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Prevalence of premenstrual syndrome and its relationship with blood pressure in young adult females

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Summary
Premenstrual syndrome is a collection of symptoms which women experience 1 to 2 weeks before menstruation which clear with onset of menstrual flow and capable of interfering with life functions. An association between Premenstrual syndrome and hypertension has been suggested leading to the suspicion that it may be one precussor trait of hypertension in the normal population. Since people who develop hypertension later in life start from the higher range of normal earlier on, we sought to find if premenstrual syndrome had any bearing on hypertension. Consenting female subjects in three institutions in Jos, Nigeria were studied. Self-administered questionnaires designed to diagnose premenstrual syndrome and anxio-depressive status were used. Medical, family and menstrual history, as well as height, weight, pulse and blood pressures were documented; and data analysed. Four hundred and fourty seven subjects aged between 17 and 38 years with a mean of 23.6 + 3.9 were studied. Sixty one percent of them satisfied the criteria for diagnosis of premenstrual syndrome. When the data for those in luteal phase was split into the early (1st) and late (2nd) parts, there was a statistically significant rise in systolic and diastolic blood pressure from 1st to 2nd parts only for those with premenstrual syndrome (SBP 107.3 + 11.05 to 111.39 + 13.48 mm Hg, p=0.05 and DBP 65.06 + 10.38 to 70.69 + 10.03, p=0.004). Those with premenstrual syndrome also had higher anxiety and depression scores (chi-square 47.9 and 28.4 respectively). The symptoms of premenstrual syndrome peak in the 2nd part of the luteal phase. They are associated with a lot of stress. Since blood pressure elevation with this change was significantly higher among subjects with premenstrual syndrome, it is felt that premenstrual syndrome may predict future hypertension among currently normotensive females.

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Résumé
Le syndrome post menstruel est un ensemble des symptômes que les femmes expérimentent une á deux semaines avant la menstruation et qui finissent après le début des menstrues et capable d'interférer avec les fonctions vitales. L'association entre le syndrome pré menstruel et l'hypertension a été suggère conduisant á la suspicion que ces symptômes peuvent être des signes précurseurs de l'hypertension chez une population normale d'autant que celles qui développent l'hypertension tard dans la vie. Dans cette étude, nous recherchons si le syndrome pré menstruel a un lien avec l'hypertension. Les femelles consenties dans trois institutions dans l'état de Jos, Nigeria étaient étudiés. Des questionnaires étaient administres et utilises pour diagnostiquer le syndrome prémenstruel et le statut anxio-depressive. Autres données telles que l'histoire médicale, familiale et menstruelle bien que la taille le poids, pouls et les pressions sanguines étaient documentées et les données analysées. Quatre cent quarante quatre sujets entre 17- 38 ans avec une moyenne d'age de 23.6±3.9 ans étaient étudies. 61% satisfaisaient les critères du diagnostic du syndrome pre mentruel. A la phase lutéale, les données étaient divisées en deux phase ; la phase précoce (I) et la phase tardive (II). Il y avait une augmentation statistiquement significative de la pression sanguine systolique et diastolique de la phase I a II seulement a celles qui avaient les symptômes pre mentruel (SBP =107±11.05 á 111.39 ± 13.48mmHg, P= 0.05 et DBP= 65.06 - 70.69 ± 10.03mmHg, P=0.004). Celles-ci avaient également des taux anxiété et dépression plus élevées.

Introduction

It has been stated that the aetiology of hypertension varies considerably among patients in a large population [1]. This is because the disease is complex with a plethora of interactive aetiologies namely age, gender, nutrition, environment, stress, obesity, genetics

as well as dysfunctional renal, endocrine and neural circulatory control mechanisms [2]. This may explain why hypertensives respond differentially to diverse classes of therapeutic agents [1]. Recently, Lillie and O'Connor suggested that precussor traits of hypertension cluster within the normotensive population [3]. World wide, optimal control of hypertension is still lagging behind expectation [4]. This fact has fuelled high level research into pathologic mechanisms of hypertension, which has begun to yield dividends [5].

Premenstrual Syndrome (PMS) is a collection of physical, psychological and emotional symptoms that women experience during one or two weeks before a menstrual period [6]. The symptoms usually peak premenstrually and disappear soon after the onset of menstruation [7]. Among the several theories explaining its causation, it is thought that the cyclic changes in female sex hormones, pituitary hormones, prostaglandins and serotonin is the most plausible [8]. The perception of stress in these individuals is said to be exaggerated [9]. In a short survey of PMS among females with established hypertension, one of us (BNO) found that the female hypertensives were more likely to suffer PMS than their non-hypertensive counterparts. This tended to corroborate the findings of Andersch *et al* [11] that women who developed sustained hypertension after a previous pregnancy complained more significantly of premenstrual sadness than their normotensive counterparts.

Innovative concepts of hypertension in the opinion of Frohlich [12], stand to improve the understanding and management of the disease. The link between PMS and arterial hypertension in women may be innovative, since no such clear link has been established to the best of our knowledge. The impact of this on management would be in the areas of primary prevention, adjunctive treatment with drugs of proven benefit in PMS; and improved blood pressure control in affected women. To establish a link, it was necessary to avoid women with established hypertension, as it would not be possible to control for many confounding factors. We therefore came up with a hypothesis that among young women not known to be hypertensive, the blood pressure of those with PMS would be higher than those without; and that this difference would be related to the phases of the menstrual cycle when symptoms cluster. Their increased perception of stress was thought to have a bearing on this. This work therefore set out to determine the prevalence of PMS among selected young women in our environment, and how if at all it impacts on arterial blood pressure.

Subjects and methods

This study involved all female students in all levels of the medical faculty of the University of Jos, as well as their counterparts in the Schools of Nursing and Medical Laboratory Technology based in Jos University Teaching Hospital. Jos is a cosmopolitan city which serves as seat of government of Plateau State of Nigeria as well as commercial and academic nerve centre of the state. The study was done between January and February of 2006 to avoid examinations in the institutions with the attendant stress. The students studied cut across all ethnic groups in Nigeria with diverse backgrounds. The permission of the Dean of Faculty and Principals of the other schools were sought and obtained. The procedures followed were in accordance with institutional guidelines. The ethics committee of Jos University Teaching Hospital gave approval for the study.

After explaining the study to the participants, consenting students who signed a written informed consent form were enrolled if they were not pregnant. Two sets of questionnaires were given to them to complete by themselves. One sought information on their demographic characteristics, personal, medical, menstrual and family histories; as well as ascertaining if they suffered from PMS. Whether or not they suffered from PMS was determined during analysis from the answers given by the respondents using the American College of Obstetrics and Gynaecology recommended criteria developed by the University of California at San Diego. At least one from two groups of selected Affective and Somatic symptoms during the five days before menses in each of the last three cycles, which clear towards the end of the menstrual flow define PMS [13]. The other questionnaire utilized the hospital anxiety and depression scale of Zigmond and Snaith [14]. This is a 14 items questionnaire rated on a 4 point scale per item. It is designed to measure the severity of emotional disorder in both the general out patient and community populations; despite the use of hospital in the title. The scale consists of 7 depression and 7 anxiety items. It is easy to administer, can be completed within a short time; and has good psychometric status. All 14 items on the scale are rated on a 4 point scale ranging from 0 to 3 depending on the absence or severity of the symptom. The maximum score for each sub-scale is 21. Scores of over 10 are required for either sub-scale to diagnose an anxiety or depressive state. The questions were selected such as to distinguish the effects of physical illness from mood disorders. Hence symptoms likely

to be present in both (for example dizziness and headache) were excluded. Also, distinctions were made between symptoms of anxiety and depression [15]. Medical and surgical conditions are known to predispose individuals to developing anxiety and depressive symptoms or disorders. This depends on the duration, severity, suddenness of these as well as the coping ability of the individual. The scale has been validated by Abiodun *et al* [16] in a study that gave a sensitivity and specificity for anxiety sub-scale as 92.9% and 90.6% respectively; while those for the depression sub-scale were 86.5% and 91.1%. It was therefore recommended as a valid screening instrument in non-psychiatric units in hospitals and for mental morbidity studies in community settings in developing countries.

Each subject was then examined for weight in kilograms and height in metres on a standing scale and stadiometer (SECA model). Body Mass Index (BMI) was calculated using the formula weight (in kg)/ square of height (in metres). Blood pressure was taken on the right arm using a mercury sphygmomanometer (Accoson model) with standard adult cuff on 2 occasions separated by about 5 minutes by 2 different physicians. Subjects were seated with the arm resting on a table at the level of the heart. Two of the authors (BNO and JTO) as well as 3 resident doctors in the Cardiology Unit participated in the blood pressure and pulse examination. Being clinicians regularly checking blood pressure of patients they encounter in practice, no special training for blood pressure measurement was required. Phases I and V Korotkoff sounds were used for systolic and for diastolic blood pressures respectively. The average of 2 blood pressure recordings was used for analysis. Pulse rate was counted at the radial artery for one full minute on the 2 occasions when blood pressure was measured and averaged for analysis.

Statistical analysis

Data were grouped into PMS and no PMS and for each group into follicular and luteal phases of the menstrual cycle. This was determined using information of their Last Menstrual Period (LMP) and Ketamania (K). The latter is defined by number of days that the individual menstruates over the interval in days between 2 menstrual cycles. A subject was taken to be in luteal phase if as on the day of examination, she was within 14 days to the next menstruation. Any period preceding the luteal phase was taken as the follicular phase. Furthermore, for each group (PMS or no PMS), those in luteal phase were split into two. This was easily divided into early (1st) or late (2nd) parts of 7 days each since the luteal phase was consistently close to 14 days in the normal menstrual cycle [17]. After grouping as stated above, they were then entered into a micro-computer after checking for errors and consistency. Analysis was done by (CO) using the SPSS 10.0 for Windows soft ware package. Comparison of discrete variables was done by test of means calculation using student t-test; while that of categorical variables was by test of proportions using chi square test. Statistical significance was set at $p < 0.05$.

Results

Only those with complete data were analysed. They were 447. Of this number, 273 satisfied the criteria for diagnosis of PMS giving a prevalence of 61%. Their ages ranged from 17 to 38 years with a mean of 23.6 + 3.9. Most of the subjects (289) were in the 20 to 24 years age bracket. Thirty two out of the 447 were less than 20 years. Ninety four were between 25 and 29 years and thirty two were above 30years. There were no statistically significant differences in Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), BMI and Pulse Rate (PR) between the subjects who were suffering from PMS and those who were not (Table 1).

Table 1: Blood pressure, pulse rate and BMI characteristics of study subjects

Index	PMS (n=273)	No PMS (n=174)	p value
SBP(mmHg)	108.5 (12.9)	110.6 (15.4)	0.15
DBP(mmHg)	68.7 (10.7)	69.8 (11.3)	0.30
PR (per min)	78.2 (10.4)	77.6 (11.2)	0.55
BMI(kg/m2)	21.3 (3.6)	21.5 (4.1)	0.60

Data represent mean (sd). No statistically significant difference emerged between groups.
PMS – Premenstrual Syndrome, SBP – Systolic Blood Pressure, DBP – Diastolic Blood Pressure, PR – Pulse Rate, BMI – Body Mass Index.

Among the 273 with PMS, clear separation into follicular and luteal phases was possible only in 256. These were those in whom menstrual cycles were reasonably regular and information on LMP and K were complete. The same was done for those without PMS. Clear separation was possible in 160 out of 174. Table 2 shows the data on SBP, DBP, PR and BMI grouped along these lines. SBP tended to

Table 2: Blood pressure, Pulse rate, and BMI characteristics of study subjects based on phase of menstrual cycle.

Index	PMS (n=256)			No PMS (n=160)		
	F.P.(n=138)	L.P.(n=118)	p value	F.P(n=67)	L.P. (n=93)	p value
SBP(mmHg)	107.7(13.5)	110.4(14.6)	0.16	107.2(12.9)	112.7(17.1)	0.03
DBP(mmHg)	68.9(10.4)	68.9(11.4)	1.0	68.0(9.5)	70.6(12.4)	0.16
PR(per min)	77.3(10.4)	78.9(10.9)	0.25	76.3(10.9)	79.1(11.2)	0.06
BMI(kg/m2)	20.9(3.3)	21.6(4.2)	0.2	21.6(3.6)	21.8(4.5)	0.10

Data are mean(sd).
F.P. – Follicular Phase, L.P. – Luteal Phase.
SBP tended to rise from follicular to luteal phase attaining significance only for the no PMS group. Other parameters did not differ significantly between phases of the menstrual cycle.

Table 3: Blood pressure, Pulse rate and Body mass index changes in the two parts of the luteal phase among main study group subjects (PMS and No PMS)

Index	PMS, Luteal phase (n=118)			No PMS, Luteal phase (n=93)		
	1st part (n=66)	2nd part (n=52)	p value	1st part (n=53)	2nd part (n=33)	p value
SBP(mm Hg)	107.03(11.05)	111.39(13.48)	0.05	113.51(17.33)	111.33(16.33)	1.0
DBP (mmHg)	65.06(10.38)	70.69(10.03)	0.004	69.79(12.04)	71.82(13.09)	0.40
PR (per min.)	79.05(11.23)	77.89(10.03	0.6	78.19(11.81)	80.64(10.15)	0.20
BMI (kg/m2)	21.24(11.23)	21.70(10.48)	0.55	22.32(5.42)	21.27(3.66)	0.20

Data represent mean(sd). In the PMS group, values of the 2nd or premenstrual part of the luteal phase were significantly higher than the 1st part of the luteal phase for SBP and DBP. No significant differences emerged in the No PMS group

rise from follicular to luteal phase attaining significance only for the no PMS group. Other parameters did not differ significantly between phases of the menstrual cycle. Symptoms of PMS are usually worse as the luteal phase draws to a close premenstrually.

Since luteal phase is invariably 14 days in every woman with normal menstrual cycle, it was divided into two parts namely: early (1st) and late (2nd) parts of 7 days each. To see what difference this made on the measured indices, values in the 2 parts of the luteal phase were compared in the groups with and without PMS. The results are shown in table 3. In the PMS group values of the second or premenstrual part of the luteal phase were significantly higher than the first part for SBP and DBP. No significant difference emerged in the no PMS group.

When the presence of anxiety was compared between those with PMS and those without, the former recorded significantly higher anxiety status (chi square value= 47.9; p=0.00). The same trend was recorded for depression with those suffering from PMS having more depression (chi square value=28.4; p=0.00) See table 4.

Table 4: Relationship between PMS and Anxiety/ Depression

	Anxiety				Depression		
PMS	Yes	No	Total	PMS	Yes	No	Total
Yes	155	118	273	Yes	131	142	273
	56.8%	43.2%	100%		48%	52%	100%
No	40	134	174	No	39	135	174
	23%	77%	100%		22.4%	77.6%	100%
Total	195	252	447	Total	170	277	447

Chi-squared = 47.9; p=0.00 Chi-squared = 28.4, p=0.00
PMS – Premenstrual Syndrome

Discussion

The prevalence of PMS in this group of young women turned out to be 61%. It is difficult to compare prevalence rates of PMS from different studies. As stated by Dean *et al* [18], prevalence of PMS varies with the criteria used to define it. It is therefore understandable that while our study that used the American College of Obstetrics and Gynaecology criteria developed by the University of California at San Diego was recording 61%, Takeda et al [19] reported 95% prevalence in Japan using the

premenstrual symptoms questionnaire. Tabassum *et al* [20] reported 53% in Pakistan using a symptom diary for 2 prospective cycles rating each symptom daily on a scale and diagnosing PMS according to ICD 10 symptom check list while Rasheed *et al* [9] reported 96% in Saudi Arabia. They used a list of 13 symptoms, asking subjects if they experienced them during the last 6 months on 3 or more occasions 1 week prior to onset of menstruation and generally ending with the onset of the period. Premenstrual scores were calculated for each subject and rated as no PMS, mild or severe PMS. On the average, estimates of clinically significant PMS currently stand at 12.6% to 31% among reproductive age women [21]. Therefore, our prevalence of 61% and the 85.5% reported by Antai *et al* [22] from Calabar, Nigeria where PMS was diagnosed based on subject's experience on a regular basis of somatic and psychological symptoms which occur in the luteal phase, peak before menses and remit during or shortly after onset of menses with a symptom free period before ovulation every month go to show that most Nigerian women suffer from PMS.

When subjects with PMS were compared with those without, there was no statistically significant difference in SBP, DBP, PR and BMI (Table 1). This on the surface would tend to covey the impression that the subject with PMS does not have a greater predisposition to hypertension. This may be because even though there was PMS, they were not all in the critical luteal phase when the symptoms and attendant stress give rise to elevated blood pressure. In fact as shown in Table 2, more PMS subjects were in the follicular phase when symptoms are absent.

Since the rise in blood pressure is suspected to be related to the symptoms of PMS which cluster in the luteal phase, the groups were sub-analysed first under follicular and luteal phase categories. As shown in Table 2, there was a rise in most indices considered, from follicular to luteal phase. This is the expectation as reported by Greenberg *et al* [23], who in a retrospective analysis showed that mean level of SBP varied with stage of menstrual cycle. Since symptoms of PMS are worse in the second half of the luteal phase [7], luteal phase data were further sub-analysed into early (1st) and late (2nd) parts for the PMS and no PMS groups. The differences in the no PMS group were both inconsistent and insignificant. For the PMS group however, there was a statistically significant rise in both SBP and DBP from the first to the second part of the luteal phase (see table 3). As reported earlier [23], SBP in the later part of the luteal phase was higher than the luteal phase as a whole, and on all other days of the cycle. From our result, this phenomenon appears to apply more for subjects with PMS.

We believe that these surges in blood pressure during the 2nd part of the luteal phase are related to the increased stress and heightened perception of stress felt by women with PMS in this part of the menstrual cycle [9]. That weight gain or sodium and water retention of luteal phase have nothing to do with the blood pressure changes is borne out by our results. BMI did not differ significantly between the groups in all the phases. In other studies, no consistent result in this regard has emerged between PMS and their non PMS counterparts [24]. Stress is known to increase blood pressure [25]. As shown in this study, more patients with PMS had anxiety and depression in comparison to those without (Table 4). This accords with what was reported by Kim *et al* [26] on the relationship of PMS with anxiety and mood disorders. Anxiety and depression as consequences of stress trigger increased production of catecholamines and corticosteroids that result in blood pressure elevation. Initially, this would be paroxysmal and labile, corresponding to the phase of the menstrual cycle when symptoms cluster, that is the 2nd part of the luteal phase. This may later become persistent. Labile hypertension in some patients is known to represent a precussor of fixed hypertension later in life [27, 28]. The surges have been shown to produce endothelial damage [29]. As one of the initial steps in atherogenesis [30] which raises after load, a pathological hall mark of hypertension, elevated blood pressure with time may become sustained. The effect of the periodic rises is also likely through the agency of the kidney to sustain elevation of blood pressure [31].

Given the foregoing, it would not be a surprise to find PMS more in a female hypertensive cohort as already alluded to [10]. We suspect that PMS may consistute an intermediate phenotype which might be helpful in identifying those women with a stronger predisposition to later development of hypertension. They would provide a good population to apply primary prevention to, with a view to preventing or delaying the onset of hypertension. Factoring this into the management of hypertension in women should also improve control rates thus reducing morbidity and mortality consequent on hypertension.

Conclusion

Higher youth blood pressure even within normal range is significantly associated with PMS symptoms in the luteal phase; but more in the few days preceding menstruation. Given the polygenic nature of

hypertension, it may be argued that these findings have limited clinical significance. Nevertheless, our observations are of medical importance as they support the concept that PMS may be contributing to hypertension in women. Further studies are needed to confirm and shed more light on these observations.

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