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Significant Improvement of Medication Adherence In Cardiovascular Patients Using Digital Platform Technology – A Prospective Study

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ABSTRACT

Medication nonadherence is fairly common concern which leads to increases risk for adverse cardiac events, including mortality. The phenomenon has added consequences for patients with chronic disease. The main aim of the study is to have a simple method of improving medication adherence of the cardiovascular patients over 12 months in the Department of Cardiology at a multi-specialty hospital in Chennai. The study included 192 patients prescribed cardiovascular medicines for acute myocardial infarction (AMI), congestive cardiac failure (CCF), and/or ischemic heart disease (IHD). Medication adherence was assessed using the eight-item Morisky Medication Adherence Scale (MMAS-8) which was assessed every 30 days interval up 12 months. Patients were randomized into two groups: Group I (96 patients) received weekly medication compliance reminders via WhatsApp, while Group Il (96 patients) did not receive such reminders. The results revealed that medication adherence rates in Group I exhibited better medication adherence compared to Group II based on MMAS scale analysis.

The study results suggest that using the WhatsApp mobile application for reminder strategies may be an effective and easy intervention to improve medication adherence. However, further studies with extended timelines are necessary to confirm these results and provide a more comprehensive understanding of the intervention's long-term efficacy. Future research should aim to explore the factors that influence medication adherence.

Keywords: *Cardiovascular medicines, Medication Compliance, Medication adherence, Medication Non-adherence, Prospective study.*

1. INTRODUCTION

Non- adherence to cardiovascular disease (CVD) accounts for ≈18 million deaths annually worldwide in low & middle income countries and high-income countries[1,2,5]. A variety of interventions have been implemented to improve medication adherence and have been tested in clinical trials by improving patient education, implementing medication reminders, testing cognitive behavioral interventions, reducing medication costs, utilizing healthcare team members, and streamlining medication dosing regimens[3]. AI use is increased now a days to increase patient medication compliance by sending personalized reminders, monitoring patient behavior, and providing tailored interventions to address underlying factors that contribute to non-adherence[4]. Mobile apps interventions are more effective to improve medication adherence in adults with chronic diseases when compared with conventional care[6]. Due to the extensive use of text message reminders as electronic reminders aiming at improving medication adherence, we need to achieve a better understanding of the effects of this method of reminding. Most of the studies reported the effectiveness of the intervention and significant improvements in medication adherence in patients receiving reminder messages. Studies measuring the level of medication adherence in various ways like self-report and self-report was the most commonly used method to measure medication adherence[7].Hence, understanding this viability of software for communication, we had conducted this study prospectively by using WhatsApp to assess the improvement in adherence to cardio medications in a super specialty hospital.

2. MATERIALS AND METHODS

Materials:

A smartphone with WhatsApp installed was used. Detailed information about the patient's medication schedule, dosages, and timing was gathered to send reminders from a simple calendar app. Data was collected by means of a comprehensive patient questionnaire and medication records.

Methods:

This was a prospective clinical study carried out over 12 months period in the Department of Cardiology of a multi-speciality hospital. Both male and female patients (age ≥ 18 years) who had undergone Interventional or surgical procedures and preferred medical therapy were prescribed at least one cardiovascular medication, which may have included antihypertensives (β-blockers, calcium antagonists, diuretics, angiotensin converting enzyme inhibitors, and angiotensin II receptor antagonists), antihyperlipidemic (statins), or anticoagulants (direct-acting oral anticoagulants) were included. Patients were considered ineligible if they were identified with co-morbid conditions such as chronic liver and kidney diseases, chronic obstructive pulmonary diseases, malignancy, and collagen vascular diseases and were excluded from the study.

The patients were randomized in two groups. (Group I & II). Patients who were willing to answer study specific reminder and questionnaire through google forms using WhatsApp once in a week and a monthly assessment with eight items Morisky's Medication Adherence Scale (MMAS-8) were included in Group I and the patients who were not willing for a weekly study specific reminder and google forms using WhatsApp once in a week but agreed for a monthly assessment with eight items Morisky's Medication Adherence Scale (MMAS-8) were included in Group-II. Patients were considered adherent to medication if they answered negatively to all eight questions.

Adherence was measured using the 8-item Morisky Medication Adherence Scale (MMAS-8). This self-reporting tool assesses medication-taking behaviour. The MMAS-8 consists of eight questions with yes or no answers. Items 1 to 7 provide "yes" or "no" responses. Item 8 uses a modified scoring for responses such as Never was considered No; and rarely, once in a while, Sometime, Usually, All the time were all considered Yes. The total score ranges for Yes or No were used to classify adherence[8]

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2013 and Institutional Ethics Committee permission was obtained prior to conducting the study. Written consent was obtained from all patients for being included in the study.

Statistical Analysis:

Statistically significant intergroup differences were observed by the Chi-square test, with statistical significance considered at $P<0.05P<0.05$ and $P<0.001P<0.001$. Cronbach's alpha for the scale was 0.92, indicating high reliability. ANOVA (Analysis of Variance) test was performed to compare the means of overall adherence for the data with patients who said No to all the questions to determine the statistical difference between groups.

3. RESULT

All patients included in the study were South Asian Indian. The mean age of all the patients under study was 57.01± 6.98 years. The majority of the patients in this study were from rural areas and predominantly of low socioeconomic status, despite this, most patients were well-educated, with a significant number being graduates (Table 1). 192 patients were included in this observational study and were allocated to Group-I and Group-II with 96 patients each. Of the 192 patients the Mean age of the patients suffering from CVD were 57.62 ± 9.33 years, 56 ± 2.17 years, 57 ± 6.83 years and 55.71 ± 8.37, 53.5 ± 1.60, 57.96 ± 6.08 in Group I and Group II respectively. Male patients outnumbered the female patients. The comparative analysis of the Morisky Medication Adherence Scale (MMAS) data reveals that Group I (GI) generally exhibited better medication adherence between 55% to 85% when compared to Group II (GII) across most questions were 30% to 69%. (Fig.13). The differences between the groups were statistically significant for all questions, indicating that the interventions or conditions affecting GI were more effective in promoting adherence.

Table 1 Characteristics of Patients Population in the study

Variables	Overall	Stratified Overall with Chronic Disease)			Stratified with Chronic Disease for GI and GII					
					GI (n = 96)			GII (n = 96)		
	General	AMI	CCF (n=23)	IHD (n=10	AMI (n=26	CCF (n=1	IHD (n=5	AMI (n=35	CCF	IHD (n=53

	(n= 192)	(n=61)		8)	)	5)	5)	)	(n=8)	)
Age (n ± SD)	57.01 ±6.98	56.52 ±8.76	55.13± 2.30	57.68 ±6.45	57.62 ±9.33	56± 2.17	57± 6.83	55.71 ±8.37	53.5± 1.60	57.96 ±6.08
Gender- Male: Female	175: 17	62: 0	18: 5	96: 12	24: 0	12: 3	49: 6	36: 0	6: 2	48: 6
Education Groups (%)										
Illiterate	12	0	0.00	11.11	0	0	7.27	0	0	15.09
Primary (Up to 10th standard)	28	0	13.04	23.15	0	0	21.8 2	0	0	15.09
Secondary (10th Grade passed)	49	50.82	0.00	16.67	46.15	60	16.3 6	54.29	0.00	15.09
Higher Secondary (11th and 12th Grade Passed)	22	19.67	21.74	4.63	15.38	20	5.45	22.86	25.00	3.77
Graduates and above	81	29.51	65.22	44.44	38.46	60	47.2 7	22.86	75.00	41.51
Socioeconomic Status										
Higher (family income INR ≥ 50000): Lower (family income INR >50000)	40: 152	13: 50	13: 10	15: 94	4: 22	7: 8	8: 47	8: 27	6: 2	7: 46
Region Ratio (Rural: Urban)	97: 95	41: 20	10: 13	46: 62	19: 7	6: 9	27: 28	22: 13	4: 4	19: 34
Living arrangements (Alone:Partner)	18: 174	18: 43	0: 23	0: 108	6: 20	0: 15	0: 55	12: 23	0: 8	0: 53

n = numbers, SD = Standard Deviation, AMI- Acute Myocardial Infraction, CCF – Congestive Cardiac Failure, IHD- ischemic heart disease, G-I = Group I, G-II = Group II

4. DISCUSSION

The present study aimed to assess the impact of WhatsApp reminders on medication adherence among 192 cardiovascular patients using the Morisky Medication Adherence Scale (MMAS) over a period of 12 months. The findings indicate high levels of medication adherence, with the majority of patients reporting consistent adherence behaviours throughout the study period in Group 1, who receive weekly WhatsApp reminders to monthly assessments over a period of 30 days up to 360 days with an interval of 30 days each in GI showed higher adherence rate increasing between 55% to 85% when compared to GII which was between 30% to 69%. This shows regular reminders sent through a widely-used platform like WhatsApp may be an effective strategy to improve medication adherence. Using WhatsApp reminders for medication adherence in cardiovascular disease patients offers several advantages. Regular reminders improve adherence by helping patients remember to take their medications on time, which is crucial for managing cardiovascular conditions. WhatsApp's widespread use and accessibility make it a convenient platform for receiving reminders without needing additional apps. These reminders can be personalized to fit individual schedules and medication regimens, enhancing their effectiveness. Additionally, WhatsApp allows for two-way communication, enabling patients to ask questions or report issues directly to their healthcare providers. Utilizing an existing platform like WhatsApp is also cost-effective compared to developing a separate medication reminder system. The overall medication adherence p-value is much lower than 0.05, indicating that there is a statistically significant difference between the two groups (GI and GII) over the period of time. The high F-statistic suggests that the variance between the groups (GI and GII) is much larger than the variance within the groups, reinforcing the significance of the difference. At each point, the percentage of patients in Group I (GI) who said "no" to all the MMAS questions is consistently higher than in GII. The difference between the two groups is statistically significant at each time point, as indicated by the p-value being less than 0.001 throughout the study period. The intervention or condition associated

with Group I was more effective in improving patients' adherence to the behaviours or conditions evaluated by the MMAS questionnaire.

One important feature of the scale is that treatment-related attitude and behavior problems that the patient may be facing can be immediately identified and health care providers may provide reinforcement and advice such that the patient can take positive steps early on to address these issues [8].

Various studies have shown that poor compliance and lack of persistence with prescribed medication regimens lead to higher morbidity and mortality rates for various illnesses, as well as increased healthcare costs[9]. The accurate assessment of adherence depends, to a large degree, on the development of a trusting and accepting relationship between the patient and the healthcare team. Adherence assessments that are simple (presenting as little burden to the respondent as possible) and nonthreatening will also likely yield the most honest and accurate responses.[10]

One of the key findings of this study is the high percentage of patients who reported not forgetting to take their medication (87.5% to 92.71%). This suggests that patients are generally effective in managing their medication regimens through continuous reminders. Additionally, the low proportion of patients who sometimes forgot their medication (7.29% to 12.5%) indicates that forgetting is not a significant barrier to adherence in this population. (Fig.1 to Fig.12)

The study also found high levels of intentional adherence, with 89.58% to 98.96% of patients reporting no intentionally missed days. This suggests that patients are motivated to adhere to their medication regimens and are not intentionally skipping doses. The low proportion of patients who intentionally missed their medication (1.04% to 10.42%) indicates that forgetting is not a significant barrier to adherence in this population. (Fig.1 to Fig.12)

The majority of patients (82.29% to 98.96%) did not cut back or stop their medication without consulting their doctor, indicating good adherence to treatment plans. the low proportion of patients who sometimes stop their medications without consulting their doctor (1.04 % to 17.71%). (Fig.1 to Fig.12)

The high percentage of patients who remembered to bring their medication when they travel or leave home was (87.5% to 100%). The percentage of those who forgot ranged from 0% to 12.5%. (Fig.1 to Fig.12).A very high adherence rate was observed, with 94.79% to 98.96% of patients taking all their medicine the day before the questionnaire assessment. The percentage of patients who did not take all their medicine the previous day was very low, between 1.04% and 5.21%. (Fig.1 to Fig.12).

A high percentage of patients (90.63% to 96.88%) did not stop taking their medicine when they felt their symptoms were under control. The percentage of patients who did stop ranged from 3.13% to 9.38%. (Fig.1 to Fig.12).The study also explored factors that may influence adherence, such as feeling hassled about sticking to the treatment plan. The majority of patients (91.67% to 100%) did not feel hassled, suggesting that treatment plans are generally manageable and not overly burdensome with nonadherence at the rate of small percentage (0% to 8.33%) (Fig.1 to Fig.12) reported feeling hassled. The majority of patients (86.46% to 91.66%) reported no difficulty in remembering to take their medication. A minority (8.33% to 13.54%) reported having difficulty. (Fig.1 to Fig.12)

The findings of this study have implications for healthcare providers and policymakers. The high levels of medication adherence observed in this study suggest that patients are generally motivated to manage their health conditions effectively. However, the study also highlights the need for ongoing support like continuous reminders and education to help patients maintain good adherence behaviours.

explore the integration of other mobile health technologies.

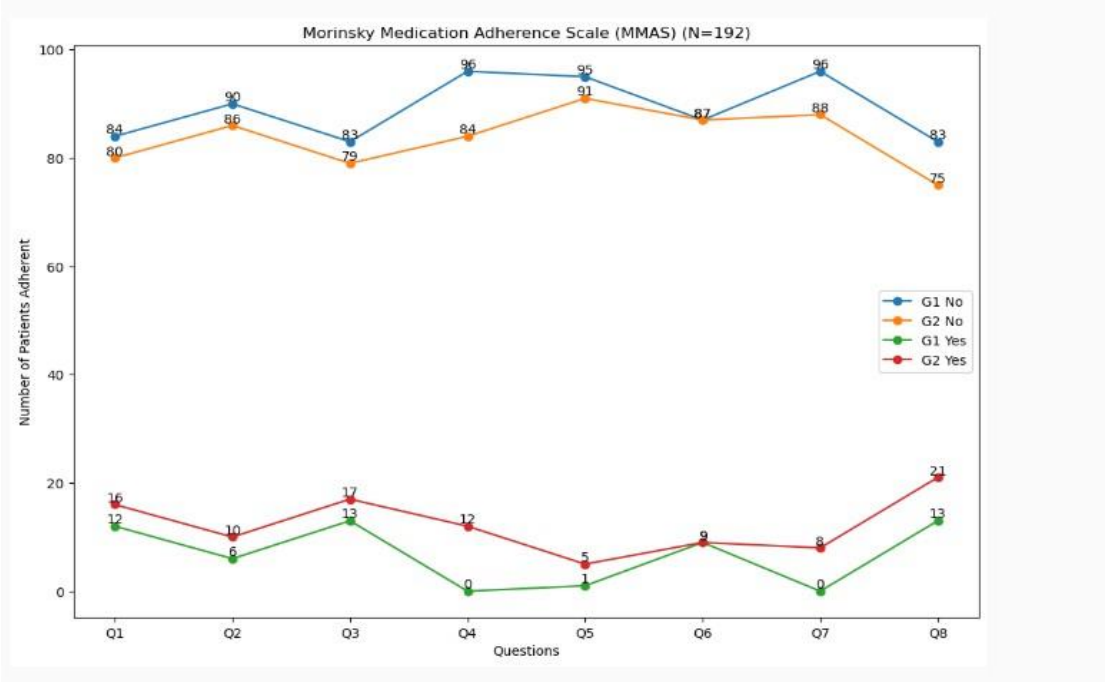

Fig 1. Morisky Medication Adherence scale (MMAS) (n=192) -30 DAYS

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001) Cronbach's alpha =0.92.

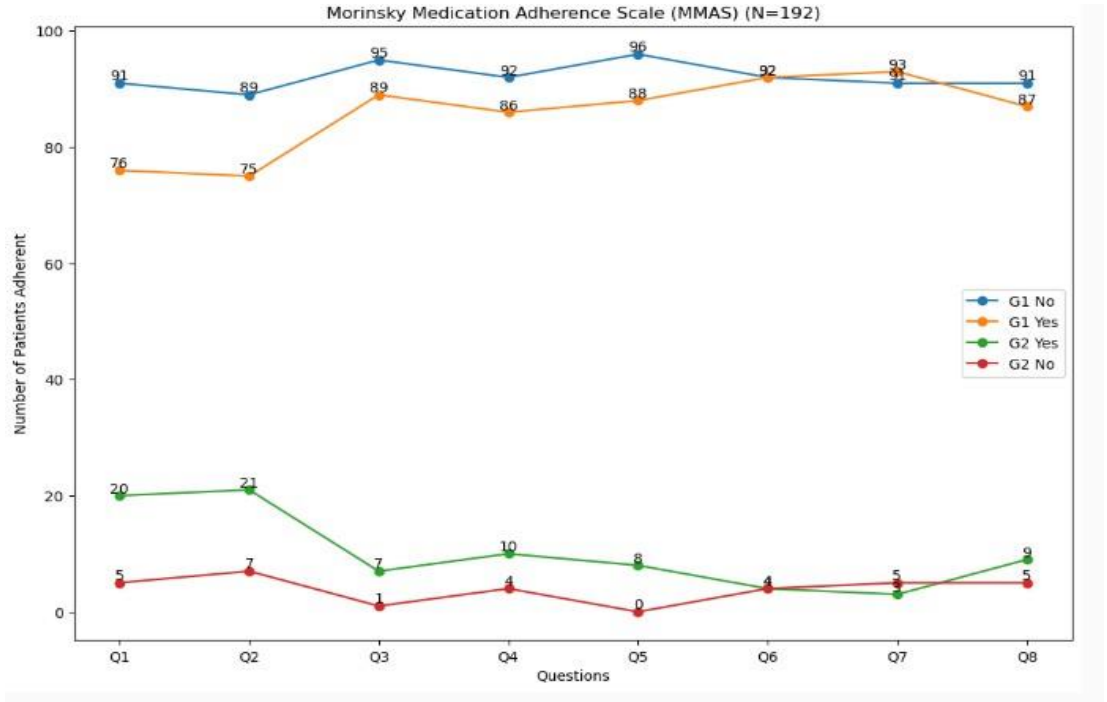

Fig 2. Morisky Medication Adherence scale (MMAS) (n=192)- 60 DAYS

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.98

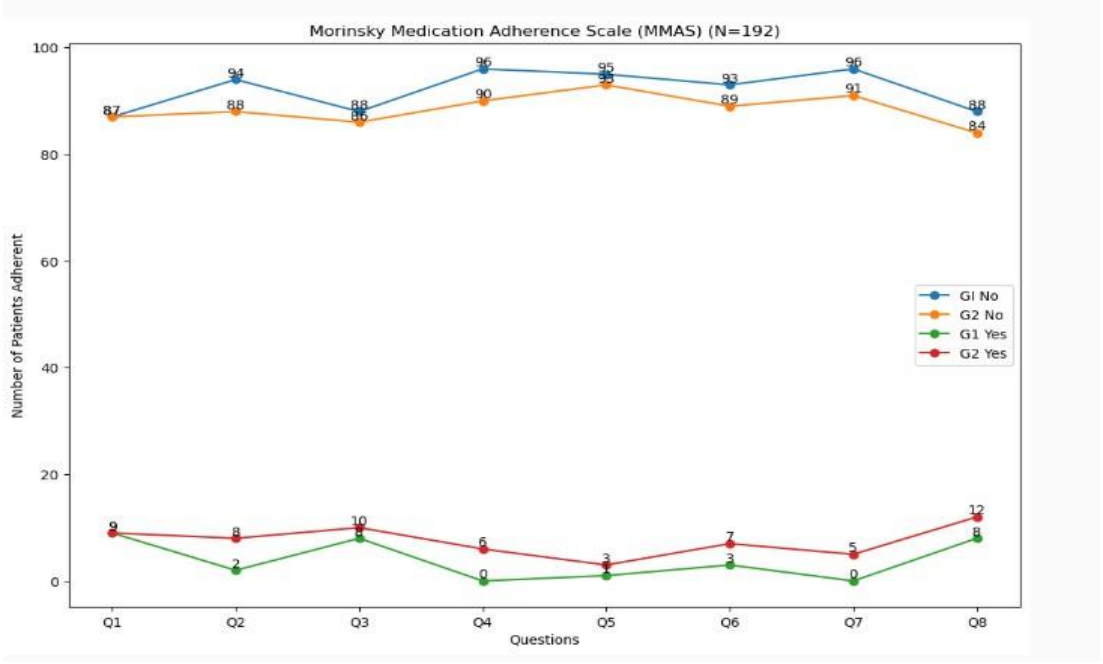

Fig 3. Morisky Medication Adherence scale (MMAS) (n=192) – 90 DAYS

Never was considered No and rarely, once in a while, Sometime, Usually, All the time were all considered Yes.

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.96

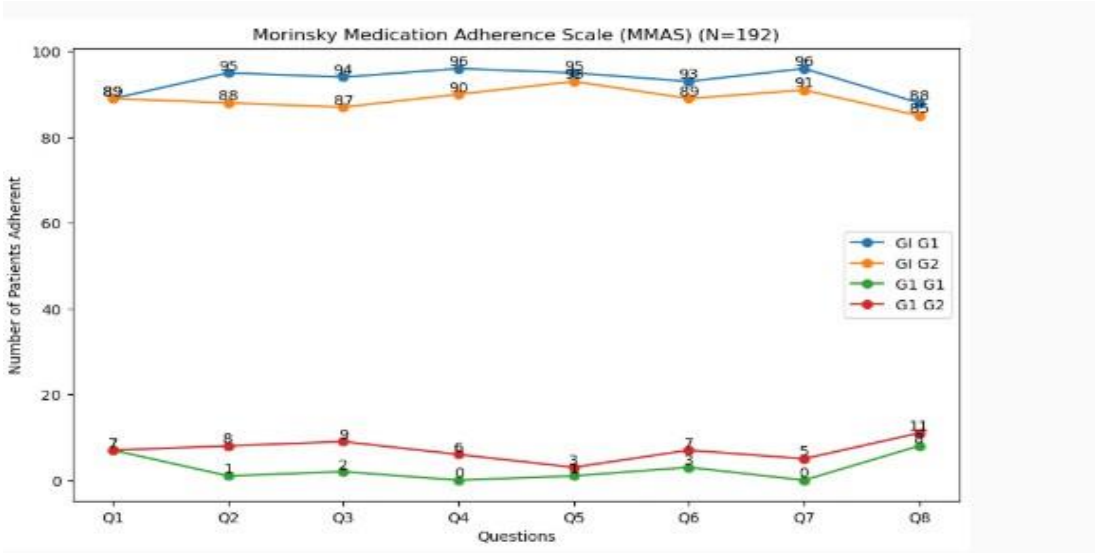

Fig 4. Morisky Medication Adherence scale (MMAS) (n=192)-120 DAYS

Never was considered No and rarely, once in a while, Sometime, Usually, All the time were all considered Yes.

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.92.

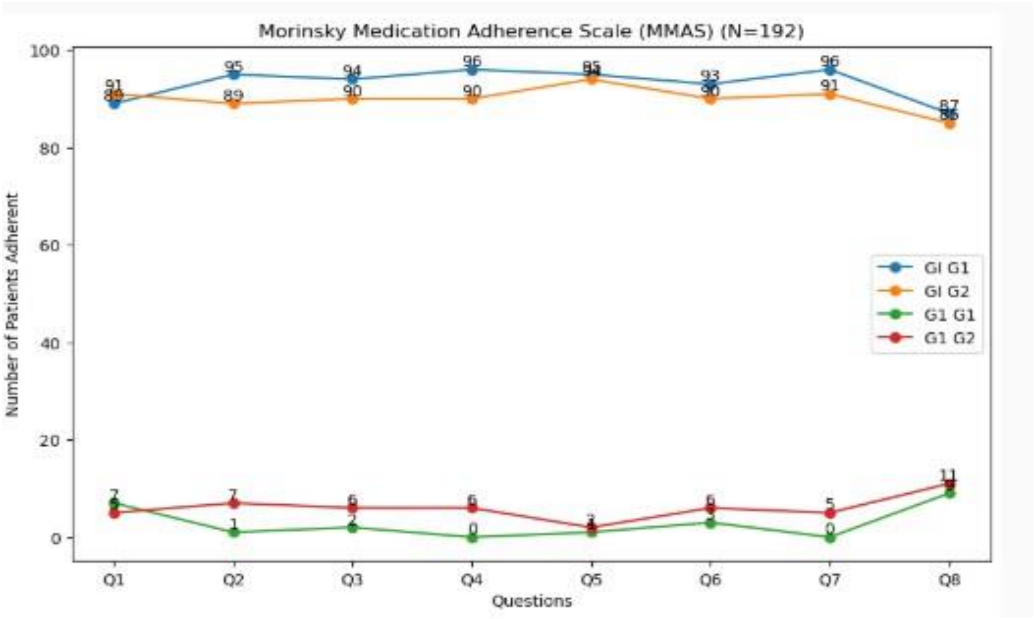

Fig 5. Morisky Medication Adherence scale (MMAS) (n=192)-150 DAYS

Never was considered No and rarely, once in a while, Sometime, Usually, All the time were all considered Yes.

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.99.

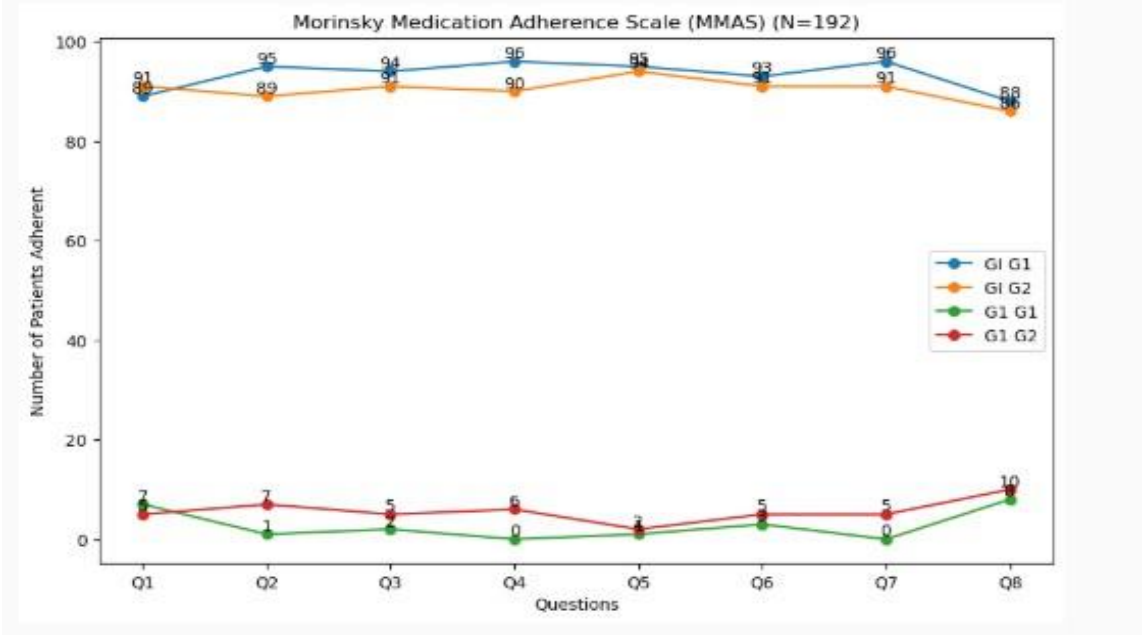

Fig 6. Morisky Medication Adherence scale (MMAS) (n=192)-180 DAYS

*Never was considered No and rarely, once in a while, Sometime, Usually, All the time were all considered Yes.

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.94

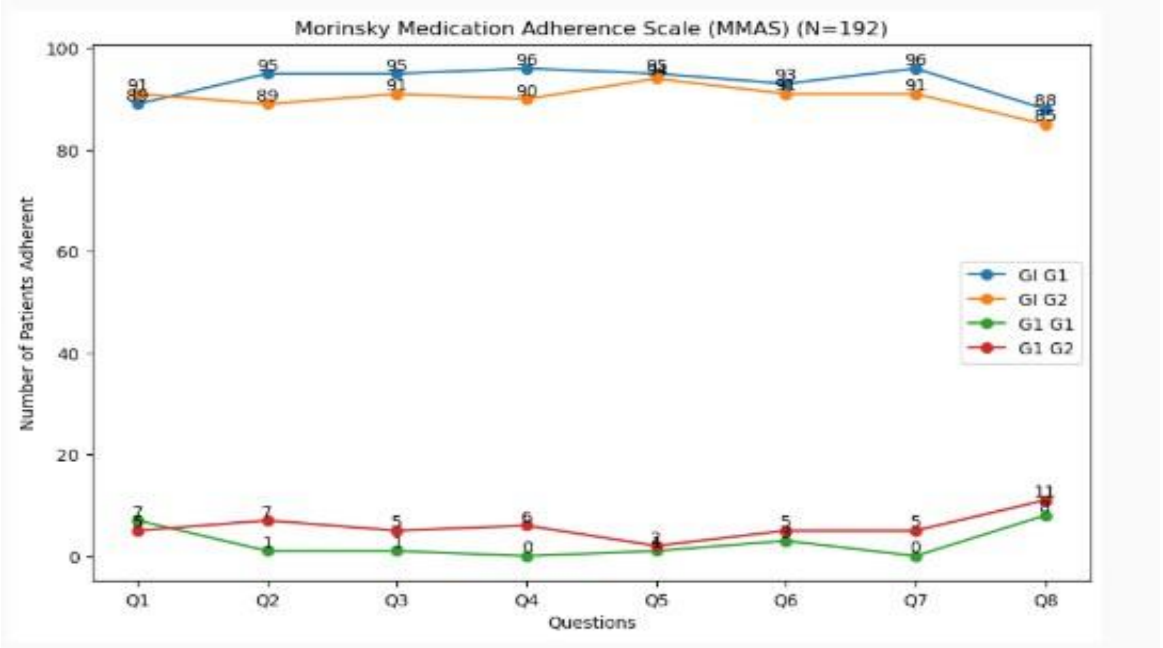

Fig 7. Morisky Medication Adherence scale (MMAS) (n=192)-210 DAYS

*Never was considered No and rarely, once in a while, Sometime, Usually, All the time were all considered Yes.

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.96

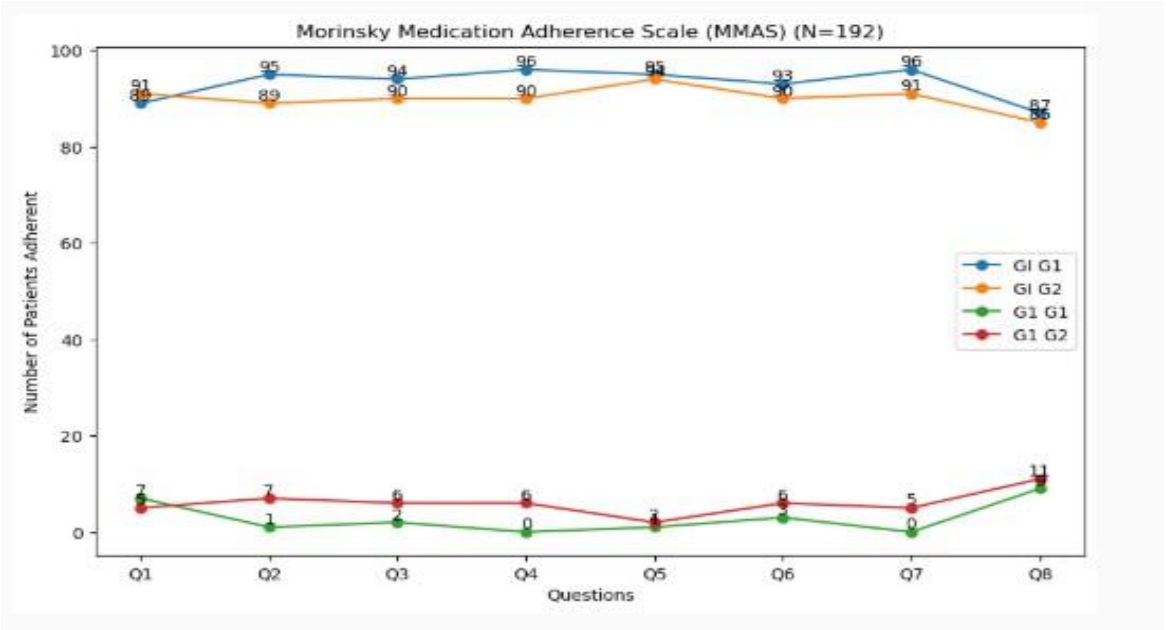

Fig 8. Morinsky Medication Adherence scale (MMAS) (n=192)-240 DAYS

Never was considered No and rarely, once in a while, Sometime, Usually, All the time were all considered Yes.

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.98

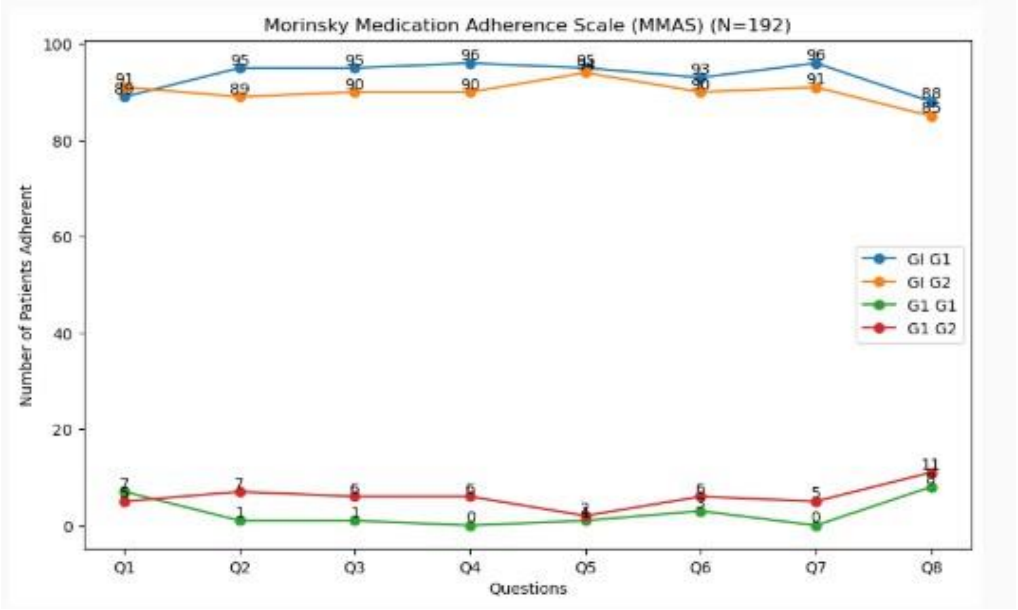

Fig 9. Morisky Medication Adherence scale (MMAS) (n=192)-270 DAYS

*Never was considered No and rarely, once in a while, Sometime, Usually, All the time were all considered Yes.

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.94

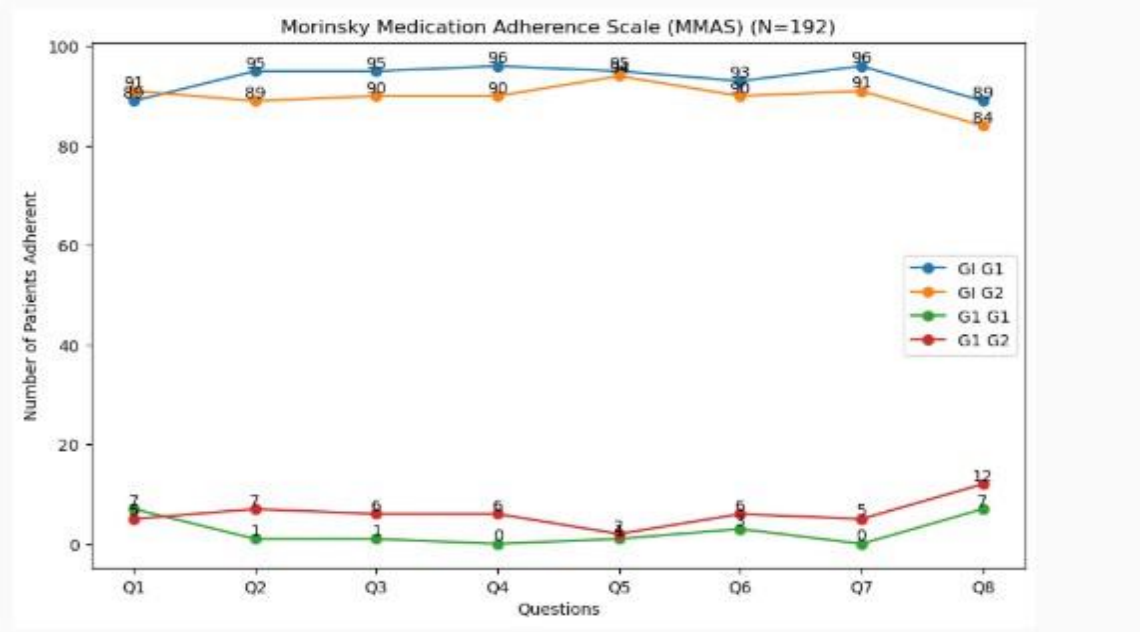

Fig 10. Morisky Medication Adherence scale (MMAS) (n=192)-300 DAYS

*Never was considered No and rarely, once in a while, Sometime, Usually, All the time were all considered Yes.

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.96

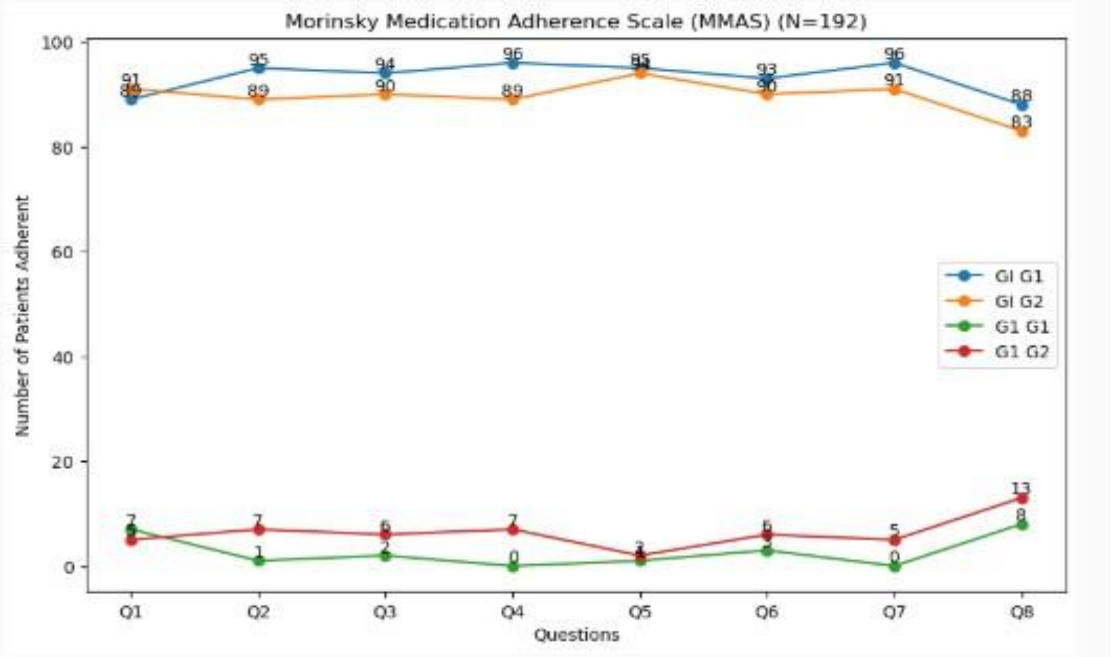

Fig 11. Morisky Medication Adherence scale (MMAS) (n=192)-330 DAYS

*Never was considered No and rarely, once in a while, Sometime, Usually, All the time were all considered Yes.

Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.98

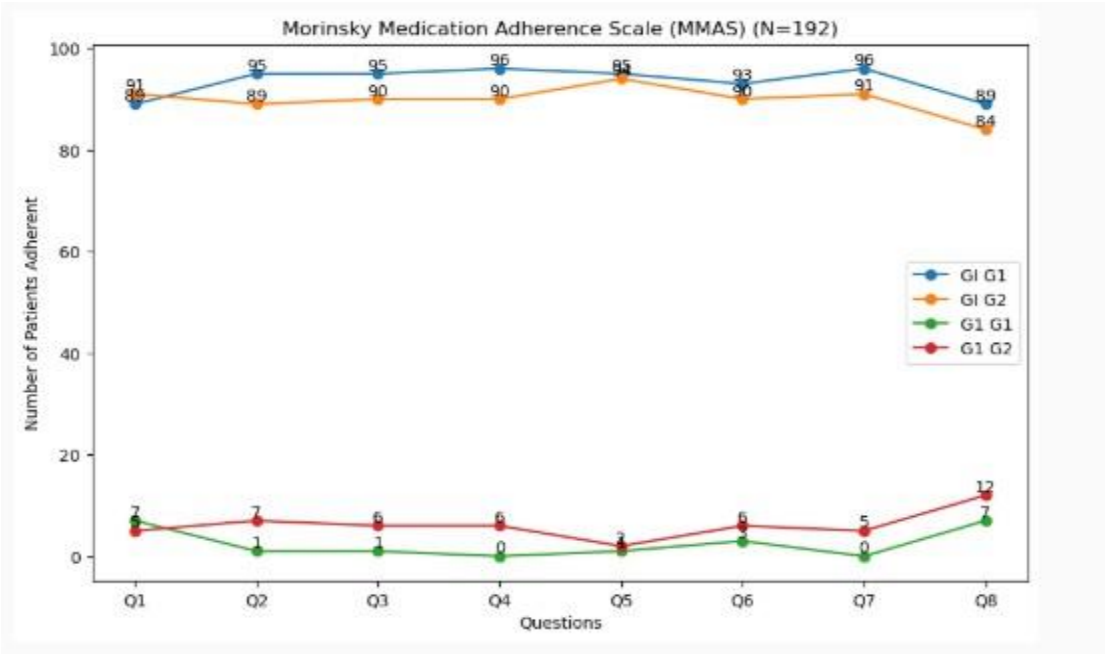

Fig 12. Morisky Medication Adherence scale (MMAS) (n=192)-360 DAYS

Never was considered No and rarely, once in a while, Sometime, Usually, All the time were all considered Yes. Statistically significant (S.S) intergroup differences were observed by the Chi-square test. (Statistical significance was considered at P<0.05; P<0.001). Cronbach's alpha =0.97

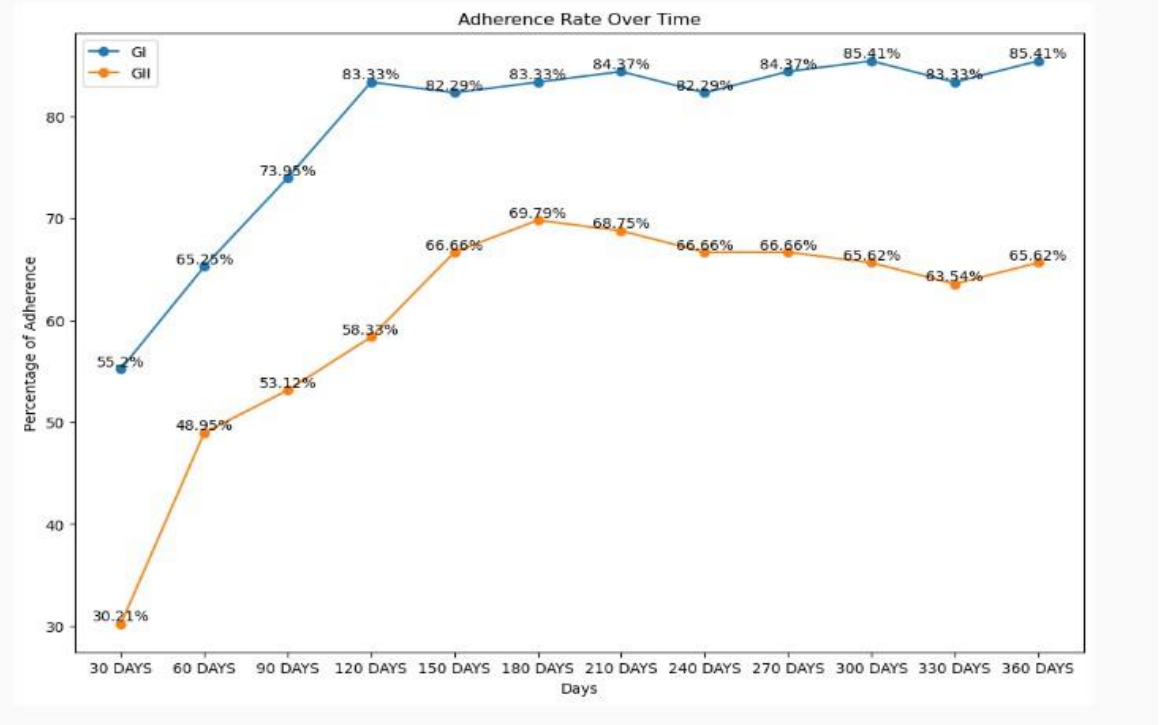

Fig 13. Morisky Medication Adherence scale (MMAS) Comparison of overall treatment compliance over a period of 30-360 DAYS.

5. CONCLUSION

The comparative analysis of the Morisky Medication Adherence Scale (MMAS) data reveals that Group I (GI) generally exhibited better medication adherence compared to Group II (GII) across most questions. The differences between the groups were statistically significant for all questions, indicating that the interventions or conditions affecting GI were more effective in promoting adherence.GI consistently showed higher adherence rates across various aspects, such as not forgetting to take medicine, not missing doses for other reasons, and not feeling hassled about the treatment plan. The differences between the groups were statistically significant ($P<0.005$), highlighting the effectiveness of the interventions or conditions in GI. Overall, the findings suggest that targeted strategies to improve medication adherence can have a significant impact on patient outcomes. By addressing specific challenges faced by different patient groups, healthcare providers can design more effective adherence programs, leading to better health outcomes and reduced healthcare costs. While this study provides valuable insights into medication adherence behaviours, it has some limitations. The study relied on self-reported data, which may be subject to biases. Additionally, the study sample may not be representative of all patients with chronic health conditions. Future research should aim to explore the factors that influence medication adherence. This could include investigating the role of patient beliefs, medication side effects, and healthcare provider-patient communication in shaping adherence behaviours. Additionally, studies could explore the effectiveness of different interventions aimed at improving medication adherence and

F-statistic: 18.97; p-value: 0.00025; Statistically significant (S.S) intergroup differences were observed by the ANOVA test. (Statistical significance was considered at $P<0.05$; $P<0.001$)

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