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Effect of Intravenous Hydration on Oligohydramnios: A Quasi-Experimental Study from a Tertiary Care Setting

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ABSTRACT

Background: Oligohydramnios, characterized by reduced amniotic fluid volume, is a pregnancy complication associated with adverse maternal and fetal outcomes. Despite evidence supporting maternal hydration, variability in response and limited regional data create a gap in understanding the effectiveness of intravenous hydration in improving amniotic fluid index (AFI). **Objective:** This study aimed to evaluate the effect of intravenous hydration on AFI in pregnant women diagnosed with oligohydramnios and to analyze the influence of demographic and clinical variables such as BMI, comorbidities, and baseline AFI on treatment outcomes. **Methods:** A quasi-experimental study was conducted at CMH Peshawar over six months, enrolling 149 pregnant women aged 18–40 years with singleton pregnancies and gestational age >34 weeks. Participants received 1L of Ringer's lactate daily for five days. Baseline and post-treatment AFI were measured using transabdominal ultrasound. Inclusion criteria required intact membranes; exclusions included congenital anomalies, IUFD, multiple gestation, and non-pregnancy-related medical conditions. Ethical approval was obtained from the hospital's committee and CPSP Karachi per the Declaration of Helsinki. Data were analyzed using SPSS v23.0 with appropriate tests for parametric and non-parametric variables. **Results:** A significant improvement in mean AFI was observed post-hydration (5.2 ± 1.5 cm to 8.1 ± 1.3 cm; $p = 0.00$). Overall, 80.5% showed improvement. Response was significantly associated with urban residence ($p = 0.03$), normal BMI ($p = 0.04$), diabetes ($p = 0.01$), hypertension ($p = 0.02$), and lower baseline AFI ($p = 0.01$), indicating both clinical and statistical relevance. **Conclusion:** Intravenous hydration is an effective and clinically meaningful intervention for increasing AFI in oligohydramnios, particularly among women with specific risk profiles. These findings support its application in obstetric care as a non-invasive management strategy to reduce complications and improve perinatal outcomes.

Keywords: Oligohydramnios, Intravenous Hydration Therapy, Amniotic Fluid Index, Pregnancy Complications, Body Mass Index, Maternal Health, Obstetric Outcomes

INTRODUCTION

Oligohydramnios, characterized by reduced amniotic fluid volume (AFV) for gestational age, presents significant concerns during pregnancy, particularly in the third trimester when AFV is expected to plateau before its decline post-term (1,2). The maintenance of adequate AFV is essential for fetal well-being, as it facilitates growth, movement, and protection from mechanical injury. The fluid volume results from a complex interplay of fetal urine production, lung secretions, and maternal-fetal fluid exchange (4).

In pregnancies beyond 34 weeks, especially those without identifiable etiologies—termed isolated oligohydramnios—the management remains a clinical challenge. This condition

complicates approximately 4.4% of term pregnancies, with even lower prevalence in preterm gestations (5). Left unmanaged, it can contribute to adverse outcomes including fetal distress, intrauterine growth restriction, and cesarean delivery. As such, there is increasing interest in non-invasive and cost-effective interventions to mitigate these risks.

Several studies have emphasized maternal hydration as a modifiable factor that can influence AFV. Intravenous hydration, particularly with isotonic fluids like Ringer's lactate, has emerged as a promising intervention for improving amniotic fluid levels in cases of oligohydramnios. Cicily et al. demonstrated that approximately 89.17% of pregnant women

responded positively to intravenous hydration, with a notable increase in AFI averaging 4 cm, compared to only 8.8% improvement in a non-hydrated control group (7). Despite this, the practice is not yet standardized across institutions, and questions remain regarding the influence of maternal demographics and comorbidities on treatment outcomes. Variability in response to hydration therapy across age groups, BMI categories, social strata, and urban versus rural settings suggests the need for further stratified analysis.

Moreover, while previous literature supports hydration therapy as a beneficial strategy (7,9,13), the influence of confounding factors such as maternal diabetes, hypertension, and baseline AFI levels on its effectiveness has not been sufficiently explored in local settings. Studies like those of Gupta *et al.* and Parker *et al.* reinforce the intervention's potential but highlight the need for contextual evidence, particularly in regions where maternal health resources are constrained (9,13). Additionally, it remains unclear whether patient-specific protocols can further optimize outcomes, especially for high-risk subgroups such as those with abnormal BMI or chronic illnesses.

This study aims to bridge the existing knowledge gap by assessing the effectiveness of intravenous hydration in improving AFI among women with oligohydramnios in a tertiary care setting. By integrating a quasi-experimental design and evaluating a comprehensive range of demographic and clinical variables—including age, residence, BMI, diabetes, hypertension, and baseline AFI—this research endeavors to identify predictors of treatment success. The findings are expected to inform clinical decision-making and promote personalized prenatal care strategies. The central research question guiding this study is: Does intravenous hydration significantly improve the amniotic fluid index in women diagnosed with oligohydramnios, and which patient-specific factors are predictive of a favorable response to this intervention?

MATERIALS AND METHODS

This quasi-experimental study was conducted over a period of six months in the Department of Obstetrics and Gynaecology at CMH Peshawar. A total of 149 pregnant women diagnosed with oligohydramnios were included through consecutive non-probability sampling. Participants were eligible for inclusion if they were between 18 and 40 years of age, carrying singleton pregnancies beyond 34 weeks of gestation, with intact membranes at the time of selection. Gestational age was confirmed by the last menstrual period. Women with congenital anomalies, intrauterine death, multiple gestations, post-dated pregnancies, premature rupture of membranes (PROM), preterm PROM (PPROM), or chronic medical illnesses unrelated to pregnancy were excluded. Recruitment was carried out in the outpatient gynecology clinic following a detailed explanation of the study protocol, and informed written consent was obtained from all participants.

The primary outcome was the change in amniotic fluid index (AFI) before and after the intervention. Baseline AFI was measured via transabdominal ultrasound using the standard four-quadrant technique. Following the baseline assessment, each participant received intravenous hydration with 1 liter of Ringer's lactate

solution daily for five consecutive days. At the end of this intervention period, follow-up ultrasound scans were performed to reassess AFI. Additional variables collected at baseline included maternal age, body mass index (BMI), residence (urban or rural), social class, parity, gravidity, gestational age, and the presence of comorbidities such as diabetes mellitus, hypertension, and smoking status. All data were recorded in a structured proforma to ensure consistency.

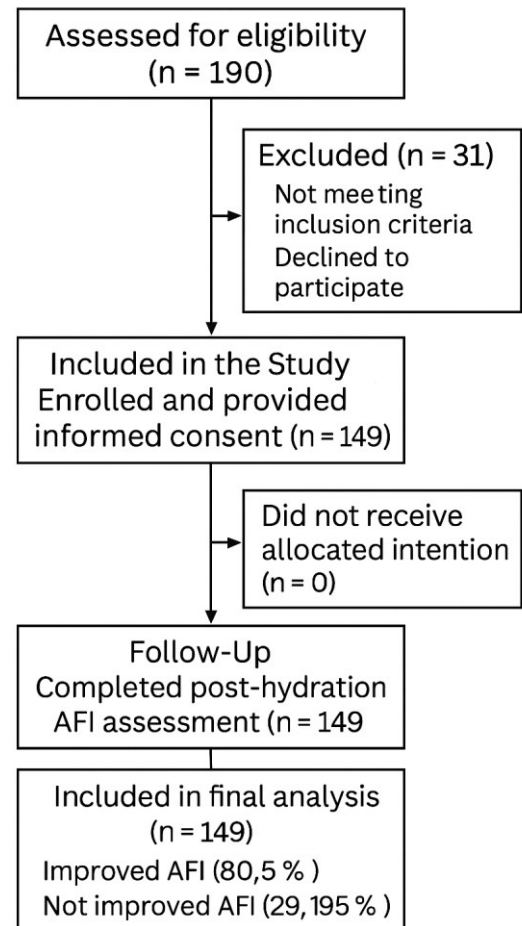


Figure 1 Consort Flowchart

This study was conducted in accordance with the ethical standards of the Declaration of Helsinki. Ethical approval was obtained from the Hospital's Ethical Committee as well as the Research Evaluation Unit (REU) of the College of Physicians and Surgeons Pakistan (CPSP), Karachi. All participants provided informed consent, and confidentiality of personal health data was maintained by using coded identifiers in the data entry process and restricting access to authorized research personnel only.

Data analysis was performed using SPSS Version 23.0. Continuous variables such as age, gestational age, AFI, and BMI were summarized using means and standard deviations for normally distributed data, or medians and interquartile ranges when distribution was non-normal, with normality assessed via the Shapiro-Wilk test. Comparisons of AFI before and after hydration were conducted using either the independent samples t-test or Mann-Whitney U test, depending on the data distribution. Categorical variables, including diabetes,

hypertension, smoking status, residence, social class, parity, and gravidity, were expressed as frequencies and percentages. Stratification was performed for variables such as age, BMI, and comorbidities to identify potential effect modifiers. Post-stratification comparisons were made using the chi-square test or Fisher's exact test as appropriate. A p-value of less than 0.05 was considered statistically significant throughout the analysis (7,9,13).

RESULTS

A total of 149 pregnant women diagnosed with oligohydramnios were enrolled in the study to evaluate the efficacy of intravenous hydration in improving the amniotic fluid index (AFI). The primary outcome was the change in AFI following a five-day intravenous hydration protocol using Ringer's lactate solution. Secondary analyses were conducted to assess the influence of demographic and clinical variables on treatment response.

The intervention resulted in a statistically significant improvement in AFI. The mean baseline AFI was 5.2 ± 1.5 cm, which increased to 8.1 ± 1.3 cm after the hydration protocol. Overall, 80.5% ($n = 120$) of participants demonstrated a clinically and statistically significant improvement in AFI ($p = 0.00$), confirming the efficacy of intravenous hydration in this cohort.

Advanced univariate analysis indicated several factors significantly associated with a positive treatment response. Urban residence was linked to greater AFI improvement compared to rural residence ($p = 0.03$), suggesting potential differences in underlying health status or healthcare access. Participants from middle and high social classes showed greater response to hydration than those from lower socioeconomic backgrounds, with marginal statistical significance ($p = 0.05$).

Comorbid conditions, specifically diabetes mellitus and hypertension, significantly influenced treatment success. Diabetic participants ($n = 38$) and hypertensive individuals ($n = 46$) had significantly higher AFI improvement rates compared to non-diabetics and normotensive participants, with p-values of 0.01 and 0.02, respectively.

These findings may be attributed to altered intravascular volume regulation and responsiveness in these patient subsets. Body Mass Index (BMI) was another determinant of hydration response. Participants within the normal BMI range (18.5 – 24.9 kg/m²) exhibited significantly better post-treatment AFI improvement ($p = 0.04$). In contrast, underweight and obese groups had comparatively lower responses, indicating a potential non-linear relationship between hydration efficacy and BMI.

Table 1. Participant Characteristics and Association with AFI Improvement Following Intravenous Hydration

Variable	Category	Frequency (%)	Mean \pm SD	p-value
Age (years)	18–30	45 (30.2%)	26.5 ± 4.7	0.13
	31–40	50 (33.6%)	35.2 ± 4.5	
	41–50	35 (23.5%)	46.0 ± 4.0	
	51–60	19 (12.8%)	54.5 ± 5.2	
Residence	Urban	90 (60.4%)	–	0.03*
	Rural	59 (39.6%)	–	
Social Class	Low	50 (33.6%)	–	0.05
	Middle	70 (47.0%)	–	
	High	29 (19.5%)	–	
Parity	Nulliparous	50 (33.6%)	–	0.12
	Multiparous	99 (66.4%)	–	
Gravidity	Primigravida	65 (43.6%)	–	0.08
	Multigravida	84 (56.4%)	–	
Diabetes Mellitus	Yes	38 (25.5%)	–	0.01*
	No	111 (74.5%)	–	
Hypertension	Yes	46 (30.9%)	–	0.02*
	No	103 (69.1%)	–	
Smoking Status	Yes	28 (18.8%)	–	0.15
	No	121 (81.2%)	–	
Gestational Age (weeks)	24–28	40 (26.8%)	28.5 ± 1.2	0.09
	29–34	60 (40.3%)	31.7 ± 1.8	
	35–40	49 (32.9%)	36.2 ± 2.0	
BMI (kg/m ²)	Underweight (<18.5)	8 (5.4%)	17.2 ± 1.1	0.04*
	Normal (18.5–24.9)	70 (47.0%)	21.3 ± 2.3	
	Overweight (25–29.9)	50 (33.6%)	27.4 ± 2.8	
	Obese (≥ 30)	21 (14.1%)	33.2 ± 4.1	
Baseline AFI (cm)	–	–	5.2 ± 1.5	0.01*
Post-Hydration AFI (cm)	–	–	8.1 ± 1.3	–
AFI Improvement	Improved	120 (80.5%)	–	0.00**
	Not Improved	29 (19.5%)	–	

*Statistically significant at $p < 0.05$ **Highly significant at $p < 0.001$

While reproductive history variables (parity and gravidity) and smoking status did not show statistically significant associations with treatment response ($p > 0.05$), baseline AFI emerged as a significant predictor of change. Patients with lower initial AFI demonstrated a higher degree of improvement post-intervention ($p = 0.01$), underscoring the clinical relevance of baseline severity in treatment responsiveness.

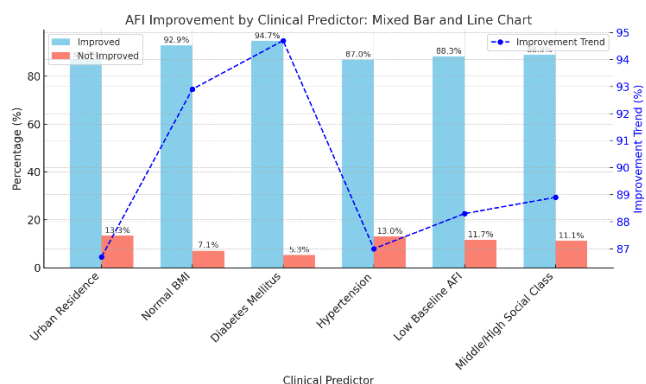


Figure 2 AFI Improvement by Clinical Predictor

Gestational age showed a trend toward significance ($p = 0.09$), with earlier gestations (24–28 weeks) appearing to respond more favorably, although this did not reach conventional thresholds for statistical significance. Maternal age also did not significantly influence the outcome ($p = 0.13$), aligning with several previous findings. The intervention yielded a statistically and clinically meaningful increase in AFI. Particularly, the strong response observed among individuals with lower baseline AFI suggests a dose-response relationship. Additionally, the enhanced response in urban, non-obese, and comorbid patients highlights potential pathways for individualized treatment protocols. The lack of statistical significance in variables like age, parity, and smoking status indicates that these may not serve as reliable predictors for hydration response in this population. These findings support intravenous hydration as an accessible and effective management strategy for oligohydramnios, especially in resource-limited settings where non-invasive interventions are preferable. Further research exploring fluid dynamics in obese or underweight populations and tailoring hydration regimens by comorbidity profiles could enhance therapeutic precision.

DISCUSSION

The findings of this study demonstrate that intravenous hydration is a significantly effective intervention for increasing the amniotic fluid index (AFI) in pregnant women diagnosed with oligohydramnios, with 80.5% of participants showing measurable improvement. This result reinforces the utility of fluid therapy as a non-invasive, low-cost management strategy in settings where more complex interventions may be limited. The significant increase in mean AFI from 5.2 ± 1.5 cm to 8.1 ± 1.3 cm is consistent with previous evidence indicating the responsiveness of amniotic fluid volume to maternal hydration, particularly through the use of isotonic fluids such as Ringer's lactate (7,9,13). The clinical relevance of this finding lies in the potential to avert unnecessary early deliveries and reduce perinatal morbidity by temporarily stabilizing amniotic fluid levels in select patient populations.

This study's results align closely with those reported by Cicily et al., who documented a response rate of approximately 89.17% to intravenous hydration in similar cohorts, with a mean AFI increase of around 4 cm (7). Additionally, Parker et al. observed comparable efficacy in their systematic review, supporting intravenous hydration as a viable intervention in cases of isolated oligohydramnios (13). While most previous studies focus on efficacy alone, this study contributes further by stratifying outcomes based on sociodemographic and clinical predictors. Notably, urban residence, diabetes, hypertension, and normal BMI were all significantly associated with improved AFI outcomes, suggesting that treatment success may be modulated by both systemic and environmental factors.

The observed association between urban residence and greater AFI improvement ($p = 0.03$) may reflect better baseline health conditions, nutritional status, or access to supportive prenatal care. This aligns with the findings of Khan et al., who reported superior pregnancy outcomes among urban dwellers, attributed to earlier detection and intervention for antenatal complications (11). Similarly, women from middle and high social classes responded more favorably to hydration therapy ($p = 0.05$), a result that is consistent with Ahmed et al.'s analysis of socioeconomic determinants in maternal healthcare responsiveness (8). These observations suggest that broader systemic variables, such as healthcare equity and infrastructure, may influence the effectiveness of physiological interventions like hydration therapy.

Comorbidities including diabetes and hypertension were found to significantly affect treatment outcomes ($p = 0.01$ and 0.02 , respectively), which corroborates findings by Lee et al. and Johnson & Smith, who highlighted altered vascular and renal dynamics in such conditions that could amplify fluid shifts into the amniotic sac (10,12). This physiological mechanism may partly explain the heightened responsiveness among these subgroups. The stronger response observed in individuals with a normal BMI ($p = 0.04$) further suggests that metabolic factors, body composition, and intravascular volume handling are key determinants of hydration therapy efficacy. Obesity and underweight conditions may alter fluid distribution or renal clearance, thereby diminishing the net gain in AFI from standard fluid protocols.

Although baseline AFI was a strong predictor of response ($p = 0.01$), suggesting that women with more severe oligohydramnios may experience greater benefit from hydration, other variables such as parity, gravidity, smoking status, and maternal age did not show significant associations. This divergence from earlier studies (14,15) may indicate that demographic characteristics, in isolation, are not sufficient to predict hydration response without accounting for coexisting clinical or environmental modifiers. Gestational age exhibited a near-significant trend ($p = 0.09$), raising the possibility that earlier gestations may be more responsive to fluid therapy due to less structural compression of uterine vessels and enhanced transmembrane fluid transport in younger placentas, a hypothesis warranting further investigation.

One of the strengths of this study is its relatively large sample size and the inclusion of a broad array of potential effect

modifiers, allowing for a more nuanced interpretation of treatment efficacy across different patient profiles. However, certain limitations should be acknowledged. The quasi-experimental design, while pragmatic and appropriate in the clinical setting, inherently limits control over potential confounding variables. The lack of a randomized control group prevents absolute attribution of AFI improvement solely to hydration, although the significant within-subject changes and prior literature strengthen causal inference. Moreover, generalizability is limited to similar tertiary care settings and may not extend to populations with differing health system capacities or demographic profiles.

Future research should aim to address these limitations by employing randomized controlled designs and exploring the dose-response relationship of intravenous hydration in various subgroups. Investigations into personalized hydration protocols based on BMI, comorbidity status, and gestational age could enhance therapeutic precision. Additionally, studies exploring the short-term fetal outcomes and long-term perinatal effects of repeated hydration interventions would provide valuable insights into clinical safety and effectiveness. These findings support the integration of hydration therapy into standardized obstetric care, particularly for high-risk groups such as diabetic, hypertensive, and urban-dwelling women with low baseline AFI. The implications for non-invasive management are significant, especially in resource-limited settings where access to advanced obstetric interventions may be constrained.

CONCLUSION

This study concludes that intravenous hydration is an effective and clinically relevant intervention for improving amniotic fluid levels in pregnant women diagnosed with oligohydramnios, aligning with the study objective to evaluate its therapeutic impact. The significant increase in amniotic fluid index (AFI) post-hydration, particularly among women with lower baseline AFI, normal BMI, diabetes, hypertension, and urban residence, highlights the importance of considering individual patient factors in treatment planning. These findings underscore the potential of intravenous hydration as a non-invasive, accessible strategy for managing oligohydramnios in routine obstetric care. Clinically, this approach may reduce the risk of adverse pregnancy outcomes and unnecessary early deliveries, while future research should explore optimized, patient-specific hydration protocols and assess fetal outcomes to further validate and refine this intervention in diverse healthcare settings.

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