Available online: http://journal.ipb.ac.id/index.php/jgizipangan ***J. Gizi Pangan, March 2022, 17(1):47-56***
Accredited based on DGHE, Republic of Indonesia No. 28/E/KPT/2019 *DOI: https://doi.org/10.25182/jgp.2022.17.1.47-56*
ISSN 1978-1059 EISSN 2407-0920

An Additional Adequate Water Intake Increases the Amniotic Fluid Index in Pregnant Women with Oligohydramnios: A Systematic Review

Tria Rosemiarti[1], Parlindungan Siregar[2], Hardinsyah Hardinsyah[3*], Sudung O. Pardede[4], Budi Iman Santoso[5], Ras Adiba Riza[5], Erinna Tjahjono[6]

[1]Department Nutrition and Science of The Tirta Investama, Jakarta 13920, Indonesia
[2]Siloam Hospitals Lippo Village, Tangerang, Banten 15811, Indonesia
[3]Department of Community Nutrition, Faculty of Human Ecology, IPB University, Bogor 16680, Indonesia
[4]Department of Pediatrics, Faculty of Medicine, Universitas Indonesia/RSCM, Jakarta Pusat 10430, Indonesia
[5]Department of Obstetrics and Gynecology, Faculty of Medicine, Universitas Indonesia/RSCM, Jakarta Pusat 10430, Indonesia
[6]Department of Medical Editorial of The Inti Medika, Jakarta 12310, Indonesia

ABSTRACT

This systematic review aimed to answer whether an additional amount of water intake can increase the Amniotic Fluid Index (AFI) in pregnant women with oligohydramnios. Article searches were conducted and data was obtained from "SCOPUS", "EBSCO", "PUBMED", "COCHRANE" and "Google Search" databases using the following keywords: "hypovolemic", "dehydration" "pregnancy" "outcome", "hydration". "water intake", "oligohydramnios", and "amniotic fluid index". We used MeSH headings (hydration pregnancy) for search keyword, Inclusion criteria were subjects who were pregnant women with oligohydramnios (without any pathological disorder in the mother and fetus), the outcomes include AFI of <5 cm, study design was prospective cohorts and clinical trials, consumption of plain water (non-calorie beverages) and language restriction applied for articles published in English. Out of 391 articles, eight articles that met these criteria for anaylsis. Result showed that additional amount of water intake for pregnant women with oligohydramnios without maternal/fetal abnormalities in the third trimester (28−37 weeks) can increase AFI. Oral maternal hydration gave a better effect than intravenous maternal hydration on AFI. The additional amount of water intake per day required by pregnant women with oligohydramnios to increase AFI to normal ranges from 1,500 to 2,500 ml depending on the condition of each pregnant woman. Additional water intake via oral can be a strategy for oligohydramnios therapy in pregnant women.

Keywords: amniotic fluid index, oligohydramnios, pregnant women, water

INTRODUCTION

Water intake is extremely essential for maintaining body homeostasis. Inadequate water intake may cause dehydration, which can bring unpleasant impacts (Subudhi *et al.* 2012). The European Food Safety Authority has suggested that each person should consume adequate water intake and has recommended daily water intake of 2,500 ml and 2,000 ml for men and women, respectively, in order to maintain urine osmolality at 500 mOsmol/kgH^2O (EFSA 2010; El-Sharkawy *et al.* 2015).

Studies have shown that hydration improvement through oral and/or intravenous routes can improve Amniotic Fluid Index (AFI) in pregnancy (Borges 2011). However, the minimum amount of additional daily water intake for the prevention of oligohydramnios for pregnant women is still unclear.

A study on urban women residing in the Indonesian capital, Jakarta, showed that 52.6% experienced dehydration and the lack of water intake can cause oligohydramnios (Mulyani *et al.* 2021). Oligohydramnios is a clinical condition when the amniotic fluid volume is <500 ml or AFI of <5 cm or <5 percentile of gestational age or a single deepest pocket of <2 cm (Chauhan *et al.* 2018). In general, the prevalence of oligohydroamnios in pregnant women is 3−5%, and it commonly occurs in the third trimester (Aggarwal & Patra 2018). A study conducted in

[*]**Corresponding Author:** tel: +628129192259, email: hardinsyah.apps@ipb.ac.id
(Received 07-07-2021; Accepted 02-03-2022; Published 27-03-2022)

the low-middle income countries suggested that oligohydroamnios occurs at the incidence of 1 out of 150 pregnancies, and it is strongly associated with dehydration during pregnancy (Figueroa *et al.* 2020).

Pregnant women requires extra fluid as there are physiological changes and fetal growth to maintain. Physiologically, there is intra- and extracellular fluid retention in pregnant women to ensure good metabolism during pregnancy (Ekpenyong *et al.* 2020). Studies have demonstrated adequate hydration intervention in pregnant women may improve oligohydroamnios, either by oral or intravenous hydration (Rawat *et al.* 2015; Lanni *et al.* 2007).

Evidences have shown that adequate hydration therapy in pregnant women could improve conditions in oligohydramnios. A review based on four studies in 2009, regarding the correlation between water intake and oligohydramnios have supported this hypothesis. (Hofmeyr *et al.* 2010). However, it has not revealed which method or route to insert water (oral or intravenous) has more impact on AFI? and how much additional drinking water is sufficient to correct oligohydramnios? Based on the description above, this review aimed to answer the question: can additional water intake improve oligohydramnios (AFI)?

METHODS

This review is based on the following hypotheses and conceptual framework: Does additional water intake could improve oligohydramnios; if benefits are obtained, what is the recommended additional amount of water intake and how is it administered to pregnant women with oligohydramnios? (Figure 1). This review method was a quantitative systematic review which include studies that have numerical data.

Design, location, and time

The design of this study was a systematic review based on published articles during the last 15 years (2006−2021), using PRISMA reporting guidelines. This study will follow the following guidelines: 1) establishing eligibility criteria; 2) establishing information sources; 3) selecting the study; 4) establishing the data collection procedure; and 5) establishing the data item selection

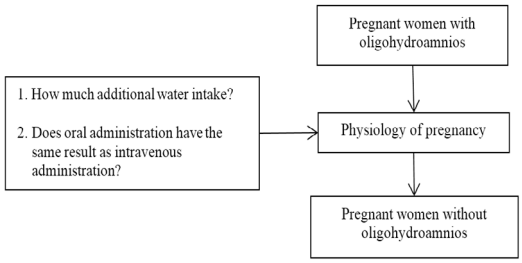


Figure 1. Conceptual framework

(Rethlefsen *et al.* 2021). Figure 2 illustrates the steps involved in performing a systematic review. The data source was secondary data, in which the data were obtained from results of previous studies. The sources of the data fulfilled inclusion criteria that had been determined earlier by the investigators. The Inclusion Criteria (IC) for this study included: 1) original and peer-reviewed research written in English, 2) pregnant women with oligohydroamnios (AFI of <5 cm) without any pathological disorder in the mother and fetus, 3) the design of the studies were clinical trials or prospective cohorts, and 4) consumption of plain water (non-calorie beverages). Only articles written in English were selected.

Study selection

The following four phases comprised the study selection process, as suggested by Rethlefsen *et al.* 2021: 1) Data were extracted

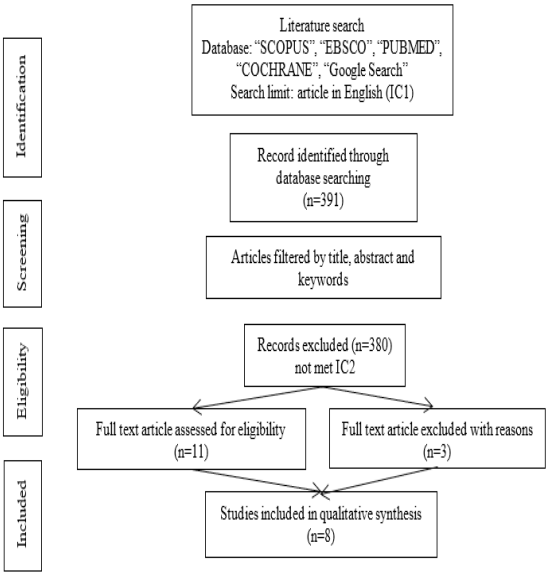


Figure 2. PRISMA flow diagram

by searching manuscripts from "SCOPUS", "EBSCO", "PUBMED", "COCHRANE", "Google Search" databases using the following keywords "hypovolemic", "dehydration" "pregnancy" "outcome", "hydration". "water intake", "oligohydramnion","amniotic fluid index"; 2) The title, abstract, and keywords of detected publications were analyzed and selected based on their eligibility requirements; 3) Complete or partial readings of the articles that were not removed in the previous phases were done to determine their suitability for inclusion in the review based on the eligibility criteria; 4) The reference lists of the publications were scanned to identify pertinent studies, and this phase was initiated with Phase 2.

The seven authors collaborated on these phases through an iterative process of author evaluations. Thus, any disagreements among the seven authors were discussed until a unanimous agreement was obtained. The summary table for this review was created manually from each selected study, using a data extraction form that included the following information: journal author, year, study setting, participant, research methods, study result, and conclusion. Each author evaluated publications that might be of relevance. The assessment procedure included reviewing both the complete text and the extracted data. These keywords resulted in the acquisition of 391 articles. However, only eight articles met the criterion for inclusion (Table 1).

RESULTS AND DISCUSSION

Results

Eight manuscripts met the criteria, which were included in the journal analysis. Table 2 presents a summary of eight selected studies including study design, sample size, intervention, results, strengths and weaknesses of each study. The obtained results of the studies discussed about oligohydroamnios in the third trimester (gestational age ranging from 28 to 37 weeks) of pregnancies.

The results showed that there were six articles discussed and compared oral and intravenous administration of water; and two articles discussed only oral administration in pregnancy. Regardless, the routes and the types of water administration, the result of each of eight studies show that water administration had an effect on improving oligohydramnios to be normo-hydramnios, which is measured by AFI.

All studies measured the quantity of additional water intake given to oligohydramnios pregnant woman with oligohydramnios whose gestational age ranging from 28−37 weeks. The result show that the quantity of additional water intake given to pregnant woman was between 1,500 ml to 2,500 ml per day. The duration of the water administration was from two hours until seven days, with the routes of administration through oral or intravenous.

In eight studies the water given were plain water and isotonic solution in four studies. The number of water administrated through oral ranging from 1,500 to 2,500 ml, and through intravenous ranging from 1,500 to 2,000 ml. All subjects in all studies with no pathological condition except oligohydramnios.

All of these studies have consistently provide evidences that oral hydration therapy for pregnant women with oligohydroamnios during the third trimester can increase AFI. Moreover, an oral hydration has better effect than intravenous

Table 1. Search strategies

Databases	Search strategies	Found	Used
SCOPUS	"hydration pregnancy" [MeSH Terms] OR ("preg-nant"[All Fields] AND "oligohydram-nios" [All Fields]) OR " amniotic fluid index" [all fields]	124	4
EBSCO	"hydration pregnancy" [MeSH Terms] OR ("preg-nant"[All Fields] AND "oligohydram-nios" [All Fields]) OR " amniotic fluid index" [all fields]	120	3
PUBMED	"hydration pregnancy" [MeSH Terms] OR ("preg-nant"[All Fields] AND "oligohydram-nios" [All Fields]) OR " amniotic fluid index" [all fields]	45	1
COCHRANE	"hydration pregnancy" [MeSH Terms] OR ("preg-nant"[All Fields] AND "oligohydram-nios" [All Fields]) OR " amniotic fluid index" [all fields]	7	1
Google search	Pregnancy and oligohydramnios, pregnancy and amniotic fluid index, hydration in preg-nancy, water intake in pregnancy	95	2

Tabel 2. Descriptive analysis of trials included in the systematic review

Authors & year	Study setting	Methods	Results	Conclusions
Lorzadeh *et al.* 2008	Design: Clinical trial. Subjects: 80 patients with low AFI and gestational ages greater than 35 weeks were studied without any maternal complications. AFI 5 cm, full-term gestational age greater than 35 weeks with intact amnion, maternal age between 15 and 38 years, women with parity of one to four Criteria for exclusion: Complications in the mother, including as hypertension, diabetes mellitus, cardiovascular, and hyperthyroidism; proven pre-eclampsia, verified fetal anatomical abnormalities as determined by ultrasound, and membrane ruptures.	Patients were randomized into four groups, which were: 1) Oral hydration group of 2,000 ml/2 hours; 2) Isotonic solution group of 2,000 ml/2 hours given by intravenous route (IV); 3) Hypotonic solution group of 2,000 ml/2 hours given by IV route; 4) Control group. Maternal AFI is determined prior to and following hydration treatment.	The increase in mean AFI following hydration treatment was significantly greater in the oral hydration group ($p<0.0001$), but not in the IV isotonic or IV hyptotonic groups compared to the control group.	In comparison to other groups, maternal hydration via oral water consumption is more beneficial. Numerous prior research have been undertaken to determine the effect of hydration therapy on AFI in oligohydroamniotic women. However, the majority of studies had a small sample size and studied pregnant women for a short length of time (gestational age >35 weeks). Additional studies with a large sample size and a wide range of gestational ages are needed to confirm the validity of this method in pregnant women with oligohydroamnios who are 35 weeks pregnant and have oligohydroamnios in order to avoid premature labor induction and serious consequences for mothers and their neonates.
Umber 2010	Design: Quasi experimental study. Subjects: 50 pregnant women with oligohydroamnios in the third trimester (AFI<5cm) were recruited prospectively. Inclusion criteria: Singleton pregnancy, full-term gestational age, intact amnion, absence of complications (moderate to severe anemia, heart disease, renal disease, moderate to severe pre-eclampsia or hypertension, or diabetes), absence of fetal morphological abnormality, and absence of symptoms of fetal distress.	The 50 patients were randomly assigned to one of two groups using a probability sampling technique (the intravenous hydration group and oral hydration group). The specific gravity of maternal urine and AFI were evaluated prior to and following hydration therapy. Within two hours, the intervention group received intravenous hydration therapy in the form of 2 liters 5% D/W. The group receiving oral hydration therapy was directed to consume 2,000 ml of water within two hours.	Hydration therapy improves amniotic fluid volume in pregnant women in the intravenous hydration group (altered mean AFI from 4.5 cm±1.25, CI:4.00−5.00; $p<0.05$), but not in the oral hydration group (altered mean AFI from 4.3 cm±1.23, CI:3.80−4.79; $p<0.05$). However, the percentage of mean AFI in the intravenous hydration group was 58.6%, which was not significantly greater ($p>0.05$) than the percentage of mean AFI in the oral hydration group, which was 58.2% In both groups, maternal hydration is associated with a decrease in urine specific gravity.	Although both intravenous and oral hydration enhance AFI in pregnant women with oligohydramnios, neither appears to be more effective at increasing amniotic fluid volume, and both may be beneficial in the management of oligohydroamnios (equal effect was found for oral and IV routes). This study suggests that hydration therapy can enhance amniotic fluid index and perinatal outcomes in patients with oligohydroamnios. Indeed, the outcomes may have detrimental implications related with oligohydroamnios.
Akter *et al.* 2012	Design: Randomized controlled trial. Subjects: 64 pregnant women with gestational age of 32 to 35 weeks within a year period in order to identify maternal hydration using oral route water drinking in subjects with oligohydroamnios with AFI<5 cm.	The women in the study were randomly assigned to one of two groups. Group A (intervention group): Patients were told to consume 2,000 ml water within two hours, followed by an additional 2,000 ml water each day for seven days. Subjects in Group B (control group) were permitted to drink water as normal. AFI was determined in both groups after two hours, 24 hours, and seven days of oral hydration treatment.	Mean AFI before therapy was 4.77 cm±0.42 (mean±SD) vs. 4.80 cm±0.43 (mean±SD), and post-therapy AFI was 6.35 cm±0.65 vs. 4.81 cm±0.42 after two hours, and 7.08 cm±0.21 vs. 5.0 cm±0.20 after 7 days, respectively, in the oral hydration and control groups. Labor occurs in 53.1% vs. 12.4% of women between 37 and 40 weeks, normal labor with vaginal birth occurs in 71% vs. 21.8%, caesarian section occurs in 29% vs. 78. 2%, and low birth weight infants occur in 12.5% vs. 81.25% in the intervention and control groups. Between intervention and control, the healthy fetus outcome was 87.1% vs. 59.4%, dyspnea was 12.9% vs. 50%, and perinatal death was 3.22% vs. 21.8%.	Maternal oral hydration therapy has significantly increased AFI, reduced caesarean section rate and increased fetal outcomes.

Continue from Table 2

Authors & year	Study setting	Methods	Results	Conclusions
Patrelli *et al.* 2012	Randomized controlled prospective study comparing pregnant women with idiopathic oligohydroamnios (group A, 66 women) against pregnant women without oligohydroamnios (control group, 66 women - group B, 71 women)	Oligohydramnios was identified using a 5 cm AFI. A 3.5-MHz convex probe was used for sonography. Daily intravenous infusions of 1,500 ml isotonic solution were administered to Group A for six days. AFI, non-stress test, and fetal bio-physical profile measurements were made on day 0 and day 7. Group A was subdivided into A1 and A2 subgroups. The subgroup A1 received 1,500 ml of oral hydra-tion per day, while the grouping A2 received 2,500 ml per day.	In general, no significant difference existed between the two groups. During recruitment, the mean AFI SD was 39.68±11.111 mm in group A, but 126.92±10.59 mm in group B ($p<0.001$). On day 7, the mean AFI in group A was 77.70±15.03 mm, whereas there was no change in group B. The mean AFI at birth was 86.21±16.89 mm in subgroup A1, but 112.45±14.92 mm in subgroup A2 ($p<0.001$). There was no statistically significant difference in fetal and neonatal outcomes between the control and study groups, as measured by the APGAR score, the pH of the umbilical artery at birth, and the necessity for transfer to a neonatal intensive care unit.	The study clearly demonstrated that pregnancies with oligohydroamnios who received acute phase intravenous hydration therapy for six days had significantly increased amniotic fluid volume compared to pregnancies without complication at the same gestational age who did not receive hydration therapy during the same time period. The study's data indicate that intermittent oral hydration therapy of 2,500 ml/day considerably raised amniotic fluid volume, resulting in normal AFI at birth. Only by randomly assigning group A to two subgroups with varying daily oral hydration protocols (i.e. 1,500 ml in subgroup A1 and 2,500 ml in subgroup A2) were the investigators able to determine critical and novel elements, namely the volume of daily drinking water intake required to achieve optimal performance. Indeed, even when both groupings reported an increase in AFI following medication, 2,500 ml daily oral intake may result in a higher rise in AFI than 1,500 ml daily oral intake. The study's primary limitation may include its small sample size.
Zafar *et al.* 2017	Design: Randomized controlled trial. Subjects: 80 pregnant women with gestational age of >28 weeks, AFI of <5cm, singleton pregnancy and intact membrane	Subjects were randomized and categorized into two groups of 40 people in each group. Group A received extra water intake of 2,000 ml in addition to their daily intake for seven days and group B was the group with daily usual hydration and their water intake was determined based on their sensation of thirst. AFI was measured before and after hydration therapy in 48 hours and one week following the therapy.	The pre-treatment mean AFI was 3.45 cm±0.50 in group A and 3.40 cm±0.49 in group B ($p=0.656$). The post-treatment mean AFI in group A was 6.83 cm±0.81 and it was 5.05 cm±0.75 in group B ($p=0.001$).	There was a significant increase of AFI after additional oral hydration therapy compared to daily usual water intake in subjects with oligohydroamnios during their third trimester and the therapy can be used compared to the invasive technique.
Ali & Ahmad 2018	Design: A quasi-experimental study model Subjects: 45 pregnant women with oligohydroamnios and the women were categorized into three groups of 15 women in each group: the first group received Intravenous (IV) isotonic solution,	The form of therapies in the three group were: 1) IV isotonic solution (normal saline) of 2,000 ml/2 hours; 2) IV hypotonic solution (Ringer solution) of 2,000 ml/2 hours; 3) Oral water intake of 2,000 ml/2hours. The instruments used in the study were: maternal questionnaire,	AFI increased significantly from 0.35 cm±0.07 to 1.7 cm±0.5 in IV isotonic group; while AFI increased significantly from 0.37 cm±0.08 to 1.9 cm±0.9 in IV hypotonic group. Moreover, increased AFI was found more obviously from 0.37 cm±0.07 to 2.7 cm±0.8 in the oral hydration group. The maternal and fetal outcomes were not significantly different among the groups, but the increase was more obvious in the oral hydration group AFI	The study showed a good effect of oral hydration compared to intravenous route. Women with oligohydroamnios might have a better chance of cure using oral hydration therapy than intravenous fluid and might achieve better maternal and fetal outcome with oral hydration therapy compared with other methods in other groups.

Continue from Table 2

Authors & year	Study setting	Methods	Results	Conclusions
	the second group received hypotonic IV solution and the third group received drinking water.	sonography report to measure AFI in women with oligohydroamnios before and after hydration, fluid diagram and data form of mothers and their babies.	increased significantly in the IV isotonic group and IV hypotonic group. However, AFI increased more obviously in the oral hydration group. Outcomes: Mode of delivery and the incidence of PPH were not significantly different among the groups. Moreover, APGAR score of five and NICU care as neo-natal outcomes were not significantly different among the groups.	Oral hydration is recommended for pregnant women with oligohydroamnios until the labor. Limitation: It was an interventional study and therefore, it was difficult to perform randomization and there was no control group to compare the interventional effectiveness.
Zafar *et al.* 2020	Design: Randomized clinical trial. 38 pregnant women with gestational age of 28−36 weeks, AFI<5 m, singleton pregnancy and intact membrane.	Subjects were randomized and categorized into two groups and each group contained 19 subjects. Group A received water intake of 2,000 ml within two hours every day for one week and group B received 2,000 ml intravenous fluid within 24 hours for 1 week. AFI was measured before and after 48-hour hydration and one week later.	Baseline AFI before therapy was 3.316 cm±0.8368 in group A and it was 3.211 cm±0.8178 in group B (p=0.697). AFI after 48 hours for group A was 5.926 cm±0.4593 and it was 5.784 cm±0.4622 for group B (p=0.348). AFI after 7 days was 8.286 cm±0.6000 for group A and 7.868 cm±0.2810 for group B (p=0.014).	There was a significant increase of AFI after oral therapy compared to those receiving intravenous fluid. Oral hydration can be used instead of intravenous hydration because it is simple, safe and noninvasive method. It is also easily acceptable to the patient.
Malik *et al.* 2021	Comparative prospective survey design (trial pre-post two groups of oral and IV). There were 100 patients with singleton pregnancy (50 in each group) with an AFI of <5cm gestational age of 28−37 weeks.	Patients were randomly assigned to two groups (each with 50 patients) using a lottery system. Patients in group A were told to drink 2,000 ml water everyday for seven days, whereas those in group B were given 2,000 ml 5% D/W in addition to their normal fluid intake. In both groups, the amniotic fluid index was determined before and after hydration.	Improvement was reported in 39 (78%) of group A patients and 22 (44%) of group B patients following the experiment (p<0.001). The pre-hydration mean AFI was 4.79 cm±0.53 in group A and 4.87 cm±0.36 in group B (p=0.383). The post-hydration mean AFI in group A was 6.79 cm 1.22 and in group B was 5.97 cm 1.37 (p=0.002).	In women with oligohydroamnios, oral hydration therapy is more successful than intravenous hydration therapy in terms of the frequency of increased amniotic fluid volume during the third trimester.

AFI: Amniotic Fluid Index; PPH: Post-Partum Hemorrhage; APGAR: Appearance, Pulse, Grimace, Activity, Respiration; NICU: Neonatal Intensive Care Unit

fluid therapy on AFI. This study has demonstrated that non-calorie water intake of 1,500−2,500 ml/day through oral route within several hours for seven days during the third trimester of pregnancy could increase and achieve normal AFI.

Discussion

The present review supports the previous review by Hofmeyr *et al.* (2002) that both oral hydration administration and intravenous solution administration can increase AFI in pregnant women with oligohydramnios. Furthermore, the majority of eligible studies (five of eight study) reported information regarding the oral administration gave a better effect than intravenous maternal hydration on AFI in pregnant women with oligohyramnios. The amount of additional water intake of 1,500 to 2,500 ml/day during the third trimester of pregnancy with oligohydramnios is suggested in order to increase and achieve a normal AFI.

The body weight of women at full-term pregnancy increases approximately 12.5 kg, which consists of six to eight liters of extracellular fluid (intravascular and interstitial fluid) and the remaining is intracellular fluid. The interstitial fluid includes amniotic and placental fluid (Cunningham *et al.* 2014; IOM 2009). Water accounts for around 62% of total gain at term, fat accounts for 30%, and protein accounts for 8%; however, these figures vary considerably. The component of weight increase attributable

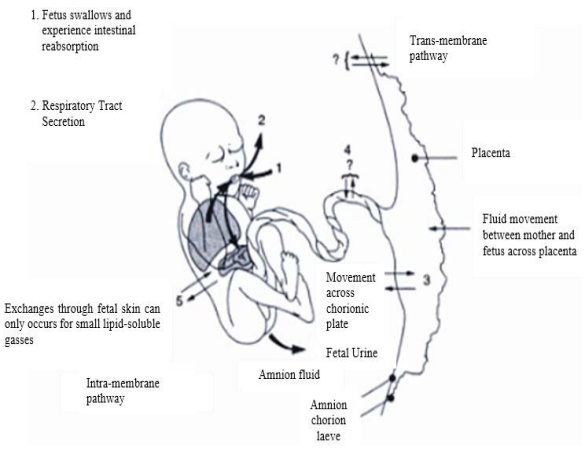
to bodily water is the most variable. A positive correlation between increased total body water and infant birth weight has been documented (Kominiarek *et al.* 2017; Mulyani *et al.* 2021). At the early stage of pregnancy, there is reduced plasma osmolality, which causes reduced sense of thirst and secretion of antidiuretic hormones. (Carmody *et al.* 2009). Fluid requirements depend on energy intake, which is 1 to 1.5 ml fluid for each kilocalorie of energy intake. During pregnancy, there is increased mean energy expenditure of 300 kcal/day; therefore, a pregnant woman needs at least 300 ml additional water intake (one glass to two glasses). Furthermore, additional water intake is required for amniotic fluid, 500−1,200 ml (Indonesian Society of Obstetrics and Gynecology 2013).

Prerequisite for well intrauterine development of fetus and good neonatal outcome is adequate amniotic fluid. Available data suggests that hydration has advantages in increasing amniotic fluid volume in subjects with oligohydroamnios and normo-hydramnios. However, the mechanism of how maternal hydration could increase amniotic fluid volume still not yet understood. Five studies have been conducted to compare the effectiveness between oral and intravenous hydration and all of those studies reveal that oral route is more effective than the intravenous. The advantages of oral hydration are that it is easy, low budget, noninvasive and it does not need hospitalization or strict monitoring (Zafar *et al.* 2020). Kilpatrick and Safford reported that maternal hydration increases AFI, both in subjects with oligohydroamnios and normo-hydramnios (Kilpatrick *et al.* 1991; Kilpatrick *et al.* 1993). Fait *et al.* (2003) demonstrated that 75% of mothers with oligohydroamnios who consumed water of 2,000 ml/day have increased AFI as much as 50%. Increased hydration in pregnant women could speed up the mean uterine artery rate, which will result in increasing AFI; however, the mechanism of this increase has not been clearly identified. The increase may be caused by increased perfusion of uterine placenta.

Amniotic fluid is mostly created by fetal urine during the second trimester of pregnancy and is eliminated via fetal swallowing. Additionally, amniotic fluid is absorbed through the fetal lungs and placenta. When nearing full-term pregnancy, maternal hydration and osmolarity have an effect on the volume of amniotic fluid, which has an effect on the production and reabsorption of fetal urine (Figure 3 and Figure 4). Shahnazi *et al.* (2012) demonstrate that increased water intake in pregnant women with oligohydroamnios will increase utero-placental blood flow and increase the production of fetal urine, hence increasing the amniotic fluid volume.

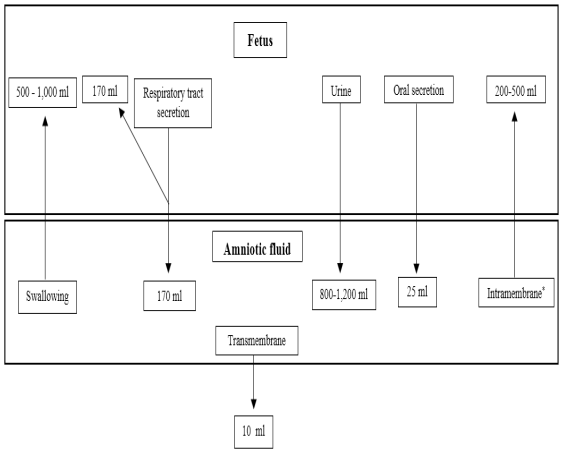
In adults, diuresis has direct correlation with osmolality and intravascular fluid volume. Based on clinical data, fetal could have a response to osmolality changes and maternal intravascular fluid volume. The production of fetal urine may alter with maternal osmolality changes. A previous study showed that improvement of utero-placental perfusion as a result of increased maternal plasma volume would increase fetal oxygenation (Shahnazi *et al.* 2012). Magann *et al.* (2011) demonstrated that amniotic fluid volume and AFI increase significantly after pregnant women experienced oral hydration.

Oligohydroamnios could cause complications in pregnancy and affects mother and fetus. Based on study by Wright *et al.* (2010), it is found that normal maternal hydration status could reduce prematurity rate, abortion rate and other complications, both for mother and fetus. A cohort prospective study by Mulyani *et al.* (2018) in Jakarta revealed that, there are differences in water intake levels between dehydrated and hydrated pregnant women. Mean body weight and length, head circumference, and chest circumference of the newborns from dehydrated pregnant women were lower than those from hydrated pregnant women (Mulyani *et al.* 2021).



Source: Brace (2004)

Figure 3. Movement of fluid flow into and out of the amniotic cavity



Source: Brace (2004)

Figure 4. Movement pathway of fluid flow into and out of the amniotic cavity

The results of the study have implications on the urgency of healthy hydration education such as amount of water intake, quality and safety of drinking water for productive age women, expectant mothers as well as pregnant women. The IOM determined the dietary reference value for total water consumption based on the median total water intake observed in NHANES III, which was 3,000 ml/day for pregnant women (IOM 2004). In terms of public health, according to the Ministry of Health of the Republic of Indonesia's decree number 28 of 2019, it is advised that pregnant women in Indonesia take between 2,450 and 2,650 ml of water per day, or the equivalent of approximately 10−11 glasses (MoH RI 2019). As with EFSA, the Indonesian Ministry of Health established dietary reference values based on a theoretical relationship between water and energy intake, recommending that between 1−1.5 ml of water should be consumed for each kcal of energy intake (Bardosono *et al.* 2017). The other reason is mean body weight and height of healthy adult female in calculating the DRI of water by IOM (2004) was 61 kg and 163 cm respectively; while for calculating DRI of water for Indonesian women by MoH RI was 55 kg and 159 cm. Assuming similar level of physical activity, at normal condition the lower the body weight the lower the requirement for energy and water, as such also applies to pregnant women.

Implementation of healthy hydration education recommendation at individual and clinical settings for pregnant women depends on various things such as body size, physical activity, gestational age, environmental temperature and health condition. For this purpose, healthy hydration education and training are important for healthcare professionals, productive age women, expectant mothers as well as pregnant women. Pregnant women with specific health problem should consult to healthcare professionals.

In addition, since the mechanisms of water intake for overcome oligohydramnios are not fully understood, further studies are required to identify the mechanism of hydration to increase AFI in pregnant women with various kind of pathological conditions as well as the minimum water requirement of each pathological condition.

CONCLUSIONS

Pregnant women with oligohydramnios without other maternal/fetal abnormalities in the third trimester (28−37 weeks) could increase AFI through drinking water. Oral hydration provides a better effect than intravenous hydration on AFI in pregnant women with oligohydroamnios. The additional adequate water intake for pregnant women with oligohydramnios in order to have the effect of increasing and achieving a normal level of AFI, ranges from 1,500 to 2,500 ml or the equivalent of about six to ten glasses per day depends on the clinical condition of the pregnant woman. Healthy hydration educational sessions are necessary for healthcare professionals, productive age women, expectant mothers as well as pregnant women. Especially, for pregnant women this education should stress on the amount of water intake required for pregnant women to prevent the development of oligohydroamnios.

Further studies are required to identify the mechanism of hydration to increase AFI in pregnant women with various pathological conditions. It is crucial to conduct a review about the effects of the quality of drinking water of pregnant women on fetal and neonatal growth and development, with emphasize on linear growth and cognitive function.

ACKNOWLEDGEMENT

The researcher would like to extend its gratitude and appreciation to Netta Meridianti Putri who participated in the literature search.

DECLARATION OF INTERESTS

There is no conflict of interest in this present study.

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