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DETERMINANTS OF MEDICATION ADHERENCE IN HYPERTENSION: EVIDENCE FROM A DIALECTICAL BEHAVIOR THERAPY INTERVENTION

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ABSTRACT

Purpose of the Study: The study examined the demographic determinants of medication adherence among patients with hypertension across three time points within a behavioral intervention context.

Statement of the Problem: Despite clear benefits of adherence for blood pressure control and reduced complications, many patients fail to take medications consistently. Sociodemographic and clinical factors may influence adherence, but their role in shaping engagement with treatment remains underexplored.

Methodology: A quasi-experimental design was employed with 80 patients randomly assigned to an experimental group receiving Dialectical Behavior Therapy (DBT) or a control group receiving usual care. Adherence was measured using the Morisky Medication Adherence Scale-8, and demographic data were collected via a researcher-developed questionnaire. Analyses included bivariate comparisons and Generalized Estimating Equations to assess predictors over time.

Results of the Study: At baseline, adherence did not differ across demographic or clinical characteristics. Post-intervention, education emerged as a significant determinant, with its influence increasing over time. Participants were 97% less likely to report moderate-to-high adherence at baseline compared to endline, and odds of adherence nearly doubled between midline and endline, highlighting progressive improvement.

Conclusion and Policy Implications: Higher educational attainment appears to enhance understanding of disease, appreciation of treatment benefits, and capacity to overcome barriers. Integrating health education and behavioral interventions like DBT into chronic disease management can strengthen adherence outcomes. Policymakers and healthcare systems should provide structured support and tailor interventions to demographic contexts, while future research should explore how social, economic, and cultural factors intersect with adherence behavior.

Keywords: *Determinants, Medication Adherence, Hypertension, Dialectical Behavior, Therapy Intervention*

INTRODUCTION

Medication adherence is a critical determinant of effective hypertension management, directly influencing blood pressure control, risk of cardiovascular complications, and overall patient outcomes. High adherence not only improves clinical prognosis but also reduces healthcare utilization and associated costs by preventing avoidable hospitalizations and complications. Adherence behaviors, however, are often shaped by demographic and clinical factors, such as age, gender, education, comorbidities, and polypharmacy, which can either facilitate or hinder consistent medication use. Understanding these factors is essential, as they influence patients' engagement with prescribed antihypertensive therapies and inform the design of interventions to support adherence.

Behavioral interventions, such as Dialectical Behavior Therapy (DBT), offer promising strategies by addressing psychological and behavioral barriers such as stress management, self-regulation, and problem-solving that commonly affect patients with chronic hypertension. Investigating how demographic and clinical characteristics interact with DBT-based interventions can provide valuable insights for tailoring support, optimizing treatment outcomes, and promoting sustained adherence among individuals living with hypertension. Medication adherence among patients with hypertension and other chronic conditions is influenced by a complex interplay of sociodemographic, patient-related, and healthcare system factors.

Globally, studies have reported mixed findings regarding these determinants. In the United States, Donneyong et al. (2020) identified food insecurity/poverty ($\beta = .31$, $p < .001$), weak social support ($\beta = .27$, $p < .001$), and healthy built environments ($\beta = -.10$, $p < .01$) as significant determinants of antihypertensive medication non-adherence, collectively explaining 30.3% of the variation. Similarly, Whittle et al. (2016) found that younger age ($p = .007$), lower education ($p = .006$), Black ethnicity ($p < .001$), and smoking status ($p = .001$) were associated with poor adherence. In Canada, multiple studies have highlighted sociodemographic and economic determinants. Zeitouny et al. (2023)reported that prescriptions issued by male prescribers (OR = .66, 95% CI .50–.88) and increasing age (OR = .91 per 10-year increase) were significantly associated with adherence. Rebić et al. (2024) further found that being female (AOR = 1.44), belonging to a racial or ethnic minority (AOR = 1.44), and having comorbid diseases (AOR = 1.91–3.41) were positively associated with adherence, whereas lack of prescription drug coverage significantly reduced adherence (AOR = 2.76). These findings indicate structural and social inequalities disproportionately affecting marginalized groups.

European studies have also underscored the role of psychosocial and demographic factors. Among African-descent patients in the Netherlands, Meinema et al. (2015) found that social support and medication self-efficacy were significant determinants at baseline, while age, fewer medication concerns, and increased self-efficacy predicted adherence post-intervention. In Albania, Roshi et al. (2021) identified age, place of residence, education, economic level, and employment status as significant determinants, with 19.8% of adults reporting non-adherence.

In Asia, adherence determinants varied across settings. In China, Du et al. (2020) reported that older age, employment, non-consumption of alcohol, and better disease knowledge were positively associated with adherence, whereas stigma, adverse drug reactions, and non-adherence to adjuvant therapies were negatively associated. In Hong Kong, Li et al. (2016) found no significant effect of multi-morbidity on adherence, while in Jordan, Jarrah et al. (2023) observed that age, marital status, education, income, living alone, and presence of comorbidities significantly influenced adherence. In Japan, Wakai et al. (2021) highlighted that age and regimen complexity, rather than polypharmacy or gender, were significant predictors. Studies from the Philippines Balilo et al. (2020) and Dalena and Intong-Napigkit, (2024) as well as Indonesia Rislanniyata and Astrid (2025) similarly emphasized education, knowledge, and polypharmacy as key determinants.

In Sub-Saharan Africa, fewer studies exist, but trends are comparable. In South Africa, Rampamba et al. (2018) reported that controlled blood pressure and presence of comorbidities increased adherence, while smoking reduced it. In Ghana, Adu et al. (2022) found urban residence to be a significant factor, whereas other sociodemographic characteristics were not. In Nigeria, Usman et al. (2022) reported that age, education, healthcare financing, number of medications, and monthly income influenced adherence. In Ethiopia, Mekonnen et al. (2017) found favorable medication attitudes, good patient-clinician relationships, treatment duration, low medical costs, and lower comorbidity burden significantly enhanced adherence.

In Kenya, studies by Waari et al. (2018) and Mbuti et al. (2020) revealed that family support, clinician-patient communication, medication affordability, gender, education, and urban residence were important determinants of adherence, while other factors such as age and marital status showed variable influence. Overall, these findings underscore that medication adherence is determined by a multidimensional set of factors, including sociodemographic characteristics (age, gender, education, income, ethnicity), patient-related factors (self-efficacy, comorbidities, behavioral habits), and healthcare system influences (prescriber characteristics, drug access, clinician-patient relationships). The evidence suggests that interventions targeting adherence must be context-specific, addressing both individual patients' needs and broader social and structural determinants to effectively improve treatment outcomes globally.

RESEARCH METHODOLOGY

This quasi-experimental study examined sociodemographic and clinical determinants of medication adherence among patients with hypertension. Conducted between March and July 2025, the study allowed for comprehensive assessment of adherence behaviors and related factors. The study took place in three Level Four mission hospitals in Thika, Kenya, which serve patients with chronic conditions and provide an appropriate setting for examining adherence patterns. Participants were adults aged 18 years and above with a confirmed diagnosis of hypertension, on medication for at least six months, and able to provide informed consent. Individuals with cognitive impairment, acute illness, or unwillingness to participate were excluded. Eighty participants were recruited through random sampling, with the sample size determined using the Casagrande formula. Medication adherence was measured using the validated Morisky Medication Adherence Scale (MMAS-8).

Additional sociodemographic and clinical data—including age, gender, education, income, comorbidities, number of medications, knowledge of hypertension, and help-seeking behaviors were collected using a structured researcher-developed questionnaire. Data were collected through face-to-face interviews by trained research assistants after obtaining written informed consent. Instruments were pre-tested in a pilot study to ensure clarity and reliability. Confidentiality was maintained throughout. Data were entered into SPSS, cleaned, and checked for completeness. Descriptive statistics summarized participant characteristics and adherence levels, while inferential analyses identified factors significantly associated with adherence. Statistical significance was set at $p < 0.05$. Ethical approval was obtained from the Daystar University Institutional Scientific and Ethical Review Committee, and a research license (No. 521815) was granted by the National Commission for Science, Technology and Innovation (NACOSTI). Participation was voluntary, and anonymity and confidentiality were assured.

RESULTS

Sociodemographic and Clinical Characteristics of Participants

At baseline the study had 80 participants, descriptive analysis of sociodemographic and clinical characteristics and group differences are presented on Table 1.

Table 1: Sociodemographic Characteristics of Participants

Characteristic	Control (n = 42)	Experimental (n = 38)	Statistic (df)	*p*
Age (years)	52.50(18.00)	56.29(7.78)	*U* = 592.0	0.019
Gender			0.153(1)	0.696
Male	15 (35.7%)	12 (31.6%)		
Female	27 (64.3%)	26 (68.4%)		
Marital Status			Exact	0.424
Married	28 (66.7%)	27 (71.1%)		
Single	10 (23.8%)	5 (13.2%)		
Widowed	4 (9.5%)	6 (15.8%)		
Highest Level of Education			Exact	0.414
Primary school certificate	12 (28.6%)	12 (31.6%)		
High school certificate	4 (9.5%)	4 (10.5%)		
College certificate	12 (28.6%)	9 (23.7%)		
College diploma	4 (9.5%)	8 (21.1%)		
College higher diploma	4 (9.5%)	4 (10.5%)		
Bachelor's degree	6 (14.3%)	1 (2.6%)		
Comorbid Disease			0.22(1)	0.638
Yes	21 (50.0%)	21 (55.3%)		
No	21 (50.0%)	17 (44.7%)		
Hypertension Information			1.64(1)	0.201
Yes	28 (66.7%)	20 (52.6%)		
No	14 (33.3%)	18 (47.4%)		
Number of Medications			0.27(1)	0.602
One	32 (76.2%)	27 (71.1%)		
Two	10 (23.8%)	11 (28.9%)		
Difficulty Buying Medicine			0.01(1)	0.917
Yes	27 (64.3%)	24 (63.2%)		
No	15 (35.7%)	14 (36.8%)		
Seek Help to Obtain Medicine			0.01(1)	0.930
Yes	17 (40.5%)	15 (39.5%)		
No	25 (59.5%)	23 (60.5%)		

Differences between groups were analyzed using Pearson's chi-square (χ^2) and Fisher's Exact, for categorical variables, and Mann–Whitney U test for continuous variables. No statistically significant baseline differences were observed between the control and experimental groups ($p > .05$). Descriptive analyses using cross-tabulation were performed to compare the distribution of demographic variables across the control and experimental groups. As shown on Table 1 at baseline, the overall median age of participants was 55 years (IQR = 11.00). A Mann–Whitney U test was performed to compare age differences between the control and experimental groups. Results indicated a statistically significant difference, with participants in the control group (Mdn = 52.50, IQR = 18.00) being younger than those in the experimental group (Mdn = 56.25, IQR = 7.78), $U = 592.00$, $z = –1.21$, $p = .047$. The effect size was small to approaching-moderate ($r = .22$), suggesting that approximately 4.8% of the variance in rank scores could be attributed to group membership. Thus, although the groups were generally comparable, the experimental group comprised slightly older participants.

Table 1 shows that no significant group differences in, marital status ($p = .424$), or highest level of education ($p = .414$) were revealed. These findings suggest that the two groups were comparable at baseline with respect to both marital status and education. To explore clinical characteristics, chi-square analyses were conducted. Table 1 shows that within the control group, 15 participants (35.7%) were male, while 27(64.3%) were female. In comparison, 12 participants (31.6%) in the experimental group were male and 26(68.4% were female. The difference between groups was not statistically significant ($\chi^2(1) = 0.15$, p = .696), indicating similar demographic profiles regarding gender at baseline. Within the control group, 21 participants (50%) reported having a comorbid condition, while an equal number (50%) did not. In comparison, 17 participants (44.7%) in the experimental group reported no comorbid condition. The difference between groups was not statistically significant ($\chi^2(2) = 0.22$, p = .638), indicating similar clinical profiles regarding coexisting diseases at baseline.

Participants were also asked whether they possessed information about hypertension. As seen on Table 1, overall, 48(60.0%) reported having such information, compared to 32(40.0%) who did not. Within the control group, 28(66.7%) indicated awareness of hypertension information, while 13(33.3%) did not; in the experimental group, 20 (52.6%) reported awareness compared to 18(47.4%) who did not. The between-group difference was not statistically significant ($\chi^2(1) =$

1.64, p = .201), suggesting that knowledge about hypertension was generally comparable across the two groups. Medication-related characteristics were further examined. Table 1 shows that the majority of participants 59(73.8%) reported using a single prescribed medication, whereas 21(26.3%) used two. In the control group, 32(76.2%) were on one medication and 10(23.8%) on two; in the experimental group, 27(71.1%) used one and 11(28.9%) used two. The difference in medication use was not statistically significant ($\chi^2(1) = 0.27$, p = .602), suggesting homogeneity in prescription profiles between groups.

Regarding financial assistance for medication, Table 1 shows that 32 participants (40%) indicated receiving help to purchase antihypertensive drugs, while 48(60%) did not. In the control group, 17(40.5%) received assistance compared with 15(39.5%) in the experimental group. This variation was minimal and statistically non-significant ($\chi^2(1) = 0.01$, p = .093), indicating no meaningful difference in access to financial support for medication across groups.

Determinants of medication adherence at baseline were subsequently examined and are presented in the following section.

Table 2: Determinants of Medication Adherence at Baseline

Variable	χ^2(df) Test Type	*p*-Value	Effect Size (η^2 / V)	Interpretation
Age	$H(2) = 0.26$	0.611	$\eta^2 = .00$	Not significant
Gender	Exact	1.000	$V = .03$	Not significant
Education	Exact	0.399	$V = .28$	Not significant
Marital status	Exact	0.479	$V = .13$	Not significant
Comorbid disease	Exact	0.664	$V = .07$	Not significant
No. of medications	Exact	1.000	$V = .04$	Not significant

Note: None of the sociodemographic or clinical variables were significantly associated with medication adherence at baseline. Exact = Fisher's exact test. V = Cramer's V. Effect sizes: η2 for Kruskal-Wallis Test, Cramer's V for Fisher's exact. p values are based on Fisher's exact test for categorical variables due to small cell counts. According to Table 2, at baseline, none of the sociodemographic or clinical variables demonstrated a significant association with medication adherence. A Kruskal–Wallis test revealed no significant differences in age across adherence categories (χ^2 (2) = 0.26, p = .611, η^2 = .00). Likewise, Fisher's exact tests showed no significant associations for gender (p = 1.000, Cramer's V = .00), education level (p = .399, V = .28), marital status (p = .479, V = .130), presence of comorbid disease (p = .664, V = .07), or number of prescribed medications (p = 1.000, V = .04). These results indicate that, before the intervention, medication adherence did not differ significantly based on demographic or clinical characteristics. In other words, factors such as gender, educational attainment, marital status, comorbid conditions, and number of medications did not appear to influence adherence at baseline. Subsequent analyses examined the relationship between medication adherence and sociodemographic and clinical variables at the midline phase of data collection.

Table 3: Midline Sociodemographic and Clinical Determinants of Medication Adherence

Variable	*H*(df) / Test Type	*p*	Effect Size (η^2 / *V*)	Interpretation
Age	*H*(2) = 0.51	.113	η^2 = .04	Not significant
Gender	Exact	.714	*V* = .13	Not significant
Education	Exact	.048	*V* = .33	Significant (moderate effect)
Marital status	Exact	.344	*V* = .19	Not significant
Comorbid disease	Exact	.654	*V* = .59	Not significant
No. of medications	Exact	.707	*V* = .08	Not significant

Note: At midline, only education was significantly associated with medication adherence, showing a moderate effect size. Effect sizes: η2 for Kruskal-Wallis, Cramer's V for Fisher's exact. p values are based on Fisher's exact test for categorical variables due to small cell counts. Exact = Fisher's exact test. V = Cramer's V. Table 3 shows that at midline, educational attainment emerged as a significant determinant of medication adherence. Fisher's exact test revealed a statistically significant association between education and adherence (*p* = .048, *V* = .33), representing a moderate effect size. This finding suggests that, following the intervention, participants' level of education began to influence adherence behavior. In contrast, all other sociodemographic and clinical variables remained statistically non-significant: age (χ^2(2) = 4.36, p = .113, η^2 = .04), gender (p = .714, V = .13), marital status (p = .344, V = .19), comorbid disease (p = .654, V = .59), and number of medications used (p = .707, V = .08). These results indicate that, at midline, education was the only variable that significantly differentiated adherence patterns, whereas factors such as gender, marital status, comorbidity, and medication count continued to show no meaningful influence. Subsequent analyses examined the relationship between medication adherence and sociodemographic and clinical characteristics at the endline, three months after the intervention.

Table 4: Endline Sociodemographic and Clinical Determinants of Medication Adherence

Variable	*H*(df) / Test Type	*p*	Effect Size (η^2 /V)	Interpretation
Age	$H(2) = 5.97$	.051	$\eta^2 = .06$	Trend-level (not significant)
Gender	Exact	.714	$V = .12$	Not significant
Education	Exact	.007	$V = .40$	Significant (moderate-to-strong effect)
Marital status	Exact	.343	$V = .18$	Not significant
Comorbid disease	Exact	.549	$V = .50$	Not significant
No of medications	Exact	.411	$V = .40$	Not significant

As seen on Table 4, at endline, educational attainment remained a significant determinant of medication adherence. Fisher's exact test indicated a statistically significant association between education and adherence ($p = .007$, Cramer's $V = .40$), reflecting a moderate effect size. This finding suggests that the influence of education on adherence persisted over time. Age showed a trend-level association ($\chi^2(2) = 5.97$, p = .051, $\eta^2 = .06$), implying that age may have contributed modestly to adherence outcomes, although the result did not reach conventional statistical significance. Other variables, including gender (p = .714, V = .12), marital status (p = .343, V = .18), comorbid disease (p = .549, V = .50), and number of medications used (p = .411, V = .40), were not significantly related to medication adherence. These findings indicate that three months post-intervention, adherence was primarily influenced by educational level, while other sociodemographic and clinical factors remained stable across groups.

Therefore, at baseline, the control and experimental groups differed only in age, with all other sociodemographic and clinical characteristics being broadly comparable. None of these variables were significantly associated with medication adherence prior to the intervention. Following the intervention, education emerged as the sole sociodemographic factor consistently linked to adherence. At midline, education was moderately associated with adherence ($p = .048$, $V = .33$), and this association strengthened at endline ($p = .007$, $V = .40$). The progressive influence of education over time suggests that higher educational attainment may have facilitated better comprehension, engagement, and sustained participation in Dialectical Behavior Therapy (DBT) activities related to medication use. Although age did not significantly predict adherence at baseline or midline, a near-significant trend observed at endline ($p = .051$) suggests a possible emerging relationship warranting further exploration. Gender, marital status, presence of comorbid disease, and number of prescribed medications remained unrelated to adherence across all study phases.

Table 5: Generalized Estimating Equations Examining Predictors of Medication Adherence Across Study Time Points

Predictor	B	SE	OR	95% CI	χ^2 (df)	*p*
Thresholds						
Low vs. Moderate/High	-0.23	1.34	–	-2.86, 2.41	0.03 (1)	.864
Low/Moderate vs. High	2.51	1.39	–	-0.21, 5.24	3.27 (1)	.071
Time (Reference: Endline)					28.13	<.001
Baseline	-3.40	0.64	0.03	-4.66, -2.13	27.84 (1)	<.001
Midline	-0.68	0.22	0.51	-1.12, -0.25	9.38 (1)	.002
Group (Reference: Intervention)					14.97	<.001
Control	-1.84	0.47	0.16	-2.77, -0.91	14.97 (1)	<.001
Education (Reference: Higher diploma/Bachelor)					7.77	.021
Primary/High school	-0.80	0.70	0.45	-2.17, 0.58	1.28 (1)	.259
College certificate/diploma	0.44	0.70	1.56	-0.92, 1.81	0.40 (1)	.525
Age (per year)					1.11	.293
Age	0.021	0.02	1.02	-0.02, 0.06	1.11 (1)	.293

Time was modeled with endline as the reference. Intervention group = reference category; control coded as 0. Education collapsed into three levels: primary/high school, college certificate/diploma, and college higher diploma/bachelor's degree (reference). OR = odds ratio; values <1 indicate decreased odds of being in a higher adherence category, values >1 indicate increased odds. Age was treated as continuous. The analysis employed Generalized Estimating Equations (GEE) to evaluate predictors of medication adherence across three time points (baseline, midline, and endline). Table 5 shows that time, group allocation, age, and education were examined for their association with the medication adherence. Comparisons of outcome thresholds revealed no statistically significant differences. Specifically, participants classified as low versus moderate/high did not differ significantly ($B = -0.23$, $SE = 1.34$, $\chi^2(1) = 0.03$, $p = .864$), nor did the combined low/moderate versus high comparison reach significance ($B = 2.51$, $SE = 1.39$, $\chi^2(1) = 3.27$, $p = .071$).

These findings suggest that threshold category alone did not meaningfully predict the medication adherence over time. Time was a significant predictor of the medication adherence ($\chi^2 = 28.13$, $p < .001$), with marked differences observed across measurement points. At baseline, participants exhibited substantially lower odds of medication adherence compared to endline ($B = -3.40$, $SE = 0.64$, $OR = 0.03$, 95% CI [-4.66, -2.13], $p < .001$), indicating a strong improvement or increase in the medication adherence over the study period. At the start of the study, participants were far less likely to have high adherence to medication compared to the end of the study with the odds being 97% lower at baseline than at endline. This shows a substantial improvement over time, likely reflecting the effect of the intervention. At midline, a smaller but significant effect was observed ($B = -0.68$, $SE = 0.22$, $OR = 0.51$, 95% CI [-1.12, -0.25], $p = .002$), highlighting gradual changes toward endline. By the middle of the study, participants were about half as likely to report high adherence compared to the end of the study.

Participants in the control group had significantly lower odds of high medication adherence compared to the intervention group ($B = -1.84$, $SE = 0.47$, $OR = 0.16$, 95% CI [-2.77, -0.91], $p < .001$), demonstrating the effectiveness of the intervention in promoting medication adherence. This finding underscores the potential of dialectical behavior therapy to enhance medication adherence relative to usual care or no intervention. Overall, education level significantly contributed to the model ($\chi^2 = 7.77$, $p = .021$). However, individual comparisons between educational groups and the reference category (higher diploma/bachelor) were not statistically significant. Participants with primary or high school education showed lower odds ($B = -0.80$, $SE = 0.70$, $OR = 0.45$, $p = .259$), while those with a college certificate or diploma had slightly higher odds ($B = 0.44$, $SE = 0.70$, $OR = 1.56$, $p = .525$). These results suggest that while education may influence the outcome overall, individual differences were not pronounced in this sample. Age was not a significant predictor (B = 0.021, SE = 0.02, OR = 1.02, 95% CI [-0.02, 0.06], p = .293), indicating that the outcome did not vary meaningfully with participants' age within the studied range.

DISCUSSION

The study investigated the demographic determinants of medication adherence among participants receiving Dialectical Behavior Therapy (DBT). Bivariate analyses were conducted to explore associations between sociodemographic and clinical variables with adherence at baseline. Results indicated that none of the demographic or clinical variables—including age (p = .611, η^2 = .00), gender (p = 1.000, V = .00), education (p = .288, V = .12), marital status (p = .623, V = .09), comorbid disease (p = .664, V = .07), and number of prescribed drugs (p = 1.000, V = .00) were significantly associated with medication adherence. These findings suggest that, prior to intervention, adherence levels were largely independent of demographic or clinical characteristics, indicating a relatively homogeneous baseline profile among participants.

The present findings align with some reports but contradict others. While studies by Iqbal et al. (2021) and Mbuti et al. (2020) reported that females were more likely to adhere, the current study found no significant association, consistent with Usman et al. (2022) and Adu et al. (2022). Differences across studies may be attributed to sample size, population characteristics, and methodological approaches, particularly with regard to sampling and medication adherence measurement tools. Age, marital status, comorbid disease, and polypharmacy. Similar patterns of non-significance were observed across age, marital status, comorbid disease, and the number of prescribed medications, mirroring findings from Adu et al. (2022) and Li et al. (2016). Contrasting studies reporting significant associations may reflect differences in sampling strategies, measurement instruments, or clinical populations. Overall, these bivariate results suggest that baseline demographic and clinical factors were not strong determinants of adherence in this sample.

Building on these preliminary findings, inferential analyses using Generalized Estimating Equations (GEE) were employed to examine predictors of adherence longitudinally across baseline, midline, and endline. Comparisons of adherence thresholds revealed no statistically significant differences: participants classified as low versus moderate/high did not differ significantly (B = -0.23, SE = 1.34, $\chi^2(1)$ = 0.03, p = .864), nor did the low/moderate versus high comparison reach significance ($B = 2.51$, $SE = 1.39$, $\chi^2(1) = 3.27$, $p = .071$). These findings indicate that threshold category alone did not meaningfully predict adherence over time.

Time was a significant predictor of adherence ($\chi^2 = 28.13$, $p < .001$). At baseline, participants had substantially lower odds of adherence compared to endline (B = -3.40, SE = 0.64, OR = 0.03, 95% CI [-4.66, -2.13], p < .001), indicating a dramatic improvement over the study period. In lay terms, participants were 97% less likely to have high adherence at the start compared to the end of the study. At midline, a smaller yet significant effect was observed (B = -0.68, SE = 0.22, OR = 0.51, 95% CI [-1.12, -0.25], p = .002), showing that participants were about half as likely to adhere at midline compared to endline. This demonstrates a gradual improvement in adherence over time, with the most pronounced change occurring from baseline to endline.

Group allocation. Participants in the control group had significantly lower odds of high adherence compared to the intervention group (B = -1.84, SE = 0.47, OR = 0.16, 95% CI [-2.77, -0.91], p < .001), highlighting the effectiveness of DBT in promoting medication adherence relative to usual care. Education emerged as the most consistent determinant of adherence in the inferential analysis. While bivariate associations were non-significant at baseline, multivariate GEE modeling revealed that participants with lower educational attainment were less likely to adhere: those with primary or high school education had lower odds (B = -0.80, SE = 0.70, OR = 0.45, p = .259), whereas college certificate/diploma holders had slightly higher odds (B = 0.44, SE = 0.70, OR = 1.56, p = .525). Over time, education appeared to strengthen its influence, particularly post-intervention, consistent with literature suggesting that higher educational attainment enhances health literacy, self-efficacy, and behavioral skills critical for adherence (Park et al., 2025; Liu et al., 2025; Mirzaei-Alavijeh et al., 2025).

Consistent with bivariate analyses, age was not a significant predictor in the GEE model (B = 0.021, SE = 0.02, OR = 1.02, 95% CI [-0.02, 0.06], p = .293), indicating that adherence did not vary meaningfully with participant age in this study. Collectively, these findings indicate that while baseline adherence was not associated with demographic or clinical characteristics, the longitudinal analysis highlights the impact of DBT and time on improving adherence. Education emerged as an important determinant over time, and intervention exposure strongly enhanced adherence outcomes. These results underscore the potential of DBT to improve medication adherence and suggest that incorporating educational support may further enhance intervention effectiveness, particularly among individuals with lower baseline health literacy.

CONCLUSION

The study demonstrated that medication adherence improved significantly over time with DBT, and education emerged as a key factor supporting adherence. Other demographic and clinical characteristics, including age, gender, marital status, comorbidity, and number of medications, did not meaningfully influence adherence. These findings highlight the importance of structured behavioral interventions and educational support in promoting adherence among individuals living with chronic disease, suggesting that tailoring interventions to patients' educational needs may enhance outcomes. These findings highlight the important role of education as a social determinant of health behavior. Individuals with higher educational levels may possess greater capacity to understand treatment regimens, internalize psychoeducational content, and apply DBT skills to their daily medication-taking practices. Education may therefore facilitate the translation of DBT principles—such as mindfulness, emotion regulation, and distress tolerance—into consistent self-care behaviors. The persistence of education as a predictor of adherence over time implies that its influence extends beyond knowledge alone, encompassing broader cognitive and motivational factors that support treatment engagement.

The implications of these findings suggest that DBT interventions for individuals with chronic diseases should be designed with sensitivity to educational differences. Psychoeducational components should be simplified and supported by visual aids or interactive methods to enhance understanding among participants with limited literacy. Incorporating practical adherence exercises within DBT sessions may help reinforce behavioral consistency, while therapist-guided coaching and follow-up can assist participants in applying DBT skills to medication management. Tailoring DBT materials linguistically and culturally, and embedding adherence-focused reflections within diary cards or mindfulness activities, may further strengthen treatment uptake and maintenance. Such adaptations can ensure that participants across all educational backgrounds derive maximum benefit from DBT, reducing disparities in health outcomes.

RECOMMENDATIONS

Future research should continue to explore how education interacts with psychological variables such as health literacy, perceived control, and self-efficacy to influence adherence behavior. Longitudinal and mixed-methods studies could offer deeper insight into how these factors evolve over time within DBT-based interventions. Moreover, testing education-tailored DBT modules may provide evidence on whether simplified or context-specific adaptations enhance adherence outcomes compared to standard approaches. By integrating these insights, behavioral interventions can be refined to promote equitable access, engagement, and effectiveness for patients managing chronic conditions.

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