130.

Table 3. Odds ratio (OR) and 95% confidence interval (95%CI) for somatometric (anthropometric), and physiological variables by cases and controls distribution

Variable	Level	Cases	Controls	OR (95% CI)	*p*-value
BMI (kg/m^2) Cases: 122, Controls: 155, n=276	Normal 18.5–22.9	49 (40.5)	58 (37.4)	Reference	
	Underweight <18.5	24 (19.8)	31 (20.0)	0.91 (0.48–1.76)	0.794
	Overweight 23–24.9	14 (11.6)	19 (12.3)	0.87 (0.40–1.91)	0.734
	Obese ≥25	34 (28.1)	47 (30.3)	0.86 (0.48–1.53)	0.602
WC (cm) Cases: 122, Controls: 157, n=279	Normal <80	59 (48.4)	76 (48.4)	Reference	
	Abnormal ≥80	63 (51.63)	81 (51.59)	1.00 (0.62–1.61)	0.994
WHR Cases: 122, Controls: 157, n=279	Normal <0.80	17 (13.9)	30 (19.1)	Reference	
	Abnormal ≥0.80	105 (86.1)	127 (80.9)	1.46 (0.76–2.79)	0.254
Hypertension (SBP/DBP) mm/Hg Cases: 119, Controls: 153, n=272	Normal 120/80	62 (52.1)	98 (64.0)	Reference	
	Pre–HTN 120–139/80–89	41 (34.4)	42 (27.4)	1.54 (0.90–2.63)	0.112
	HTN Stage 1+Stage 2 >140/>90	16 (13.4)	13 (8.5)	1.94 (0.88–4.32)	0.102

Abbreviations: Pre-NTH, prehypertension, HTN, hypertension. Values in parentheses depict percentages and 95% CI, as mentioned.

Table 4. Odds ratio (OR) and 95% confidence interval (95%CI) for biochemical variables for cases and controls distribution

Variable	Level	Cases n=84	Controls n=115	OR (95% CI)	*p*-value
TC (mg/dl)	Normal<200	81 (96.4)	107 (93.0)	Reference	0.311
	Abnormal≥200	3 (3.6)	8 (7.0)	0.49 (0.13–1.92)	
TG (mg/dl)	Normal50–150	47 (56.0)	76 (66.1)	Reference	0.147
	Abnormal≥150	37 (44.0)	39 (33.9)	1.54 (0.86–2.74)	
HDL-C (mg/dl)	Normal≥50	34 (40.5)	49 (42.6)	Reference	0.763
	Abnormal<50	50 (59.5)	66 (57.4)	1.09 (0.62–1.93)	
LDL (mg/dl)	Normal<130	79 (94.0)	107 (93.0)	Reference	0.777
	Abnormal≥130	5 (6.0)	8 (7.0)	0.85 (0.27–2.69)	
VLDL (mg/dl)	Normal≤30	47 (56.0)	76 (66.1)	Reference	0.147
	Abnormal>30	37 (44.0)	39 (33.9)	1.54 (0.86–2.74)	
Non-HDLC (mg/dl)	Normal<130	67 (79.8)	88 (76.5)	Reference	0.587
	Abnormal≥130	17 (20.2)	27 (23.5)	0.83 (0.47–1.64)	
Dyslipidemia	Normal	22 (26.2)	35 (30.4)	Reference	0.513
	Abnormal	62 (73.8)	80 (69.6)	1.23 (0.66–2.31)	

Values in parentheses depict percentages and 95% CI, as mentioned.

obese (OR=0.86, p=0.60), were fewer in the case group.

Although not significant, odds of developing pre-hypertension (OR=1.54, p=0.11) and hypertension was higher in the case group when compared with the control group (Table 3).

The biochemical variables for cardiometabolic risk showed higher odds for abnormal TG (OR=0.1.54, p=0.15), HDL-C (OR=1.09, p=0.0.76), VLDL (OR=1.54, p=0.15), and dyslipidemia (OR=1.23, p=0.51) in the case group when compared with the control group. Variables like TC (OR=0.49, p=0.31), LDL (OR=0.85, p=0.78), and Non-HDLC (OR=0.83, p=0.59), were less likely to have been abnormal in the case group. Although, these increased and decreased risks were not significant (Table 4).

Discussion

The total literacy in the present population (24.1%) was found to be less than the NSSO all India literacy report, which showed that 61% of rural women to be educated in 2014 (Literacy Rate In India (NSSO And RGI) | data.gov.in). Poor obstetric history among Bhil women can be attributable to the lower mean age at 1st conception and a greater number of conceptions. Adverse lifestyle variables were found to increase the chances for metabolic syndrome (MetS) and cardiometabolic risk (Gonzalez-Chica et al. 2017; Kelishadi et al. 2016; Khalifah-Ourfali et al. 2017). Moderate alcohol consumption was associated with low risk of MetS and favourable lipid levels (Du et al. 2017). In the present study, demographic/lifestyle variables identified the relative association of adverse variables like alcoholic, smoking, illiteracy, and unemployment in the case group. It is likely that these variables might have influenced SBP and DBP in the present study. Nevertheless, SBP and DBP values were within the normal range in both case and control groups. Except for HDL-C, none of the reported mean values of lipid variables exceeded the normal range. Furthermore, our study revealed that few women in the case group exhibited an abnormal range of TC, LDL, Non-HDLC and the others members of population showed the abnormal range of TG, HDL-C, VLDL. This result concurs with other Indian studies (Bhardwaj et al. 2013; Chow et al. 2008; Gupta et al. 1994). Our study also suggests that high TGs and low HDL-C coincided with elevated LDL. Small and dense LDL-Cs was more atherogenic than their large buoyant counterparts (Bradley and Oberg 2008). Our study also identified that poor obstetric history was a risk factor for abnormal TG and HDLC. Studies have suggested atherogenic dyslipidemia to be common among South Asia (Gama et al. 2002; Gupta et al. 1997). Comparable with our study, Bhardwaj et al., (2013) noted that the rural population of Rajasthan was less overweight and obese (NFHS-4) (National Family Health Survey) than the tribal population in the present study. Abdominal obesity was more prominent in the present study in the case group which was probably contributed by alcohol consumption, smoking, high TG and low HDL-C levels and hypertension. It was uncertain whether BMI was an accurate representation of body fat distribution (Townsend et al. 2008). Thus, higher BMI in the control group did not indicate proper body-fat distribution, considering WC and WHR might have been more meaningful. Studies show that pregnancy can be related to hypertension (Hedderson et al. 2012; McDonald et al. 2008), a factor which was also observed in our study. However, this was not statistically significant. In this case, a poor obstetric history could be considered as a risk factor for hypertension among Bhil women of Rajasthan. The modernization of Indian tribal groups has seen a shift in their nutritional consumption status. The demographic transition among present tribal groups, such as the Bhils, might be affecting their nutrition status due to increasing consumption of high fat foods. Food restriction in Indian tribes was specially designed to protect human health, which consequently may have negatively affected pregnant women (Hartini et al. 2005; Santos-Torres and Vasquez-Garibay 2003). However, current food consumption pattern (consumption of processed foods, oily foods, skipping meals, lack of food availability etc.) and lifestyle (lack of physical activity, sedentary life, smoking, alcohol consumption) is estranging tribal people from the benefits of their natural diet, thereby, making it necessary to implement restrictions on non-beneficial dietary resources and promote healthy living.

Study limitations

The women in our study were not tested for any additional disorders like hypertensive disorder of pregnancy, gestational diabetes mellitus, thyroid disease, kidney diseases etc. which are additional parameters for determining cardiometabolic health. We also did not determine whether women were on oral contraceptive pills or not, which may affect cardiometabolic health. The study included both women whose progeny was under 5-years of age or more than 5 years of age. These are two different constraints which should be checked separately for more valid results.

Conclusion

Poor obstetric history is an important risk factor for cardiometabolic health among Bhil women. Proper care should be provided to women with poor obstetric history in order to minimize the risk for cardiometabolic diseases. Poor obstetric history was found to be relatively associated with adverse demographic/lifestyle variables which may enhance cardiometabolic risk factors. Women with a history of poor obstetric history need to modify their lifestyle; second, there should be early screening of their lipid variables in order to check for cardiometabolic diseases. However, studies with a large sample size are required to further validate our study. Additionally, more studies are required to explore post-partum cardiac health of women among different population groups.

Acknowledgements

The authors would like to convey their sincere thanks to DU-DST Purse grant for providing financial assistance. Also, the authors would like to acknowledge the Bhil women who had voluntarily participated in this study.

The Authors' contribution

The study was designed by PRM. Field work was carried out by SK and JM. Analysis and interpretation were conducted by JM and SK. The manuscript was written by SK, PRM and JM. The review of manuscript was conducted by PRM.

Conflict of interest

The authors declare that there is no conflict of interest.

Corresponding author

Prakash Ranjan Mondal, Department of Anthropology, University of Delhi, New Delhi - 110007, India
e-mail: prmondal1@rediffmail.com

References

Ba HJ, Peng HM, Zhu L, Lin YS, Li XD, Li SJ. 2017. Dyslipidemia in pregnancy may contribute to increased risk of congenital heart defects. Int J Clin Exp Med 10:3526–32.

Bhardwaj AK, Kumar D, Raina SK, Bansal P, Bhushan S, Chander V. 2013. Community based assessment of biochemical risk factors for cardiovascular diseases in rural and tribal area of himalayan region, India. Biochem Res Int 696845.

Bradley RD, Oberg EB. 2008. Are additional lipid measures useful? Integr Medi 7:18–23.

Chandraker R, Chakrabarty S, Mitra M, Bharati P. 2017. A Study of Reproductive and Child Health among the Dhur Gond Tribal Community of Mahasamund District, Chhattisgarh, India. Studies of Tribes and Tribals 7(2):97–103.

Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL. 2003. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 Report. JAMA 289:2560–72.

Chow CK, Naidu S, Raju K, Raju R, Joshi R, Sullivan D. 2008. Significant lipid, adiposity and metabolic abnormalities amongst 4535 Indians from a developing region of rural Andhra Pradesh. Atherosclerosis 196(2):943–52.

Committee S. 2000. WHO BMI_ASIA_Guidelines. Steering committee, 1–55. Available at: http://www.wpro.who.int/nutrition/documents/docs/Redefiningobesity.pdf

Dawoodani NA. 2013. Role of women health and reproductive health in women empow-

erment. J Mass Communicat Journalism 3:4. doi: 10.4172/2165-7912.1000157.
Dharmalingam A, Navaneetham K, Krishnakumar CS. 2010. Nutritional status of mothers and low birth weight in India. Matern Child Health J 14(2):290–8.
Du D, Bruno R, Dwyer T, Venn A, Gall S. 2017. Associations between alcohol consumption and cardio-metabolic risk factors in young adults. Eur J Prev Cardiol 24(18):1967–78.
Edison RJ, Berg K, Remaley A, Kelley R, Rotimi C, Stevenson RE, et al. 2007. Adverse birth outcome among mothers with low serum cholesterol. Pediatrics 120(4):723–33.
Fitzsimons KJ, Modder J, Greer IA. 2009. Obesity in pregnancy: risks and management. Obstet Med 2(2):52–62.
Gama R, Elfatih AB, Anderson NR. 2002. Ethnic differences in total and HDL cholesterol concentrations: Caucasians compared with predominantly Punjabi Sikh Indo-Asians. Ann Clin Biochem 39(Pt 6):609–11.
Geetha P, Chenchuprasad C, Sathyavathi RB, Reddy KS, Reddy KK. 2017. Reproductive Health Status of Sugali Tribal Women: A Field Based Study. Studies of Tribes and Tribals 13(1):73–8.
Glasier A, Gulmezoglu AM, Schmid GP, Moreno CG, Van Look PF. 2006. Sexual and reproductive health: a matter of life and death. Lancet 368(9547):1595–607.
Gonzalez-Chica DA, Adams R, Dal Grande E, Avery J, Hay P, Stocks N. 2017. Lower educational level and unemployment increase the impact of cardiometabolic conditions on the quality of life: results of a population-based study in South Australia. Qual Life Res 26(6):1521–30.
Gupta R, Gupta HP, Kumar N, Joshi AK, Gupta VP. 1994. Lipoprotein lipids and the prevalence of hyperlipidaemia in rural India. J Cardiovasc Risk 1(2):179–84.
Gupta R, Prakash H, Kaul V. 1997. Cholesterol lipoproteins, triglycerides, rural-urban differences and prevalence of dyslipidaemia among males in Rajasthan. J Assoc Physicians India 45(4):275–9.
Hartini TN, Padmawati RS, Lindholm L, Surjono A, Winkvist A. 2005. The importance of eating rice: changing food habits among pregnant Indonesian women during the economic crisis. Soc Sci Med 61(1):199–210.
Hedderson MM, Darbinian JA, Sridhar SB, Quesenberry CP. 2012. Prepregnancy cardiometabolic and inflammatory risk factors and subsequent risk of hypertensive disorders of pregnancy. Am J Obstet Gynecol 207(1):68 e61–69.
Hollingsworth DR, Grundy SM. 1982. Pregnancy-associated hypertriglyceridemia in normal and diabetic women. Differences in insulin-dependent, non-insulin-dependent, and gestational diabetes. Diabetes 31(12):1092–7.
Hubel CA, McLaughlin MK, Evans RW, Hauth BA, Sims CJ, Roberts JM. 1996. Fasting serum triglycerides, free fatty acids, and malondialdehyde are increased in preeclampsia, are positively correlated, and decrease within 48 hours post partum. Am J Obstet Gynecol 174(3):975–82.
Jejeebhoy SJ. 2007. Reproductive Health Among Youth In Bihar and Jharkhand | Economic and Political Weekly. Economic and political weekely. Available at: https://www.epw.in/reproductive-health-among-youth-bihar-and-jharkhand
Karvonen-Gutierrez C, Kim C. 2016. Association of Mid-Life Changes in Body Size, Body Composition and Obesity Status with the Menopausal Transition. Healthcare (Basel) 4(3):42.
Kelishadi R, Noori A, Qorbani M, Rahimzadeh S, Djalalinia S, Shafiee G, et al. 2016. Are active and passive smoking associated with cardiometabolic risk factors in adolescents? The CASPIAN-III Study. Paediatr Int Child Health 36(3):181–8.
Khalifah-Ourfali R, Kababie-Ameo R, Meaney E, Ceballos G, Gutiérrez-Salmeán G. 2017. Education level impact on cardiometabolic risk factors: a brief report. Integrative Food, Nutrition and Metabolism 4(5).

Available at: https://www.oatext.com/education-level-impact-on-cardiometabolic-risk-factors-a-brief-report.php.

Literacy Rate In India (NSSO And RGI). Available at: data.gov.in. https://tn.data.gov.in/catalog/literacy-rate-india-nsso-and-rgi#web_catalog_tabs_block_1.

Maternal Mortality Ratio (MMR) (per 100000 live births) | NITI Aayog. Available at: http://niti.gov.in/content/maternal-mortality-ratio-mmr-100000-live-births.

McDonald SD, Malinowski A, Zhou Q, Yusuf S, Devereaux PJ. 2008. Cardiovascular sequelae of preeclampsia/eclampsia: a systematic review and meta-analyses. Am Heart J 156(5):918–30.

National Family Health Survey. Available at: http://rchiips.org/nfhs/factsheet_nfhs-4.shtml.

Pasternak RC. 2002. 2001 National Cholesterol Education Program (NCEP) Guidelines on the Detection, Evaluation and Treatment of Elevated Cholesterol in Adults: Adult Treatment Panel III (ATP III). ACC Current Journal Review 11(4):37–45.

Saha KB, Singh N, Chatterjee Saha U, Roy J. 2007. Male involvement in reproductive health among scheduled tribe: experience from Khairwars of central India. Rural Remote Health 7(2):605.

Sanchez-Vera I, Bonet B, Viana M, Quintanar A, Martin MD, Blanco P, et al. 2007. Changes in plasma lipids and increased low-density lipoprotein susceptibility to oxidation in pregnancies complicated by gestational diabetes: consequences of obesity. Metabolism 56(11):1527–33.

Sanneving L, Trygg N, Saxena D, Mavalankar D, Thomsen S. 2013. Inequity in India: the case of maternal and reproductive health. Glob Health Action 6:19145.

Santos-Torres MI, Vasquez-Garibay E. 2003. Food taboos among nursing mothers of Mexico. J Health Popul Nutr 21(2):142–9.

Tobergte DR, Curtis S. 2004. Program of Action_Adopted at the International Conference on Population and Development, Cairo 1994. UNFPA 1:1–156.

Townsend MK, Curhan GC, Resnick NM, Grodstein F. 2008. BMI, waist circumference, and incident urinary incontinence in older women. Obesity (Silver Spring) 16(4):881–6.

Trends in maternal mortality: 1990 to 2015: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. Geneva: World Health Organization; 2015. 2015. doi:10.1016/0735-1097(90)90382-Y.

Vincent LJ, Frise CJ. 2018. Management of the critically-ill obstetric patient. Obstet Gynaecol Reprod Med 28(8):243–52.

Vrijkotte TG, Algera SJ, Brouwer IA, van Eijsden M, Twickler MB. 2011. Maternal triglyceride levels during early pregnancy are associated with birth weight and postnatal growth. J Pediatr 159(5):736–42 e731.

Why are women's health outcomes in India so poor? – The Hindu BusinessLine. Available at: https://www.thehindubusinessline.com/opinion/columns/c-p-chandrasekhar/why-are-womens-health-outcomes-in-india-so-poor/article22995212.ece

WHO Regional Office for the Western Pacific. 2008. Integrating poverty and gender into health programmes: A sourcebook for health professionals (Sexual and reproductive health). ISBN 139789290613893.

Wiznitzer A, Mayer A, Novack V, Sheiner E, Gilutz H, Malhotra A, et al. 2009. Association of lipid levels during gestation with preeclampsia and gestational diabetes mellitus: a population-based study. Am J Obstet Gynecol 201(5):482 e481-8.