

Evaluation of hydration status and fluid intake among low risk postpartum women in local community delivered in Hospital Ampang.

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Abstract

Background: Adequate fluid intake is very crucial for mothers during postpartum as any dehydration that ensues during this period may predispose them to the risk of developing venous thromboembolism event. Yet, the sociocultural influences may have deterred some of them from adequate fluid intake especially those from Asian region. This study aims to determine hydration status of low risk postpartum women during postpartum period among Malaysian women.

Methods: A prospective observational study involving assessment of hydration status at 3 points; after 24 hours, at the 3rd week and at the 6th week postpartum was conducted. Apart from hydration status where patients were requested to record on weekly basis of their input and output fluid intake in a diary, they also underwent a series of biochemical parameters assessment.

Results: 56 patients met the inclusion criteria. The sociodemographic data were analysed descriptively whereby all in the patients were in reproductive age group, with mean (SD) age of 27.96 (4.46) years. The majority were of Malay ethnicity 94.6% and 66.1% were multiparous. As many as 92% of them had at least secondary level of education and more than half were employed (55.4%). Subsequent analysis (n=15) at 3rd and 6th week following women who had completed all 3 follow ups showed; statistically significant evidence of underhydration from the biochemical test results. Repeated analysis at the 3rd week and 6th week revealed that there were significant differences using Friedman test in levels of urea ($p=0.001^b$), creatinine (0.008^b), as well as plasma osmolality ($p<0.001^b$). Similarly with urine specific gravity ($p=0.002$) and urine osmolality (0.002^a) calculated with repeated measures ANOVA from baseline. This correlated with the overall lack of fluid intake taken by patients which recorded 1.78L/day at 3rd week and 2.13L/day by 6th week, values which were lower than recommended amount for nursing mother.

Conclusion: The results suggested that lower fluid intake among low risk postpartum women during the postpartum period may predisposes risk of venous thromboembolism. Emphasizing adequate amount of fluid intake among low risk post partum women is crucial and will reduce possible risk of venous thromboembolism.

Background

Pregnancy is a hypercoagulable state where all three factors in Virchow's triad apply which include hypercoagulability, venous stasis and vascular damage. Although this state is a physiological process in pregnancy, it poses higher risk in some patients to thromboembolic events. The awareness of the risk thromboembolism and efforts in preventing it during antenatal and postpartum is increasing in the recent years. The United Kingdom maternal and mortality rate due to thromboembolism was 0.79 in 100 thousand livebirths (n= 18/155; 11.6%) between the year 2006- 2008 (Lewis, 2011). Our local data revealed higher incidents with 1.5 in 100 thousand livebirths in 2007 (n= 7/136; 5.1%). The cases

increased to 4.7/100K livebirths in the year 2008 (n= 23/133; 17.3%) (Krishnan, n.d.). Studies had also shown that incidences were 5 times higher during puerperium as compared to during pregnancy and up to 60 times higher as compared to a non pregnant woman. This is especially so, in first three weeks of postpartum. (Reducing the Risk of Venous Thromboembolism during Pregnancy and the Puerperium, 2015) (POMP et al., 2008) (Heit et al., 2005). Many studies contributed to the formation of guidelines to further improve antenatal and post natal care. Unfortunately the existing risk scoring and screening emphasize only on patients with a known higher risk to develop venous thrombosis event (VTE). These patients receive the package of proper counseling, education tools and are started on anticoagulant with frequent monitoring. On the other hand, the lower risk group does not receive equal attention where their hydration status and mobilization during their post-partum period are never objectively assessed. This is the window period which we may have missed as higher incidences of VTE happens within 6 weeks postpartum and up to 3 months (POMP et al., 2008) (Heit et al., 2005) (Kamel et al., 2014). This is also especially important in a society that has practices that affect both hydration as well as mobilization of a mother in her confinement period.

Most of Malaysian mothers were taken care by the senior family members according to their cultural practices during the 'confinement' or lying-in period post delivery. Although this cultural practice undoubtedly provide good emotional and physical support, in various Asian cultures, there are some similarities in terms of the caregivers limiting the mothers' types of food and fluids they may consume. These various cultural practices are also similar where most women will be advised to almost completely lie at home with restricted movements (Koon et al., 2005). Some extreme practices even forbid the women from washing their hair and taking bath because the culture believe that the mother needed to be kept warm to expedite the healing process (Koon et al., 2005). Unfortunately these of course exposes the women to risk of sepsis as lack of hygiene. Studies has revealed that higher risk of VTE occurs during the first few weeks, especially first to 3rd week of post partum, partly contributed by immobility and postnatal infections (Abdul Sultan et al., 2014). The culture may actually predisposing the mothers to the higher risk of developing VTE despite being a lower risk group.

Although many studies and guidelines emphasize on adequate fluid intake during the postpartum period (Koon et al., 2005) (Krishnan, n.d.) there were no exact amount mentioned and written clearly to the patients or in the thrombosis guidelines. Furthermore, there were very few published studies on the fluid intake and hydration status of postpartum women in specifically among our Malaysian mothers adhering to the local customs. Unfortunately there is also not one single index of measurement able to accurately measure the amount of body fluid (Armstrong et al., 2012) (Armstrong et al., 2013). This is because the process of water homeostasis is very dynamic, where the body fluid balance throughout the day is determined by the fluid intake and the physiological process of water absorption, reabsorption, filtration, secretion and excretion, as well as physical activity, posture and body temperature.

The body hydration status requires more than one test to provide accurate assess. Plasma osmolality, P_{osm} is one simple, safe, precise and portable test recommended for this purpose (Armstrong et al., 2013). A few studies had shown that in subjects assigned to bed-rest, whether with or without supplementation;

the plasma and urinary electrolytes such as sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg) excretion levels were significantly increased ($p \leq 0.05$). The P_{osm} , plasma protein level, whole blood hemoglobin (Hb) and hematocrit (Hct) level were also increased significantly ($p \leq 0.05$) (Zorbas et al., 2002) However many studies agreed that P_{osm} was one of the test which is consider as the gold standard to assess hydrational status (Minton and Eberman, 2009), (Armstrong et al., 2012).

The aim of this study is to assess the fluid intake and hydration status using several biochemical indices among the low risk postpartum women in Malaysia cultural setting, and to provide empirical evidences on the hydrational status among them to assess the risk of this group in developing VTE. It isa stepping stone in educating and counseling the lower risk women the importance of adequate fluid intake during their confinement period as part of post partum care.

Methodology

This study is a prospective longitudinal study over six month period, involving subjects attending maternity wards in Hospital Ampang, Selangor state of Malaysia. The study protocol was approved by the National Malaysian Research Registry (NMRR-16-1361-29016). Inclusion criteria included low risk postpartum women who consented to the study, uncomplicated antenatal records of singleton pregnancy and mothers who delivered via spontaneous vertex delivery. The initial calculated sample size with the power of 80% and 95% confidence interval was 200. These women were recruited on day one post delivery. Their sociodemographic data, and baseline examination including measurements of biochemical analysis reflecting the hydrational status (plasma and urine osmolarity, plasma sodium, urea, creatinine and serum haemotocrit levels) were recorded. Patients were taught on how to self-measure their fluid input and output throughout their confinement phase in a specific diary. Subsequent follow up visit to reassess these parameters were made at the third and sixth week post partum (Figure 1) . Data were analysed with SPSS version 24.0. Demographic data were analysed descriptively while biochemical parameters were calculated statistically and repeated measures were analysed for significance ($p < 0.05$).

Results

Table 1: Descriptive demographic profile upon day 1 of recruitment, among low risk postpartum women delivered in Hospital Ampang.

Variables	Baseline (N=56)
Age, mean (SD)	27.96 (4.46)
Ethnic	
Malay	53 (94.6%)
Chinese	1 (1.8%)
Others (Indonesian)	2 (3.6%)
Education level	
No formal education	2 (3.6%)
Completed primary level	2 (3.6%)
Completed secondary level	24 (42.9%)
Completed tertiary level	28 (50.0%)
Employment status	
Working	31 (55.4%)
Housewife	25 (44.6%)
Parity	
1	19 (33.9%)
2	19 (33.9%)
3	13 (23.2%)
4	4 (7.1%)
5	1 (1.8%)

A total of 56 subjects met the inclusion criteria. Majority of the patients (94.6%) were from Malay ethnicity with mean age of 27.96 ± 4.46 years old and multiparous, 66.1% (N=56). Half of the patients had completed tertiary level of education, while 42.9% had completed the secondary level. The majority 55.4% were working mothers while the remaining were housewives (44.6%). (Table 1)

The biochemical indices which reflect hydration status among 56 postpartum low risk women were also analysed where the level on day 1 postpartum was taken as the baseline (day 1). The mean haematocrit was 35.26% (SD 4.09) which was normal (female normal range: 36 to 48%). Median urea level at baseline was 2.10 mmol/L (SD 3.00) (normal range: 1.8 to 7.1 mmol/L) and mean creatinine level

was 45.6 $\mu\text{mol/L}$ (SD 8.82) (normal range: 44 to 97 $\mu\text{mol/L}$). The mean P_{osm} was 287.73 (SD 5.71) mOsm/kg and the measured urine osmolality, U_{osm} was 377.93 (SD 154.13) mOsm/kg. Calculated mean Urine specific gravity, U_{sg} was 1.28 (SD 0.55). (Table 2)

Subsequent measurements were taken and recorded at 3rd week and 6th week post partum. Only 15 respondent were able to complete all three visits with records of fluid input and output monitoring as well as completing all the hydration status biochemical assessment. Results showed that the haematocrit levels were elevated by the 3rd week of postpartum [mean 39.06% (SD 4.40)] and by 6th weeks [mean 39.35% (SD 3.55)] with the median of 40.1% (SD 14.00). (Table 2)

Mean urea at 3rd week postpartum was 3.37 mmol/L (SD 1.09) while the median creatinine was 59.00 $\mu\text{mol/L}$ (SD 35.00). However these indices increased by 6th week postpartum with mean urea level at 3.81 mmol/L (SD 0.97) and the mean creatinine level was; 59.93 $\mu\text{mol/L}$ (SD 9.04). These patients had P_{osm} of 297 mOsm/kg (SD 24.00) at 3rd week postpartum, while the mean U_{osm} was 652.46 mOsm/kg (SD 170.83) during the same period. The repeated measurement by 6th week post partum revealed mean P_{osm} almost unchanged, 297.33 mOsm/kg (SD 3.55). Yet, the calculated mean U_{osm} seems to be lesser at 6th week, 644.46 mOsm/kg (SD 241.93). (Table 2)

For the 15 women who completed the study, the measured U_{sg} was 1.28 (SD 0.55) at baseline and showed an increased pattern in the 3rd week to 2.18 (SD 0.59) and remained so by 6th week postpartum, 2.17 (0.78). These women were also analysed on their cumulative fluid intake and output through the 3rd and 6th week postpartum. The median cumulative amount for total fluid intake at 3 weeks was much less than at 6 weeks; 1780 ml/day per person as compared to 2130 ml/day. The fluid output also showed similar pattern, at 3rd weeks it was 1083 ml/day and increased a bit at 6th week postpartum to 1216 ml/day per person. (Table 2) The measurable output was only through the urine output. Although the patients did document the frequency of bowel opening and breast feeding in the diary, unfortunately they were not able to quantify it to be analysed. (Table 3)

Friedman Test was used to compare the differences of haematocrit, P_{osm} , urea and creatinine values between all 3 periods (baseline, 3rd week, 6th week). There was no significant change on haematocrit values ($p=0.057$). Urine specific gravity, U_{sg} had significant increment ($p<0.002^a$) from baseline to 3rd week and 6th week. (Table 3)

On the other hand, as postpartum period progressed significant changes can be seen in P_{osm} ($p<0.001$), urea ($p=0.001$) and creatinine ($p=0.008$) from baseline to 3rd week and also from baseline to 6th week postpartum. Post hoc Bonferroni analysis was done for urea level and showed significant increase level from baseline to 3rd week ($p=0.009$) and from baseline to 6th week ($p=0.001$). Similarly for creatinine, post hoc Bonferroni analysis showed a significant increase level between baseline and week 3 ($p=0.004$) and between baseline and week 6 ($p=0.004$). P_{osm} were also analysed and showed a significant increase level

between baseline and week 3 ($p=0.001$), and between baseline and week 6 ($p=0.001$) and significant between week 3 and week 6 ($p=0.008$). (Table 3).

Table 2: Description of biochemical values among low risk post partum women (N=15) at baseline, 3rd week and 6th week.

Variables (N= 15)		Baseline, Day 1	Week 3	Week 6
Haematocrit (%)	Mean	35.26 (4.09)	39.06 (4.40)	39.35 (3.55)
	Median			40.10 (14.00)
Urea (mmol/L)	Mean	2.37 (0.81)	3.37 (1.09)	3.81 (0.97)
	Median	2.10 (3.00)		
Creatinine (umol/L)	Mean	45.60 (8.82)	60.26 (10.68)	59.93 (9.04)
	Median		*59.00(35.00)	
Convert creatinine(mg/dl)			0.68(0.12)	0.68(0.1)
		0.52 (0.1)	*0.67(0.4)	
Urea/ creatinine (mmol/L)/(mg/dl)		4.56	5.02	5.60
Plasma Osmolality (mOsm/kg)	Mean	287.73 (5.71)	300.93 (7.37)	297.33 (3.55)
	Median		297.00 (24.00)	
Urine Osmolality (mOsm/kg)	Mean	377.93 (154.13)	652.46 (170.83)	644.46 (241.93)
Urine SG	Mean	1.28 (0.55)	2.18 (0.59)	2.17 (0.78)
Cumulative fluid:				
Input (ml/day)	Median	*NR	1780 (3350.5)	2130(907.9)
Output (ml/day)	Median	*NR	1083 (969.6)	1216(850.8)

*NR – not related as no fluid measurement taken upon day one post delivery.

Table 3: Repeated Measures Analysis of biochemical values among low risk post partum women at baseline, week 3 and week 6, (N=15).

Variables	Baseline	Week 3	Week 6	F-statistic	p-value
Haematocrit, mean (SD)	35.26 (4.09)	39.06 (4.40)	Mean: 39.35 (3.55) Median: 40.10 (14.00)	-	0.057 ^b
Urea, mean (SD)	Mean: 2.37 (0.81) Median: 2.10 (3.00)	3.37 (1.09)	3.81 (0.97)	-	0.001 ^b
Creatinine, mean (SD)	45.60 (8.82)	Mean: 60.26 (10.68) Median: 59.00 (35.00)	59.93 (9.04)	-	0.008 ^b
Plasma Osmolality, mean (SD)	287.73 (5.71)	Mean: 300.93 (7.37) Median: 297.00 (24.00)	297.33 (3.55)	-	< 0.001 ^b
Urine Osmolality, mean (SD)	377.93 (154.13)	652.46 (170.83)	644.46 (241.93)	F(1.026, 14.365) = 13.926	0.002 ^a
Urine SG, mean (SD)	1.28 (0.55)	2.18 (0.59)	2.17 (0.78)	F(1.134, 15.883) = 13.264	0.002 ^a

^ap-value is significant at 0.05 using repeated measures ANOVA

^bp-value is significant at 0.05 using Friedman test

Discussion

Out of 960 women who were screened for the low risk post partum mothers during the six months duration of study only 56 met the inclusion criteria. Low risk postpartum women in this study included singleton pregnancy with uneventful antenatal history; delivered vaginally and with uncomplicated post delivery. The small sample size in this study is explained by the fact that being in low risk and considering themselves healthy, the majority were reluctant to commit to a strict fluid monitoring as

required in this study during the confinement period. They were also keen to undergo their confinement period back in their hometown under the care of senior or close relatives care outside of the state. Only 15 women were able to complete the whole course of study till the end 6th week postpartum. Attrition rate was as high as 73%, contributed by reluctance to come for follow up visits since they were considered low risk, with no medical complaints that needed any medical attention. This is very much influenced by the cultural beliefs that since there were no medical problems it is best to complete the confinement phase in bound at home. Few cited transportation difficulties as reasons not to continue the study. Thus, due to these limitation, the baseline data comprised 56 patients while 15 of them completed all parameters of study measured at 3 different intervals.

The majority of our patients were of Malay ethnicity which reflects the demography composition in Malaysia where 61% of 32 million citizens are Malay (Statistic Department Malaysia). The majority of the Malay mothers still hold on to cultural practices during confinement period which include a strict regime of food and fluid intake, having series of traditional massages and abiding to ample rest that is translated into immobility and forbiddance to go out of home, for at least 40 to 60 days post partum, with the good intention to ensure good recovery period for both mothers and babies (Koon et al., 2005). Regardless of the fact that the majority of mothers' mean age were within reproductive age and many were with multiple children (multiparous) indicating that they did have experience taking care of babies, the family and society support system usually will still ensure that a senior person take care of the mother and baby during this period. Malaysia is a modern developing country and the majority of women were well educated and have careers, yet, these do not stop them from adhering to the traditional practices as a way for recovery after birth (M, N and E, 2018). The only things that may have changed were that services like massage therapy and confinement nurse have been commercialised in recent decade with trained masseurs and midwives using battery operated massaging tools as well as modern sauna apparatus. However the principles in restricting food, fluid and mobility are still highly observed.

The biochemical analyses for baseline group at day 1 post partum majority reflects normal values for hydration status. The haematocrit were normal range as expected $35.26\% \pm 4.09$ as these women were not anaemic and there were no post partum haemorrhages post deliveries. Haematocrit is a haematological indices that can resemble the hydration status with the relation to risk of VTE. There was a study that revealed a multivariable hazard ratios per 5% increment of hematocrit for the total population which adjusted for age, body mass index and smoking were 1.25 (95% CI: 1.08–1.44) for total venous thromboembolism which is a risk factor in a general population (Braekkan et al., 2009). The mean haematocrit in 3rd week and median in 6th weeks increased in as much as 4–5% which may indicate mild dehydration had ensued despite no significant history of fluid loss recorded. Median was used instead of mean in some of the parameters due to skewness and not normally distributed in such a small sample. ANOVA did not show any significant increment of haematocrit seen at 3rd and 6th week ($p = 0.057$).

Blood urea and creatinine indicate the general status of renal function. Both are important in assessing the glomerular filtration rates which in turn is crucial in maintaining body fluid and electrolytes. Elevated

urea more than creatinine in ratio, may indicate acute dehydration although it needs to be confirmed with clinical correlation.. Increased blood urea and creatinine ratio (mmol/L)/(mg/dl) > 15 (odds ratio [OR] 8.75) is an independent risk factor of developing venous thromboembolism in post acute ischaemic stroke (Kim et al., 2017). However urea is sensitive to dietary intake as it is the end product of protein and to physiological changes as compared to creatinine which is more stable in reflecting the renal function. Though urea is sensitive yet not specific, it is easily accessible and good in assessing general hydration status and renal function which explains its broad usage.. Our patients who were of low risk postpartum group, as expected showed normal hydration status and normal renal function at day 1 post delivery based on their urea and creatinine levels. However, repeated measurement analysis done at 3rd and 6th week post partum revealed significant increment of urea and creatinine level ($p = 0.001^b$ and $p = 0.008^b$). Despite significant increment, the calculated ratio increased to not more than 15. Thus, this indicated that our group of mothers a degree of less hydrated as compare to day 1 postpartum.

Plasma and urine osmolality are more reliable parameters in assessing hydrational status. They are subject to multiple factors especially when there are changes in the electrolytes and fluid intake itself (Armstrong et al., 2013). Yet, our patients who were all from low risk uncomplicated post partum group had normal electrolytes values hence ensuring that the calculated values of both plasma and urine osmolality in this study were unlikely to be influenced by electrolytes imbalance. Plasma osmolality, P_{osm} for adult generally ranges between 285-295 mOsm/kg H₂O while random urine osmolality, U_{osm} normally ranges between 50-1200 mOsm/kg H₂O (Tuazon, 2020). A twelve to 14-hour fluid restriction generally produces more than 850 mOsm/kg H₂O (SI units) U_{osm} which suggests dehydration (Wilczynski, 2019). Plasma and urine osmolality are best compared together to get a better idea upon the hydrational status reflected by the kidney function. In our study, there was statistically significant increment of P_{osm} and U_{osm} between day 1 to 3rd week and 6th week post partum (Fig. 3). Although the U_{osm} did not reach the dehydrated level > 850 mOsm/kg H₂O (Wilczynski, 2019), $P_{osm} > 296$ mOsm/kg is considered a hyperosmolar state and is associated with high risk of mortality among acute stroke (Bhalla et al., 2000). It further support that these post partum women has been underhydrated during the confinement phase.

Urine specific gravity, U_{sg} is commonly used as general tool for hydration status too, as the specimen is easily collected in a simpler clinical setting i.e outpatient clinic. It is known to be sensitive but not specific. It has been compared with P_{osm} and U_{osm} for more accurate measurement of hydration among athletes. Yet, osmolality in both urine and plasma have better specificity in comparison. Nevertheless, our patient did have significant increment of U_{sg} measurement > 1.010 which may suggest mild dehydration, and similar with other parameters throughout the duration of 3 weeks of confinement and relatively the same from 3rd week to 6th week.

Study by J Kelly et al has shown that dehydration itself is a strong independent association with VTE in patients with acute post cerebrovascular event. It revealed that significant risk of VTE with increment of P_{osm} , urea and also urea creatinine ratio (Kelly et al., 2004). Another study revealed that fluid, electrolyte and acid-base disorders had strong significant multivariate analysis ($P << 0.001$) in risk of developing

stroke and intracranial venous thrombosis post partum similar as cesarean delivery and hypertension during both peripartum and postpartum (Lanska and Kryscio, 2000).

Despite having a small cohort of sample, our study consistently revealed that the women with low postpartum risk, with limiting ambulation within their house but otherwise had normal dietary intake has been relatively dehydrated. There is no one specific biochemical measurement that able to quantify the hydration status accurately due to the dynamic process of the kidney, post partum hormonal recovery and breast feeding among these women. Yet, almost all the indices measured suggested of less hydration state among them. Although these women had been complying to the advice to maintain adequate oral hydration, the calculated amount of fluid intake was rather low, slightly more than 1.5L/day (1.78L/day at 3rd week and 2.13L/day) and the measured output were only 1L to 1.2 L/day without calculating the insensible water loss (Fig. 2). The recommended amount of fluid intake for lactating mother is 3.1 liters equivalent to 13 cups per day, as compared to non-lactating mothers where the requirements are obviously less with 2.2 liters (9 cups per day) and 2.3 liters (10 cups per day) ("Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate" at NAP.edu, 2004). Thus; our findings suggested that our local low risk nursing mothers are most likely under hydrated during the three to six weeks post partum. A study among Mexican women revealed fluid intake in between 2.62 L per day to 2.75 L per day during the first week of confinement. A large study in Indonesia with almost similar Asian cultural background showed that the fluid intake among the nursing mothers during the first week postpartum were 2.3L to 2.5 L per day. Although both study were studying the total of fluid and calorie intake in the first week post delivery among lactating mother with various socioeconomic background; both seems to have less fluid intake than recommended. Both studies did not have any hydration biochemical parameters assessed. Our data showed that the mothers' fluid intake was even lower which may predispose them to risk of dehydration and possible venous thromboembolism.

Limitation

It was rather challenging to recruit local women with low risk postpartum to commit with the prospective nature of this study that required series of visits. Despite the small sample size however, there were interesting statistically significant changes seen on the hydration parameters up to 3rd and 6th week post partum which correlated with the lower measured amount of fluid input. Perhaps a larger cohort of samples, from multicentre data where shorter distance between the home and research centre may provide promising results as it will improve subjects compliance to protocol. A comparison study between a controlled fluid intake and non control group may also provide better comparison for analysis. Calculating the insensible water loss from passing motion and breast feeding may provide more accurate amount of water loss, which our study unable to quantify. Nevertheless this study is a stepping stone for a larger study in the impact of fluid intake on the hydration status. It is a good evidence that more measures are required to educate and enhance post partum care and fluid intake among post partum women in the local communities.

Conclusion

This study aimed to evaluate the hydration status among low risk post partum women during the six week of confinement period within a Malaysian cultural setting . Despite a small cohort of samples there were statistically significant evidence of underhydration among these local women from the biochemical parameters taken namely the urea, creatinine, urine specific gravity, plasma and urine and osmolality. This was further supported by evidence of low fluid intake measured perday as compare to other studies and recommendation for nursing mother during confinement. Although underhydrated, these women were not dehydrated and had normal electrolytes levels. However, this may predispose the low risk group to possible risk of developing venous thrombosis. Perhaps, a bigger cohort may provide better correlation between hydration and water intake to risk of developing venous thromboembolism. Nevertheless, this evidence is good enough to emphasize upon our low risk group of women to adequately consume fluids during confinement a ensure healthier mother, successful breast feeding and reduce risk of venous thrombosis.

Abbreviations

P_{osm}	Plasma osmolality
SD	standard deviation
U_{osm}	urine osmolality
U_{sg}	urine specific gravity
VTE	venous thrombosis event

Declarations

Ethics approval and consent to participate

Study approved by National Malaysian Research Registry (NMRR-16-1361-29016) for ethics and publication.

Consent for publication

Study approved by National Malaysian Research Registry (NMRR-16-1361-29016) for ethics and publication.

Availability of data and material

The datasets generated and analysed during the current study are not publicly available due personal information and policy by the university but are available from the corresponding author on reasonable

request.

Competing interests

The authors have no competing interest.

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Authors' contributions

All authors involved in study process, from proposal application, collecting samples, data entry, writing and reviewing the manuscript.

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Figures

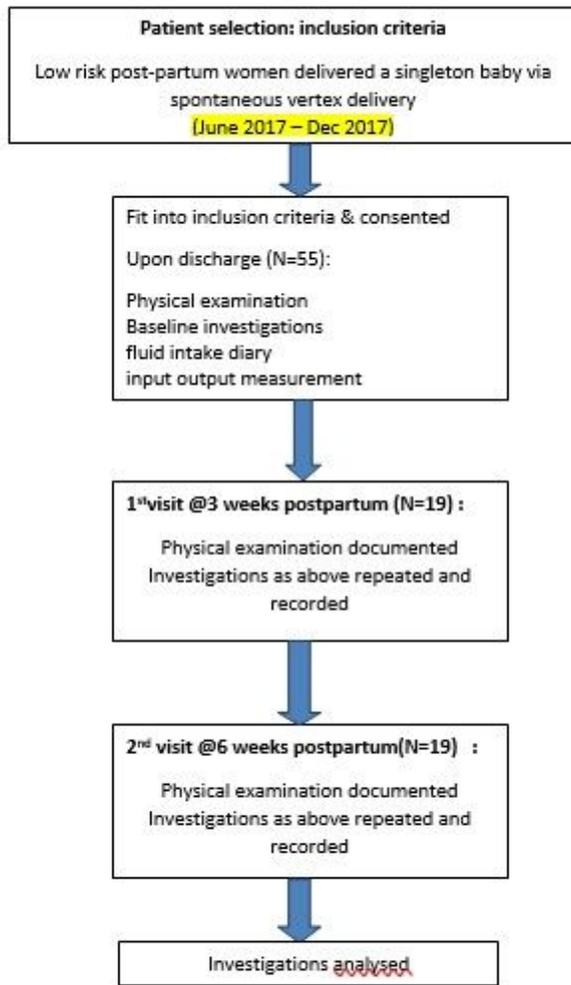


Figure 1

Study Flowchart for Recruitment and Followup Visits