The puerperium is a stressful time in a mother’s life in which she undergoes various physical and physiological changes. Postnatal depression or postpartum depression has been shown to begin within the first 6 weeks following delivery but has been reported to exist even after 1 year. It is mainly characterized by tearfulness, despondency, emotional lability, feelings of guilt, loss of appetite, suicidal ideation, and sleep disturbances as well as feelings of inadequacy and inability to cope with the infant, poor concentration and memory, fatigue, and irritability. However, quite often these symptoms are easily missed as they form a part of normal puerperium as well. Various etiological theories exist for postnatal depression, but much weightage has been given to social and obstetric factors. It has also been hypothesized that mood changes stem from the rapid withdrawal of hormones. There is also increasing evidence that is showing that a woman’s nutritional status may be a contributory factor to depression. An Indian study has highlighted that depressed patients have low levels of antioxidants and benefit with antioxidant supplementation. Nutritional deficiencies may alter cerebral biochemistry leading to an imbalance in the neurotransmitter levels. This may

**ABSTRACT**

**Context:** Studies have shown nutrition to play a role in etiology of postnatal depression, but few risk markers have been developed for the same. Anthropometric determinants have not been sufficiently researched in relation to suicidality and severity of illness in women with postnatal depression. **Aim:** The present study assesses the efficacy of anthropometric determinants as risk markers of severity of illness and suicidal ideations in postnatal depression. **Methods and Materials:** 100 women were screened at 6 weeks postnatal for the presence of postnatal depression and suicidal ideation using the Edinburgh Postnatal Depression Scale. Anthropometric determinants assessed were height, weight, weight gain in pregnancy, weight at first antenatal visit, body mass index and waist-to-hip ratio. Univariate and multivariate analysis were done for risk estimation using Spearman’s rank correlation and multiple regression analysis, respectively. **Results:** In total, 39% of the women showed the presence of postnatal depression. Out of these 39 women, 31% had suicidal ideations. The waist-to-hip ratio was the most significant factor in all the models, having a negative correlation with suicidality and severity of depression ($P < 0.05$). The multiple regression model using anthropometric determinants could significantly assess risk of both suicidality ($P = 0.03$, adjusted $R^2 = 0.08$) and postnatal depression ($P = 0.04$, adjusted $R^2 = 0.07$). **Conclusions:** The study concludes that anthropometric determinants can be used effectively as risk markers for suicidality and severity of illness in women with postnatal depression. The most significant risk factor was found to be waist-to-hip ratio in both the models.

**KEY WORDS:** Anthropometry, postnatal depression, suicidality, waist-to-hip ratio

**Introduction**

The puerperium is a stressful time in a mother’s life in which she undergoes various physical and physiological changes. Postnatal depression or postpartum depression has been shown to begin within the first 6 weeks following delivery but has been reported to exist even after 1 year. It is mainly characterized by tearfulness, despondency, emotional lability, feelings of guilt, loss of appetite, suicidal ideation, and sleep disturbances as well as feelings of inadequacy and inability to cope with the infant, poor concentration and memory, fatigue, and irritability. However, quite often these symptoms are easily missed as they form a part of normal puerperium as well. Various etiological theories exist for postnatal depression, but much weightage has been given to social and obstetric factors. It has also been hypothesized that mood changes stem from the rapid withdrawal of hormones. There is also increasing evidence that is showing that a woman’s nutritional status may be a contributory factor to depression. An Indian study has highlighted that depressed patients have low levels of antioxidants and benefit with antioxidant supplementation. Nutritional deficiencies may alter cerebral biochemistry leading to an imbalance in the neurotransmitter levels. This may
lead to varied neuropsychiatric manifestations in the mother.[8] Antenatal and postnatal periods are high demanding periods wherein a mother’s nutritional requirement is increased.[9] However, in a developing country such as India, it has been noted that many pregnant mothers suffer from malnutrition.[10] One of the direct consequences of postnatal depression includes suicide. Past studies have shown that suicidal ideations exist in 5–20% of postnatal women.[12,20] Studies in India on suicidality in postnatal depression are lacking. Moreover, there is a dearth of literature that looks into risk determinants of suicidal ideations. Hence, there is a dire need of developing effective risk determinants to facilitate early referral.

Research previously done in the arena of nutritional risk and postnatal depression has focused more on hormonal assays and hemoglobin levels.[8,10] There is mixed evidence regarding the deficiency of micronutrients and polyunsaturated fatty acid deficiencies predisposing to postnatal depression.[12,13] In spite of anthropometric determinants being used to assess nutritional status in various clinical and non-clinical settings, few have been specifically applied in depression, mainly postnatal depression.[14,15] It might be more prudent to use anthropometry as determinants of nutritional status rather than assaying micronutrients and other neurohormones as previous studies have shown inconsistent results in this regard. Also as these assays require extensive laboratory services and are expensive; which in a country like India could be potentially problematic. The one used most consistently is body mass index (BMI). Previous work has predominately focused on the hypothesis that an elevated prepregnancy BMI is associated with depressive symptoms in the postnatal period.[16] Although women with new-onset postnatal depression were shown to have slightly higher prepregnancy BMI and gestational weight gain than those without depression, accounting for prepregnancy weight and weight gain only slightly attenuated the observed association between postnatal depression and weight retention. Thus, depression appeared to beget postnatal obesity more than follow as a symptom of weight gain.[17] Waist-to-hip ratio (WHR), BMI, and abdominal girth have been shown to significantly correlate with scores on depression and anxiety scales, but no literature is available for its role in postnatal depression.[18] The correlation between obesity and depression has been shown to be bidirectional, and depression can lead to significant weight gain and elevated BMI and vice versa.[20] Evidence on the role of WHR, which is influenced by body fat distribution, is correlated with youthfulness, reproductive endocrinologic status, and long-term health risk in women.[21] Seeing as it correlates with estrogen status of the body, it may play a role in risk assessment of postnatal depression. The present study hypothesizes that anthropometric determinants such as height, weight, BMI, and WHR might have a role in risk determination of suicidal ideations and severity of illness in women with postnatal depression.

Materials and Methods

The present study is a cross-sectional observational study, which was undertaken in the outpatient department of the Department of Psychiatry of a tertiary care center in Mumbai. Ethical clearance was obtained from the Institutional Ethics Committee. The sample size was calculated by Cochran’s formula using the prevalence of postnatal depression from similar studies and assuming 95% confidence intervals, which worked out to be hundred. Hence, hundred consecutive women at 6 weeks postnatal, were included in the study. Patients having history of psychiatric illness, on psychotropic medications and not willing to give consent were excluded. Patients were explained about the nature of the study and written informed consent was obtained from them. The anthropometric determinants used in our analysis were height, weight, weight at first antenatal visit, total weight gain in pregnancy, BMI, and WHR. Antenatal records were studied to look into anthropometric measurements performed at various antenatal visits such as weight at first antenatal visit and weight at term. Anthropometric measurements of height, weight, and WHR were measured using standard techniques. Weight gain in pregnancy was calculated as the difference in weight at term and weight at first antenatal visit. The BMI was calculated as weight (in kilograms) divided by height (in meters) squared. The WHR was taken as a ratio of waist circumference (measured at the narrowest point below the ribs or halfway between the lowest ribs and the iliac crests) to hip circumference (measured at the level of the anterior superior iliac spine, where this could be felt, otherwise at the broadest circumference below the waist).[22] The Edinburgh Postnatal Depression Scale (EPDS),[23] which is a ten-item self-report questionnaire, was used to assess the severity of postnatal depression. Each question was scored 0–3 (resulting range 0–30), depending on how the women felt in the past 7 days and completion of the full scale took around 5 minutes. The cut-off score was taken as ten and scores on the EPDS above ten were considered as postnatal depression. The EPDS has been shown to have overall reliability (Cronbach’s alpha) of 0.79, sensitivity of 86%, and a specificity of 78%.[24] Question ten of the EPDS specifically asked for suicidal ideation and its score was used to assess the risk of suicide.

SPSS 20.0 was used for statistical analysis. Data were expressed as mean plus or minus standard deviation. The correlation between the anthropometric variables and postnatal depression was done by using spearman’s rank correlation. Multiple regression was used to derive a model of risk assessment for postnatal depression and suicidal tendencies according to the anthropometric data by backward elimination method. P value < 0.05 was considered statistically significant.

Results

Hundred women who presented to us at 6 weeks postnatal and who were able to complete the interview and the EPDS were taken for further analysis. The women had a mean age of 25.78 ± 5.17 years. An analysis of scores on the EPDS showed a maximum score of 19 and minimum of 0. The average score was seen to be 6.43 ± 5.97. 39 out of 100 women (39%) had significant elevation on the EPDS. On analysis of the suicidal tendencies, 12 out of 39 depressed women (31%) reported suicidal tendencies; out of which five were observed to be mild and seven had moderate suicidal tendencies. There were no women who reported severe suicidality. The rest had no
suicidal tendencies. None of the women had a history of suicidal attempts. Table 1 shows the distribution of anthropometric variables in the study population.

On correlating the anthropometric measurements to the severity of postnatal depression [Table 1], the authors observed a significant correlation with WHR and postnatal depression, and this was statistically significant ($P < 0.0001$). The correlation was negative ($r = -0.39$) indicating that lower WHR is associated with more severe depression. The other factors had no significant correlation with postnatal depression. On using a multiple regression model [Table 2], it was seen that anthropometric variables could significantly estimate the severity of postnatal depression ($P = 0.04$), and this was statistically significant. The adjusted $R^2$ for the model was calculated to be 0.07, indicating that only 7% variability of postnatal depression could be attributed to anthropometry. Among the several variables analyzed [Table 3], WHR made a significant contribution in the model ($P = 0.001$). The other variables, however, had no statistically significant contribution to the model. The standardized coefficient was maximum for WHR, which was $-0.36$, followed by weight, which was $-0.27$, indicating a very low change in risk of depression with changes in the measured anthropometric determinants. The other factors had a negligible coefficient indicating that they do not alter the risk of depression much.

Table 4 shows the multiple regression model for risk estimation of suicidal ideations. It was observed that anthropometric variables significantly estimated the risk of suicidal ideations, and this was statistically significant ($P = 0.05$). Adjusted $R^2$ for the model was 0.08, indicating only 8% accountability of anthropometric variables to estimate the risk of suicidal ideations in our population. On further assessment of individual factors [Table 5], it was noted that only WHR had a significant contribution ($P = 0.002$) to the model, whereas the other factors did not. Even in this model the standardized coefficients for the factors were low, highest being for BMI which was $-0.50$, followed by height which was $-0.44$. This indicates that even if these factors can estimate the risk of suicidal ideations in depressed mothers, it appears to be a weak one.

### Discussion

Postnatal depression is a relatively common and often severe mood disorder that develops in women after childbirth. The present study analyzed maternal anthropometric variables as potential markers for suicidal ideations and severity of illness in women with postnatal depression. Using univariate analysis, our analysis showed that only WHR had a significant correlation with the severity of postnatal depression ($r = -0.39, P = < 0.0001$). The correlation was negative indicating that women with lower WHRs during the postnatal period have more severe postnatal depression. Previous studies have highlighted that lower WHR is associated with higher estrogen levels. Although absolute estrogen levels do not correlate with postnatal depression, it is the withdrawal of hormones or the difference in levels, which is important. Hence, women with higher estrogen levels may be more at risk to succumb to the rapid withdrawal of neurohormones. The present study highlights that lower WHR may be significant in this aspect. Women with a lower waist to hip ratio may also have malnutrition, but because no clear-cut guidelines are available for this relation, further studies need to be undertaken to elucidate this relation. The other factors such as height, weight, weight gain, and BMI were not significant in the univariate analysis.

Using multiple regression model, the present study showed that the model consisting of height, weight, weight at first antenatal visit, total weight gain in pregnancy, BMI, and WHR could significantly assess the risk of postnatal depression ($F = 2.21, P = 0.04$). The adjusted $R^2$ for the model was 0.07, which indicates that only 7% of the risk can be effectively assessed by the model. This implies that other factors have a greater role to play.
play in assessment of the risk than anthropometry. The factor that was most significant was WHR, and thus, it should receive more weightage than the other modalities of measurement. Previous literature has highlighted the role of high pregravid BMI and postnatal depression.\[27\] The present regression analysis shows that even postnatal BMI has a role in risk assessment of postnatal depression, as does height, weight, and total weight gain. Studies correlating nutritional status by evaluating blood parameters have shown that blood concentrations of vitamin B12 and folate were not associated with depressive symptoms,\[25\] whereas other researchers have linked vitamin D, zinc, and selenium deficiency to postnatal depression.\[12,13,26\] They possibly act through psychoneuroimmunological mechanisms to give rise to depressive symptoms, but overall the evidence is small.\[27\] The present analysis highlights that anthropometric determinants might be more consistent in risk estimation of postnatal depression.

Maternal suicide constitutes one of the more serious side effects of postnatal depression. Our present analysis showed that 31% of the women reported suicidal ideations in the postnatal period. This is much higher than previously reported rates\[20,29\] indicating Indian women with postnatal depression perhaps are at a higher risk of developing suicidal ideations. However, none of them had a history of suicidal attempt. Babu et al. have shown that 38% of the women in their sample of postnatal psychosis had suicidal ideations and 18% had a history of suicide attempt.\[30\] Comorbid depression in their analysis was a significant risk factor.\[30\] Similarly, other researchers have demonstrated that women in the childbearing-age have a relatively low threshold for acting on suicidal ideations.\[28\] Previous studies have given weightage to social determinants of suicidality and factors such as age, employment status, and marital status have been shown to be significant.\[28,31\] The present study shows that anthropometric determinants can significantly assess the risk of suicidal ideations ($F = 2.32, P = 0.03$). The adjusted $R^2$ value for the model was 0.08, which is higher than the one for postnatal depression, albeit only by 1%. The risk estimation capacity of anthropometric variables presently studied proved to be similar for both suicidality and postnatal depression. This is expected as suicidality in itself varies with the severity of the depressive episode experienced by the mothers. However, the risk determining capacity appears to be low for both factors. Among all the factors studied, WHR made a significant contribution even in assessing the risk of suicidal ideations.

To the best of our knowledge, ours is the first study to look into the relation of anthropometric determinants and postnatal depression and suicidality. We were also able to develop a comprehensive model for risk assessment of suicidal ideations and postnatal depression using anthropometric determinants. Newer factors such as WHR and weight gain during pregnancy, which previously were never studied, also were shown to contribute in our model. However, our study was not without limitations. Only WHR and weight gain during pregnancy, which previously were never studied, also were shown to contribute in our model. However, our study was not without limitations. Only WHR came out significant among all the anthropometric determinants and the others were not. The adjusted $R^2$ for both the models was very low, indicating their role in risk determination is a small one. The standardized coefficients for all the factors were less than one, indicating a very weak relation of anthropometric determinants presently studied with suicidal ideations and postnatal depression. This could possibly be because of a small sample size. Furthermore, correlating the present findings with other variables such as parity, hormonal levels (estrogen, progesterone, luteinizing hormone, and follicle stimulating hormone), etc., was not done. Perhaps further research with larger sample size can shed better light on the relation currently being explored.

The present study concludes that anthropometric determinants can be used as risk markers for suicidality and severity of illness.
in postnatal depression. These findings also highlight the fact that nutrition could play a role in the pathophysiology of postnatal depression. Among the various factors analyzed, WHR proved to be the most important predictor. Anthropometric determinants form a part of routine prenatal and postnatal checkup and hence can be used effectively as risk predictors. The inventory of anthropometry done should also include WHR as it is a more significant predictor for postnatal depression. Obstetricians should use them to screen postnatal women who might be predisposed to develop suicidal ideation and postnatal depression. This will lead to early referral to a psychiatrist and effectual treatment, which can prevent detrimental consequences in both the mother as well as the baby.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References
1. Jevitt CM, Groer MW, Crist NF, Gonzalez L, Wagner VD. Postpartum stressors: A content analysis. Issues Ment Health Nurs 2012;33:309-18.
2. Wisner KL, Sit D, McShea MC, Rizzo DM, Zoretich RA, Hughes CL, et al. Onset timing, thoughts of self-harm, and diagnoses in postpartum women with screen-positive depression findings. JAMA Psychiatry 2013;70:490-8.
3. Hegde S, Latha KS, Bhat SM, Sharma PSVN, Kamath A, Shetty AK. Postpartum depression: Prevalence and associated factors among women in India. J Womens Health Issues Care 2012;1:1-7.
4. Johnson AR, Edwin S, Joachin M, Mathew G, Ajay S, Joseph B. Postnatal depression among women availing maternal health services in a rural hospital in South India. Pak J Med Sci 2015;31:408-13.
5. O'Hara MW, McCabe JE. Postpartum depression: Current status and future directions. Annu Rev Clin Psychol 2013;9:379-407.
6. Judge MP, Beck CT. Postpartum depression and the role of nutritional factors. In: Lammi-Keefe C, Couch S, Kirvan J, editors. Handbook of Nutrition and Pregnancy. Humana Press; 2018. p. 357-83.
7. Gautam M, Agrawal M, Gautam M, Sharma P, Gautam AS, Gautam S. Role of antioxidants in generalised anxiety disorder and depression. Indian J Psychiatry 2012;54:244-7.
8. Hogg-Kollars S, Mortimore D, Snow S. Nutrition health issues in self-reported postpartum depression. Gastroenterol Hepatol Bed Bench 2011;4:120-36.
9. Park K. Medicine and Social Sciences. Park’s Textbook of Preventive Medicine. 22nd ed. Jabalpur: Banarasidas Bhanot, 2013. p. 620-53.
10. Maun M, Oppo A, Bori C, Banti S. Suicidality in the perinatal period: Comparison of two self-report instruments. Results from PND-ReScU. Arch Womens Ment Health 2012;15:39-47.
11. Conwin EJ, Murray-Kolb LE, Beard JL. Low hemoglobin level is a risk factor for postpartum depression. J Nutr 2003;133:4139-42.
12. Benton D. Selenium intake, mood and other aspects of psychological functioning. Nutr Neurosci 2002;5:383-74.
13. Nowak G, Szweczyk B, Pilec A. Zinc and depression. An update. Pharmacol Rep 2006;57:713-8.
14. Rees AM, Austin MP, Parker G. Role of omega-3 fatty acids as a treatment for depression in the perinatal period. Aust N Z J Psychiatry 2005;39:274-80.
15. Frison S, Kerac M, Checchi F, Prudhon C. Anthropometric indices and measures to assess change in the nutritional status of a population: A systematic literature review. BMC Nutr 2016;2:76.
16. da Rocha CM, Kac G. High dietary ratio of omega-6 to omega-3 polyunsaturated acids during pregnancy and prevalence of post-partum depression. Matern Child Nutr 2012;8:36-48.
17. LaCoursiere DY, Barrett-Connor E, O’Hara MW, Hutton A, Varner MW. The association between prepuberty obesity and screening positive for postpartum depression. BJOG 2010;117:1011-8.
18. Althuizen E, van Poppel MN, de Vries JH, Seidell JC, van Mechelen W. Postpartum behaviour as predictor of weight change from before pregnancy to one year postpartum. BMC Public Health 2011;11:165.
19. Zhao G, Ford ES, Li C, Tsai J, Dhingra S, Balluz LS. Waist circumference, abdominal obesity, and depression among overweight and obese US adults: National Health and Nutrition Examination Survey 2005-2006. BMC Psychiatry 2011;11:130.
20. Luppiino FS, de Wit LM, Bouvy PF, Stijnen T, Cuijpers P, Penninx BW, et al. Overweight, obesity, and depression: A systematic review and meta-analysis of longitudinal studies. Arch Gen Psychiatry 2010;67:220-9.
21. Dixson BJ, Sagata K, Linklater WL, Dixson AF. Male preferences for female waist-to-hip ratio and body mass index in the highlands of Papua New Guinea. Am J Phys Anthropol 2010;141:620-5.
22. Wang Z, Hoy WE. Waist circumference, body mass index, hip circumference and waist-to-hip ratio as predictors of cardiovascular disease in Aboriginal people. Eur J Clin Nutr 2004;58:889-93.
23. Cox JL, Holden JM, Savigosky R. Detection of postnatal depression: Development of the 10-item Edinburgh postnatal depression scale. Br J Psychiatry 1987;150:782-6.
24. Kozinszky Z, Dudas RB. Validation studies of the Edinburgh postnatal depression scale for the antenatal period. J Affect Disord 2015;176:95-105.
25. Lukose A, Ramthal A, Thomas T, Bosch R, Kurpad AV, Duggan C, et al. Nutritional factors associated with antenatal depressive symptoms in the early stage of pregnancy among urban South Indian women. Matern Child Health J 2014;18:161-70.
26. Harrison-Hohner J, Coste S, Dorato V, Curet LB, McCarron D, Hatton D. Prenatal calcium supplementation and postpartum depression: An ancillary study to a randomized trial of calcium for prevention of preeclampsia. Arch Womens Ment Health 2001;3:141-6.
27. Ellsworth-Bowers ER, Conwin EJ. Nutrition and the psychoneuroimmunology of postpartum depression. Nutr Res Rev 2012;25:180-92.
28. Howard LM, Flach C, Mehay A, Sharp D, Tylee A. The prevalence of suicidal ideation identified by the Edinburgh postnatal depression
scale in postpartum women in primary care: Findings from the RESPOND trial. BMC Pregnancy Childbirth 2011;11:57.

29. Pope CJ, Xie B, Sharma V, Campbell MK. A prospective study of thoughts of self-harm and suicidal ideation during the postpartum period in women with mood disorders. Arch Womens Ment Health 2013;16:483-8.

30. Babu GN, Subbakkishna DK, Chandra PS. Prevalence and correlates of suicidality among Indian women with post-partum psychosis in an inpatient setting. Aust N Z J Psychiatry 2008;42:976-80.

31. Kim JJ, La Porte LM, Saleh MP, Allweiss S, Adams MG, Zhou Y, et al. Suicide risk among perinatal women who report thoughts of self-harm on depression screens. Obstet Gynecol 2015;125:885-93.