

Short Research Article

Effect of Water Intake on Constipation and Bowel Movement

ABSTRACT

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Backgrounds: Only 7.5% of colorectal cancer occurred by inheritance; the rest were habit-related and prominently associated with unhealthy eating. Nigerians are showing rising cases of colon diseases that are co-morbid with chronic constipation. Researchers suggested that constipation is associated with colon cancer.

Objective: To determine if hydration is associated with bowel movement (BM), the purpose is to reduce the risk of constipation and all diseases associated with constipation and dehydration.

Study Design: This was an experimental Study.

Place and Duration of Study: Federal University of Technology Owerri, Imo State, Nigeria. Data was collected from June 9 - 22, 2021.

Methods: A novel pilot experimental cohort study supported by traditional medicine theory, logic, and deduction principles were used for the investigation. Sampling was based on available volunteers, and the sample size n ($n= 10$) was 10. P value set at $p = .05$ at 95% confidence interval. The cohort group of 10 participants was treated with 500ml, 1000 ml, and 2000 ml of water for three days, each. Data were analyzed using SPSS statistics, ANOVA analysis, and Tukey HSD.

Results: Showed a significant ($P=.05$) relationship between water intake and Bowel Movement and time taken to move the bowel. In three days mean bowel movement for 500 ml, 1000 ml, and 2000 ml, Day 2 against Day 3 mean was 0.800*, P-value was $<.001$ for the 1000ml treatment, which showed a relationship. Low water consumption over time each day increased the constipation. The outcome can be beneficial to the general public and healthcare advisory practice.

Conclusion: There is a relationship between water intake, constipation, and bowel movement, and optimum water consumption may likely reduce chronic constipation, which is a risk factor for colon cancer and other diseases, including Parkinson disease.

Keywords: {Bowel movement and water intake, constipation treatment, constipation and dehydration}

1. INTRODUCTION

Constipation and **poor bowel movement** occurs when undigested products are not evacuated completely or frequently from the intestinal canal, and it often delays expulsion of feces from the intestine (1, 2). It affects the size, consistency, frequency, and length of time to move the bowel while in the toilet (2). Researchers have indicated that constipation and poor bowel movement is a primary gastric intestine dysfunction and a crucial problem of

patients with Parkinson's disease (3, 4, 5, 6, 9). It has also been established to be a symptom of several other disorders, namely, hypothyroidism, excess calcium, diabetes, bowel cancer, multiple sclerosis, and irritable bowel movement (3, 4, 5, 6, 9, 22, 23). New studies equally revealed that there is a growing risk of functional bowel disorders and other disease co-morbidities, namely, anxiety, depression, early trauma, quality of sleep, abdominal obesity, and unhealthy lifestyle such as smoking and alcohol consumption (6, 25, 26).

Akira and Mieko opined that the assessment of patients with Parkinson Disease showed a significantly low water intake early in their lifetime (7, 25, 26). Difficulty with bowel movement and constipation is associated with colon cancer and Parkinson Disease, suggesting that bowel movement regulation might prevent colon cancer and other associated diseases (7, 20, 22, 23). Constipation and poor bowel movement negatively impacts people's quality of life as a standalone disease and as a co-morbidity. It also brings financial and social burdens on individuals, families, and the government (3, 5, 8). For example, constipation treatment costs the United States \$800 million to buy laxatives and stool softeners annually. This figure excludes over-the-counter drugs estimated at \$200 million (8).

Sanchez and Bercik suggested that constipation affects 2%-27% of the human population. The prevalence of constipation in the general Nigerian population is 20%, with more preponderance among the elderly, and older women that experience more severe constipation than everyone else, and it was a significant cause of illnesses (8, 9). Diverticular disease cases were rising in Nigeria, and it was caused by persistent high pressure in the intra-colon tissue caused by frequent Constipation, and poor bowel movement (10). In this novel pilot experiment, the authors reassessed the folk medicine theory and established a link between water intake and constipation and bowel movement, which will benefit the future treatment or remedial approach to constipation and **poor bowel movement** associated health problems.

2. MATERIAL AND METHODS

This experimental pilot study took place at FUTO in Owerri, Imo State of Nigeria between June 9 - 22 2021. The design adopted is supported by both scientific and native medicine theories, logic, and deduction principles. It involved intervention treatment of ten volunteers with three different portable water quantities to determine whether low water constituted constipation and poor bowel movement and the quantity of water required for optimum bowel movement. This objective was determined, and the intension was to help prevent constipation, and ease bowel movement, and lower colon diseases risks, including colorectal cancer. SPSS statistical data analysis, ANOVA analysis, and Tukey HSD was performed. Relationships and direction of association were determined by bivariate regression and Spearman's ranking was used to determine the bowel movement scores, as shown in tables 1 and 2. In this study data analyses, the outcomes were first ranked. The scores ranks were placed on scales 1-3; 1 representing lowest score and 3 representing maximum score. For examples:

3 - is good outcome - Formed, soft, and complete emptying/evacuation

2 - is fair outcome - Formed, semi soft, in pellets, and partial emptying/evacuation

1 - is poor outcome - Formed, hard, pellets and partial emptying/evacuation or complete constipation/no bowel opening. From the result of the Statistical analysis of various quantities of water intake from 500 -2000 ml per person per day, the same groups with different eating habit and lifestyle showed no significant difference in the time spent and the ease of bowel movement except with change in the amount of water consumed. Also, prior to the water treatment intervention, when the participants drank water without the restrictions in Nigerian hot climate, their bowel movement showed no significant difference in bowel movement ease and time. It is important to note that Zero day (day 0) for 500 ml treatment was a pretest outcome, zero day (Day 0) for 1000 ml treatment is last day for 500 ml treatment and zero day (Day 0) for 2000 ml treatment is the last day (Day 3) for 1000 ml treatment.

2.1 Sample size and Sampling

The small number of participants captured was due to the Nigerian high level of insecurity and political turmoil during data collection and treatment, which hampered transportation and economic activities coupled with Covid-19 restrictions. Data was collected between June 9-

22, 2021. The 10 participants who willingly consented to participate in the experiment were recruited. Sample size n ($n=10$). For sampling, we used posters to advertise for our study, which we placed at strategic places namely, canteens, restaurants, market places, banks, and libraries. Through the poster we announced the date, venue, and time of our information session at the School of Health Technology Student-centre, FUTO Owerri. During the session, we introduced ourselves and our study and the purpose of the study, and stated clearly that it is for a peaceful purpose.

Also, we indicated the negative inconvenience that the study process can cause participants such as, taking restricted amount of water per day, possible constipation, when the quantity of water consumption is low, taking note of bowel movement duration and formation as well as the consistency of the faeces. Thus, the reason that we gave participants a token of gift card for lunch to compensate for the inconveniences that they experienced and the time to make journal of their bowel movement experiences during the study period. We requested them to read the Informed Consent Form and ask questions about unclear words, particularly those contiguous with safety.

We answered all their questions and those still willing to volunteer signed the Informed Consent Form. The 10 participants were made up of two males and eight females with ages ranging from 30 -50 years, and they were either obese or overweight. Only participants aged 26-64 and either have overweight or obesity that were living in FUTO, Owerri, Imo state Nigeria who were willing to volunteer were included. This was a pilot of a novel study and that explains the small sample size n ($n=10$), which could be a source of bias. Also, there could be error in the participants self-reporting of their bowel movement journal and time taken to move the bowel. The issue of confounding may be ruled out in this study because, it was the same group of participants that volunteered for 500 ml of water that volunteered for 1000 ml and 2000 ml so, each person maintained relatively similar lifestyle and eating habit. Our study is novel because at the time of this study, we did not find any literature that performed an intervention to determine the amount of water required per a person per day to experience optimum bowel movement.

2.2 Materials

Portable water, toilet, writing materials namely, pen and experiment recording journal and the schedule or calendar, cell phone or camera, and participants.

2.3 Experiment

The investigation began with a pre-test examination, on Day 0, in which case, all 10 participants were requested to visit the toilet for defecation and record how long (minutes) it took them to move their bowels, the consistency, whether formed or not formed, strong, moderately strong, or loose, and whether they had incomplete or complete evacuation. The next day, each received a total of 500 ml of water, 100 ml of water on rising from bed, 300 ml throughout the day, and 100 ml before bedtime. They repeated this therapy for two more days.

After three days, the same group received 1000 ml per day; 200 ml of water in the morning, 600 ml throughout the day (afternoon), and 200 ml on retiring to bed. This treatment was repeated for two more days. After three days, they received water therapy totalling at least 2000 ml for three days, 400 ml on rising from bed (morning), 1200 ml throughout the day, and 400 ml of water before retiring to bed.

Prior to the investigation, each subject was supplied with enough potable water that would last the whole time of experimentation and containers for measurement. They were not to take additional water except pop. For each day of the experimentation period, they were equally asked to record how long (minutes) it took them to move their bowels, the consistency, whether formed or not formed, strong, moderate, or loose, and whether they had incomplete or complete evacuation. They were equally asked to photograph the faeces in the WC sink if possible. The participants were under the strict observation of one of the investigators, a medical doctor, for medical interventions in case of any adverse effect reported. After that, the data collected were analyzed using Statistical Package SSPP Version 21, involving ANOVA analysis, and Tukey HSD. The groups are not dependent on

each other. They have different lifestyles, which each participant maintained throughout the data collection period. ANOVA was used to compare treatment outcomes when participants consumed different quantities of water, 500-2000 ml and time taken for the outcomes (dependent variables) with treatment groups (Independent groups). The effect of each treatment group was compared with another group using Post-Hoc.

3. RESULTS AND DISCUSSION

Results

Table 1: Tukey HSD outcome of bowel movement with treatment-days

Treatment group	(a) Day	(b) Day	Mean Difference (a-b)	Std. Error	P-Value	95% Confidence Interval	
						Lower Bound	Upper Bound
500 ml	Day 0	Day 1	0.100	0.264	0.981	-0.61	.81
		Day 2	1.000*	0.264	0.003	0.29	1.71
		Day 3	1.800*	0.264	<0.001	1.09	2.51
	Day 1	Day 2	0.900*	0.264	0.008	0.19	1.61
		Day 3	1.700*	0.264	0.000	0.99	2.41
		Day 2	Day 3	0.800*	0.264	<0.001	0.09
1000 ml	Day 0	Day 1	0.400	0.197	0.197	-0.93	0.13
		Day 2	0.900*	0.197	<0.001	-1.43	-0.37
		Day 3	1.100*	0.197	<0.001	-1.63	-0.57
	Day 1	Day 2	0.500	0.197	0.071	-1.03	0.03
		Day 3	0.700*	0.197	0.006	-1.23	-0.17
		Day 2	Day 3	0.200	0.197	0.742	-0.73
2000 ml	Day 0	Day 1	0.400	0.173	0.115	-0.87	0.07
		Day 2	0.500*	0.173	0.032	-0.97	-0.03
		Day 3	0.500*	0.173	0.032	-0.97	-0.03
	Day 1	Day 2	0.100	0.173	0.938	-0.57	0.37
		Day 3	0.100	0.173	0.938	-0.57	0.37

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	Day 2	Day 3	0.000	0.173	1.000	-0.47	0.47
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*. The mean difference is significant at the 0.05 level

The Kolmogorov-Smirnov value of 0.18 and 0.17 for dependent variables (evacuation outcome and time) with p-value is ($p > .05$ (0.258 and 0.241) showed that the variables were normally distributed.

Results of Levels of Bowel Movement with Different Quantity of Water in Treatment Days

Figure 1 and Table 1 show different levels of bowel movement with the intake of 500ml, 1000ml, and 2000ml for three days. Bowel movement in Day-0 (3.00) was insignificantly higher than Day-1 (2.90), p-value was ($p = .981$), but Day-0 was significantly better than Day-2 p-value was ($p = .003$) and Day-3 p-value was ($p < .001$) of 500ml treatment. Also, bowel movement was poor in Day-2 (2.00) and Day-3 (1.20) than Day-1 p-value was ($p < .05$). Similarly, bowel movement in Day-2 was significantly better than Day-3 p-value was ($p < .001$).

On the other hand, bowel movement increased when participants took 1000ml and 2000ml of water. There was a slight increase in bowel movement between Day-0 (1.60) and Day-1 (2.00) when participants were taking 1000ml of water p-value was ($p = .197$). However, there was a significantly higher bowel movement between Day-2 and Day-0 p-value was ($p < .001$), Day-3 and Day-0 p-value was ($p < .001$), and Day-3 and Day-1 (0.006). Participants that took 2000ml of water experienced a high level of bowel movement in Day-2 and Day-3 than Day-0 p-value was ($p < .05$), but no difference was observed between Day-2 and Day-3; both showed optimal bowel movements (3.00), p-value was ($p = 1.000$), because 2000 ml of water was sufficient for complete bowel emptying. Day 1 of 2000 ml consumption after three days of low water consumption of 1000 ml was not enough to hydrate the body fully to prompt full bowel emptying and p-value was ($p = .167$) so, it required a second day of full hydration with 2000 ml to cause full bowel emptying.

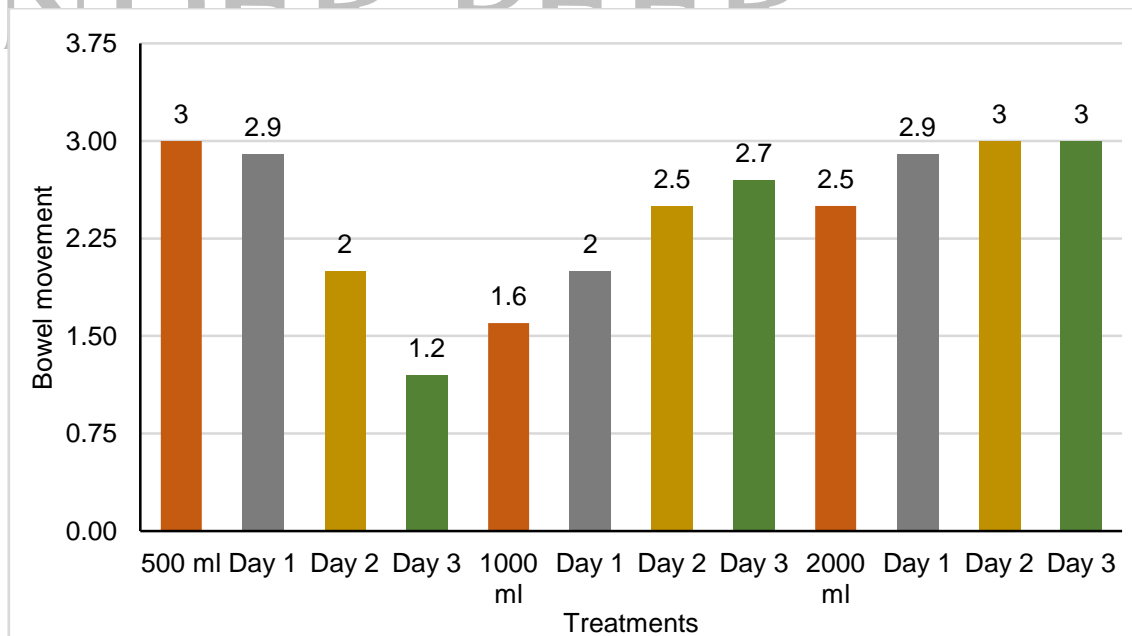


Figure 1: Bowel movement with treatment-days

The Kolmogorov-Smirnov value of 0.18 and 0.17 for dependent variables (evacuation outcome and time) with p-value is ($p > .05$ (0.258 and 0.241) showed that the variables were normally distributed.

3.1 Bowel Movement Score for all 10 participants.

Bowel movement scores were ranked on scales 1-3; 1 represents the lowest score and 3 represents maximum score. For examples:

3 - is good outcome - Formed, soft, and complete emptying/evacuation

2 - is fair outcome - Formed, semi soft, in pellets, and partial emptying/evacuation

1 - is poor outcome - Formed, hard, pellets and partial emptying/evacuation or complete constipation/no bowel opening.

The best mean bowel movement of 2.85 was recorded for all participants at 2000ml of water, compared to 2.20 at 1000ml and 2.28 at 500ml, as shown in Figure 2. There was a difference, which was not significant p-value is ($P > .05$) in the bowel movement observed between 500ml and 1000ml p-value ($p = .878$). However, the bowel movement for 2000ml was significantly higher p-value is ($P < .001$) than 1000ml and 500ml with p-value is ($p = .001$).

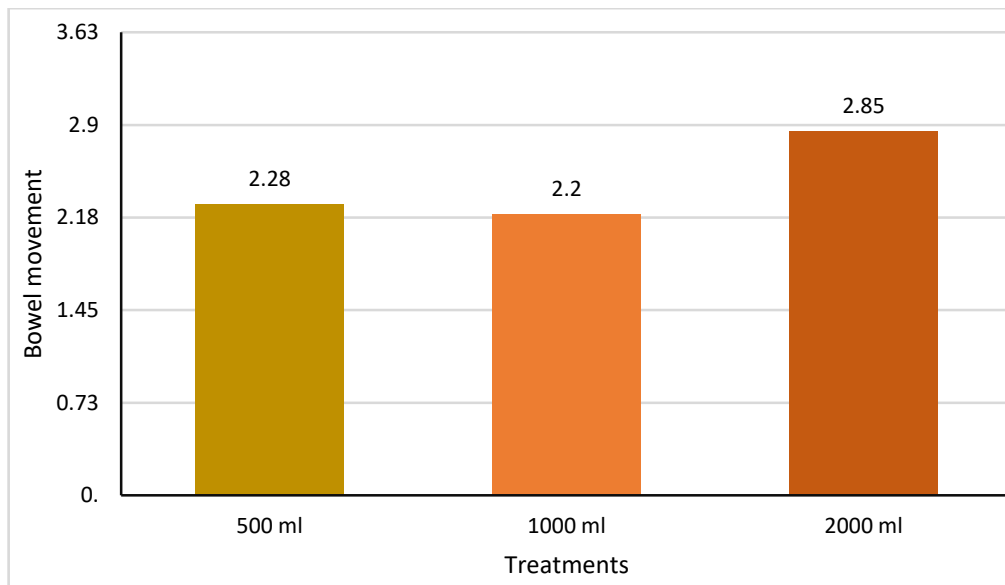


Figure 2: Bowel Movement Score with Treatments

3.1.1 Time Taken for Bowel Emptying

The mean time taken for bowel emptying was least with 2000ml treatment (3.53) compared to 500ml (4.30) and 1000ml (4.55). No significant time difference was observed between 500ml and 1000ml p-value is ($P = .777$), but there was a significant p-value is ($P < .017$) shorter bowel emptying time with 2000ml water treatment than 1000ml treatment.

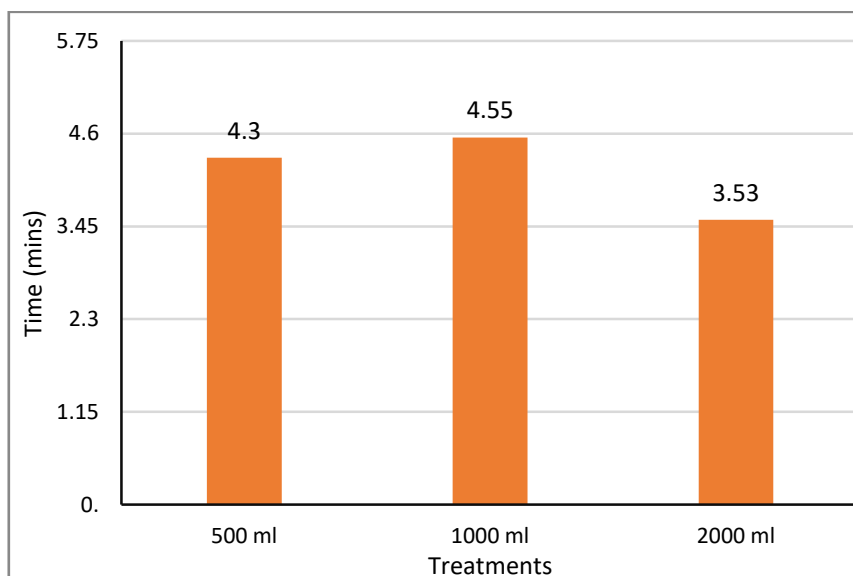


Figure 3: Time taken for Bowel Movement

The effect size is that there is no, significantly different bowel movement observed between 500ml and 1000ml (0.878), but bowel movement for 2000ml was significantly higher than 1000ml p-value is ($P < .001$) and 500ml (0.001) Table 2.

Table 2: Tukey HSD for treatment with bowel movement and time

	Treatment group	Mean Difference	Std. Error	P-value	95% Confidence Interval		
					Lower Bound	Upper Bound	
Bowel movement	1000 ml	0.075	0.154	0.878	-0.29	0.44	
	500 ml						
	2000 ml	0.575*	0.154	0.001*	-0.94	-0.21	
	1000 ml	2000 ml	0.650*	0.154	<0.001*	-1.02	-0.28
Time	1000 ml	0.250	0.369	0.777	-1.13	0.63	
	500 ml						
	2000 ml	0.775	0.369	0.094	-0.10	1.65	
	1000 ml	2000 ml	1.025*	0.369	0.017*	0.15	1.90

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*. The mean difference is significant at the 0.05 level.

3.1.1.1 Mean Bowel Movement with Different Water Treatments

Table 2 showed the mean bowel movement with 500 ml, 1000 ml, and 2000 ml for three days. Analyses of Day 2 against Day 3 mean is 0.800*, P-value is $p < .001$ for the 1000ml treatment. This result showed a relationship between water and constipation and bowel

movement because a low quantity of water consumption over time each day from Day 1-3 showed an increase in constipation from day 1 to day 3. This explains why there was a significant difference in mean squares when Day 0 or pre-treatment data was analyzed against 500 ml water treatment over three days. Analyses of Day 1 against Days 2 and 3 suggested significant differences, testifying to a relationship between water consumption and bowel treatment-day.

Table 3: Bowel Movement with Treatment-Day

Bowel movement	Treatment group			P-value
	500 ml	1000 ml	2000 ml	
Day 0	3.00 ^a ± 0.00	1.50 ^a ± 0.71	2.50 ^{ab} ± 0.71	<0.001*
Day 1	2.90 ^b ± 0.31	2.00 ^b ± 0.00	2.90 ± 0.32	<0.001*
Day 2	2.00 ^{ab} ± 0.82	2.10 ^a ± 0.74	3.00 ^a ± 0.00	0.057
Day 3	1.20 ^{ab} ± 0.79	2.40 ^{ab} ± 0.97	3.00 ^b ± 0.00	0.014*

*. The mean difference is significant at the 0.05 level; values with the same superscript alphabets in each column are significantly different at $p < 0.05$ (3 = good outcome, 2 = fair, 1 = poor) (fig. 3).

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3.1.2 Overall Treatment Outcome

Overall treatment outcome showed that bowel movement increased with an increase in water therapy while the time taken for evacuation decreased proportionately (Table & and Fig 4).

Table 4: Overall Treatment Outcomes

Treatment Day	Treatment group			
	Bowel movement	F (P-value)	Time	F (P-value)
500 ml	2.28 ^a ± 0.93		4.30 ^a ± 1.98	
1000 ml	2.20 ^b ± 0.61	10.668 ($<0.001^*$)	4.55 ^b ± 1.50	4.200 (0.017*)
2000 ml	2.85 ^{ab} ± 0.43		3.53 ^{ab} ± 1.40	

*. The mean difference is significant at the 0.05 level; values with the same superscript alphabets in each column are significantly different at $p < 0.05$ (Bowel movement; 3 = good outcome, 2 = fair, 1 = poor, shorter time shows a better outcome)

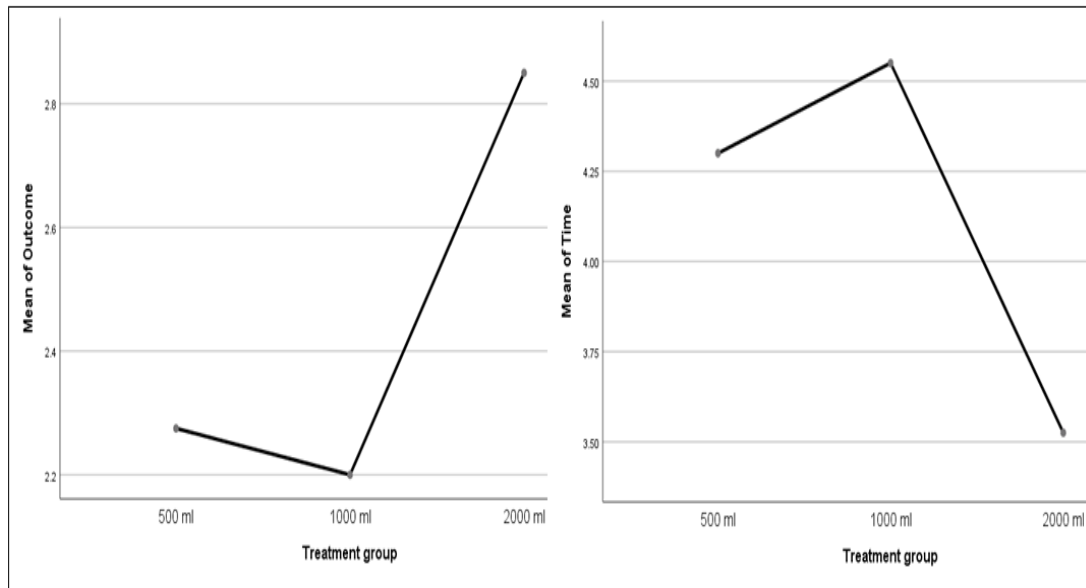


Figure 4: Overall Treatment Outcomes

3.2 Discussion

Constipation and **and poor bowel movement**, colon cancer, and other diseases associated with constipation and **poor bowel movement** are causing pain, disabilities, high treatment costs, and premature deaths, and the cases of these diseases are rising across the globe (3, 12, 13). The water treatment therapy investigated in this study showed, on average, a strong relationship between water intake and bowel movement, including the time it takes to evacuate feces from the bowel. The first therapy with 500ml resulted in marked constipation and poor with a longer time to push out feces for all participants but decreased gradually with an increase in water quantity and culminated in easiest movement both in time and quantity at 2000ml. Therefore, water consumption affects the time taken to move the bowel. Less water caused more time to move the bowel, and more water reduced the time taken to move the bowel.

Researchers in Jordan, in their studies, suggested that a healthy lifestyle and sufficient water intake, and easy bowel movement could lower the risk of colorectal cancer (15, 16). However, establishing a link between a healthy lifestyle and water consumption and colorectal cancer is out of the scope of this study.

The outcome of our study is in line with a previous study that revealed that unhealthy eating, hypothyroidism, and overweight were linked with constipation and poor bowel movement (16, 17). Since, other researchers have consistently shown an association between constipation and **poor bowel movement and** colorectal cancer and other diseases (18, 19, 21); it is appropriately innovative that this study directed energy towards a novel approach, which is geared at promoting an easy, convenient, and cheap way of preventing constipation and increasing optimum bowel movement through water treatment, which is an integral of healthy eating. Especially, when chronic constipation and **poor bowel movement** has shown significant association with colorectal cancer, other diseases, and body dysfunction, namely Parkinson's disease, hypothyroidism, and children's enuresis (1, 7, 9, 15, 16, 24).

4. CONCLUSION

Conclusively, It was established in this study that water consumption has an independent relationship with constipation and bowel movement, and the quantity of water needed to prevent constipation and move the bowel optimally is 2000 ml per day. Also, the amount of water consumed affected the time it took to empty the bowel. Less water results in a long time to empty the bowel, constipation, and incomplete bowel emptying. Sufficient water causes a shorter time to empty the bowel, softens bowel formation, and completes emptying of the bowel. However, on account of the small sample size, more and extensive scale studies are encouraged to debunk or support the result of this pilot study and ease the curiosity of critiques and other scholars. Public health, Healthcare practice, researchers, health policy, and the public are to benefit from these findings.

CONSENT (WHERE EVER APPLICABLE)

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

Institutional Review Board (IRB) approval of this study was sought and obtained from the Federal University of Technology, Owerri, Nigeria following ethical requirements of study involving human subjects and the reference number is FUT/SOHT/AD / REC/vol. 1

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki."

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