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Improving Medication Adherence Among Older Adults With Hypertension And Diabetes Mellitus Through Structured Education Supported By Stevia Sweetened Tea At Posyandu Lansia 9a Mojosongo, Surakarta

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Abstract

Medication non-adherence remains an important barrier to chronic disease management among older adults, while routine monitoring of medication-taking behaviour is not always integrated into community-based services for older adults. This community service programme aimed to improve medication adherence among older adults with hypertension and diabetes mellitus at Posyandu Lansia 9A Mojosongo, Surakarta, through structured education, individual counselling, and the introduction of Stevia Sweetened Tea as a habit-linked educational aid. A pre-experimental one-group pretest-posttest design involved 30 participants recruited through total sampling. Adherence was measured using the five-item Medication Adherence Report Scale (MARS-5), while the beverage contained 54.05% black tea and 45.95% stevia based on a published Response Surface Methodology model. All participants completed the programme. All MARS-5 items met the item-total correlation criterion ($r = 0.641$-0.866; $p < 0.001$), with good internal consistency (alpha = 0.809 pre-programme; alpha = 0.813 post-programme). The mean score increased from 17.47 ± 2.53 to 20.80 ± 2.54, yielding a mean difference of 3.33 points (95% CI 2.76-3.91; $t(29) = 11.87$; $p < 0.001$; Cohen's $d = 2.17$). This corresponded to a 19.1% relative increase

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and attainment of 83.2% of the maximum score. Substitution of the beverage composition into the reference equation produced an estimated alpha-amylase inhibition of 14.59%; this value was a literature-based extrapolation rather than a laboratory result. The increased adherence score followed the integrated programme, although causality and the contribution of each component cannot be established because the evaluation lacked a control group and relied on self-report.

Keywords: medication adherence; older adults; medication counselling; MARS-5; Posyandu for older adults; stevia.

INTRODUCTION

Medication adherence is one of the determinants of successful long-term therapy. An appropriate medicine cannot provide optimal benefit if it is not taken at the recommended dose, time, and duration. The World Health Organization (2003) estimated that only about half of patients with chronic diseases in developed countries follow their treatment consistently, and the proportion may be lower in developing countries (Organization, 2003). Non-adherence is associated with inadequate disease control, complications, hospitalisation, and healthcare costs that could otherwise be prevented (Osterberg & Blaschke, 2005).

In everyday discussion, the terms compliance and adherence are often used as if they were interchangeable. Compliance tends to portray the patient as someone who follows instructions from health professionals, whereas adherence emphasises agreement and patient involvement in carrying out the treatment plan. This distinction is important because older adults are not passive recipients of instructions; they consider the benefits of medicines, previous experience of adverse effects, scheduling difficulties, and family circumstances before making decisions. An intervention that merely repeats instructions to take medicine may therefore fail to address the reasons underlying the patient's behaviour.

Non-adherence may be unintentional or intentional. Unintentional forms include forgetting, misreading labels, being unable to open packaging, having difficulty distinguishing medicines, or having a schedule disrupted by other activities. Intentional non-adherence occurs when a patient chooses to omit, reduce, temporarily stop, or alter a dose based on personal judgement. These two forms require different responses: memory problems are more likely to be helped by reminders and simplified routines, whereas deliberate decisions require discussion of the patient's beliefs, perceived benefits, and concerns about medicines (Horne & Weinman, 1999).

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Vulnerability to non-adherence increases with age. Declining memory and executive function can make complex medication schedules difficult to follow, while impaired vision can hinder the reading of small labels. Multimorbidity is often accompanied by polypharmacy, meaning that one person may use several medicines with different schedules and directions. These barriers may be compounded by adverse effects, cost, distance and access to services, delays in obtaining medicines, and the belief that long-term use will damage the body. A review of older adults using multiple medicines found that medication-management ability and adherence are influenced by a combination of patient, regimen, support, and service-system factors and therefore cannot be addressed adequately through a single general message (Cross et al., 2020).

Hypertension and diabetes mellitus are of particular concern because both require long-term management. The 2023 Indonesian Health Survey reported a measured hypertension prevalence of 30.8% among people aged over 18 years and a diabetes mellitus prevalence of 11.7% based on blood glucose testing (Kesehatan, 2024). In many patients, both conditions may progress without clear symptoms, particularly when relatively controlled. The absence of symptoms can be misinterpreted as recovery and encourage medicine discontinuation, even though the aim of therapy is to maintain blood pressure or glucose control and reduce the risk of complications.

Posyandu services for older adults are embedded in community life and provide a strategic setting in which to identify these problems (Cahyani et al., 2026). Routine activities generally include weighing, blood pressure measurement, blood glucose testing, and health education. However, medication-taking behaviour is not always assessed in a structured manner. Consequently, uncontrolled blood pressure or glucose results may be discussed without first determining whether medicines are available, understood, and taken regularly. A brief adherence assessment can help close this gap and enable community health volunteers to direct participants who require further counselling.

One-way education is useful for conveying information to many people, but it has limitations. Participants may understand the definition of a disease without being able to relate it to the medicines used at home. Questions about adverse effects, missed doses, or decisions to stop medicines may also be uncomfortable to discuss in front of a group. A meta-analysis of interventions among older adults showed that education is more beneficial when accompanied by components that support day-to-day implementation, such as written instructions, packaging, monitoring, and repeated reinforcement (Conn et al., 2009). This evidence supports a package

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combining group education, individual counselling, and routine-based reminder tools.

This programme used Stevia Sweetened Tea as a supportive medium, not as a substitute for medicine. The beverage was selected because tea preparation is familiar to many older adults and can serve as a cue for remembering other health-related activities. Stevia provides sweetness without added table sugar, while black tea provides familiar colour and aroma. Previous food studies have reported the potential of tea and stevia compounds in preclinical or in vitro tests, but these findings cannot be equated directly with clinical benefits for participants (Nishiumi et al., 2010; Singla et al., 2019). In this programme, the beverage served primarily educational and behavioural purposes by linking adherence messages to a habit that could be repeated easily at home.

Adherence was measured using the five-item Medication Adherence Report Scale (MARS-5). This instrument briefly assesses non-adherent behaviours and uses a questioning approach that reduces the impression of judgement (Chan et al., 2020). The Indonesian version has also been reported to have adequate validity and reliability among patients with diabetes mellitus (Alfian & Putra, 2017). Its use in Posyandu provides an opportunity to replace a general question such as 'Do you take your medicine regularly?' with five behaviours that are easier to recognise and discuss.

The novelty of the programme lies in integrating three elements into a single community-service pathway: group education adapted to the characteristics of older adults, individual counselling for specific barriers, and a beverage used as a habit-based reminder with a composition justified through a published model. This programme aimed to improve medication adherence among older adults with hypertension and diabetes mellitus at Posyandu Lansia 9A Mojosongo, Surakarta. The evaluation specifically compared MARS-5 scores before and after the programme, assessed the instrument's internal performance in the target group, and explained the basis for the Stevia Sweetened Tea formulation without turning it into an antidiabetic treatment claim.

METHODS

This community service programme was evaluated using a pre-experimental one-group pretest-posttest design. The design was selected because all eligible older adults in the target group were intended to receive the intervention, and no group was deliberately denied education. The same measurement was conducted before and after the programme so that within-group change could be calculated. This design is appropriate for an initial evaluation of programme

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implementation but was not intended to establish a cause-and-effect relationship in the manner of a controlled trial.

The programme was conducted at Posyandu Lansia 9A, Mojosongo Urban Village, Jebres District, Surakarta City, Central Java. The setting was selected purposively because it had an active group of older adults with hypertension and diabetes mellitus and received support from community health volunteers and Posyandu managers. The volunteers helped publicise the programme, prepare the venue, assist participants, and connect the team with local health services. The source document did not specify the date or month of implementation, the duration of each session, or the posttest interval in days or weeks. The final measurement was only recorded as having been conducted after the intervention period; the authors should complete this calendar information before journal submission.

The target population comprised older adults registered with Posyandu Lansia 9A who had hypertension and/or diabetes mellitus and were receiving medication. Total sampling was used because the eligible population was limited and all members remained accessible to the team. Screening was conducted with the community health volunteers by reviewing the membership list and confirming disease status, medication use, ability to communicate, and willingness to complete the programme. Thirty participants were deemed eligible, and all completed the initial measurement, intervention, and final measurement; no participant withdrew after providing consent.

The inclusion criteria were age 60 years or older, registration as a member of the Posyandu target group, a diagnosis of hypertension and/or diabetes mellitus, current use of medicine for the condition, ability to communicate verbally, and willingness to provide informed consent. The exclusion criteria were severe cognitive impairment that hindered communication, current hospitalisation, inability to attend either measurement, or failure to complete the programme. The disease categories in the programme data comprised diabetes mellitus and hypertension and together totalled 30 participants. The source document did not clarify whether comorbidity was present; the categories were therefore treated as the primary recorded condition and were not used for subgroup analysis.

Programme variables were defined to ensure consistent interpretation of the procedures and results. The intervention was treated as one package delivered to all participants, while medication adherence was the primary outcome measured at two time points. The operational definitions are presented in Table 1.

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Table 1. Operational definitions of programme variables

Variable	Operational definition	Indicator	Tool	Scale	Outcome
Integrated intervention	Structured education and medication counselling plus an introduction to and brewing demonstration of Stevia Sweetened Tea	All components implemented; participant attended	Programme checklist and attendance list	Nominal	Delivered / not delivered
Medication adherence	Participant behaviour in taking medicines according to the recommended dose, time, and directions	Five non-adherent behaviours in MARS-5	MARS-5	Score	Total 5-25; a higher score indicates better adherence

MARS-5 = five-item Medication Adherence Report Scale.

Implementation was divided into four stages. The preparation stage included coordination and permission arrangements with community health volunteers and Posyandu managers, mapping of the target group, preparation of educational materials, preparation of MARS-5, and packaging of the beverage blend. The team prepared illustrated instructions so that participants could recognise the brewing sequence without relying on lengthy text. Volunteers received an explanation of the programme objectives and their role in supporting participants but were not asked to judge MARS-5 responses.

During the initial measurement stage, the team explained the objectives, procedures, benefits, and participant rights. After consent was obtained, baseline characteristics were recorded and MARS-5 was completed with assistance. Team members reread items when a participant had impaired vision or difficulty understanding a sentence but did not provide examples that might direct the response. The initial measurement described behaviour before participants received the programme materials.

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The intervention stage began with group education, followed by individual counselling and a brewing demonstration. This sequence allowed all participants to receive the same foundation of knowledge before discussing personal concerns. The beverage blend was then distributed in prepared portions together with an instruction card. Participants were reminded that the product did not replace medicine and that dose changes should only be made after consultation with a health professional.

At the final stage, MARS-5 was completed again after the intervention period. The team checked the completeness of responses and ensured that each participant had paired initial and final scores. Community health volunteers were involved in closing the session and reinforcing follow-up messages. The programme sequence is illustrated in Figure 1, while the detailed protocol is presented in Table 2.

Figure 1. Programme implementation pathway

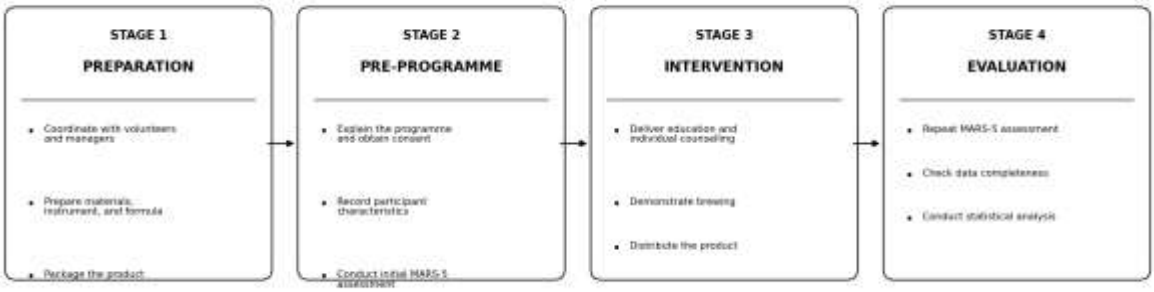


Table 2. Protocol for the integrated intervention package

Stage	Activity	Implementer	Target	Media	Output
Preparation	Coordination, permissions, preparation of materials and instrument, and product packaging	Team and volunteers	Delivery system	Materials, MARS-5, packaging	Programme readiness
Initial measurement	Explanation, consent, data collection, pre-	Team	30 participants	Information sheet and MARS-5	Baseline data and initial scores

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	programme MARS-5				
Group education	Chronic disease, treatment objectives, medication management, and strategies for forgetfulness	Team	30 participants	Presentation and illustrated cards	Understanding of key messages
Individual counselling	Exploration of barriers and development of participant-appropriate solutions	Team	Each participant	Medicines or packaging identified by participant	Personal action plan
Demonstration	Introduction to the formula, brewing, and confirmation that it is not a medicine substitute	Team and volunteers	30 participants	Product and brewing card	Participants recognise the brewing procedure
Final measurement	Post-programme MARS-5, data checking, and follow-up reinforcement	Team and volunteers	30 participants	MARS-5 and evaluation sheet	Final scores and complete data

Session duration and the calendar interval between the initial and final measurements were not recorded in the source document.

The educational content covered brief definitions of hypertension and diabetes mellitus,

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the potentially asymptomatic nature of these conditions, the objectives of long-term therapy, and the consequences of stopping medicines without guidance. Participants were encouraged to recognise the names or characteristics of their medicines, directions for use, storage requirements, and when to seek assistance from a health professional. Explanations used plain language, short sentences, repetition of key messages, and opportunities for questions. The materials did not include regimen changes and did not replace assessment by the doctor or health professional responsible for the participant's care.

Strategies for addressing forgetfulness were discussed through examples related to participants' routines. Options included a daily pill box, telephone alarm, calendar, a marker placed in a frequently seen but safe location, and support from family members. Participants were also encouraged to link medication times with relatively fixed activities, such as after meals or religious observance, provided that this was consistent with the directions for use. If a dose was missed, participants were advised not to double it without guidance and to contact a health professional when uncertain.

Counselling was conducted individually so that personal barriers could be discussed. Participants were asked to bring or name the medicines they used, after which the team explored the doses most often missed, confusion in distinguishing medicines, concerns about adverse effects, and the practice of stopping medicine when asymptomatic. Examples identified in the programme notes included forgetting a midday dose and concern that long-term medicine use would cause adverse effects. Solutions were tailored to the problem, such as moving medicines to an easily visible but safe location, preparing a pill box, involving family members, or referring participants for consultation when symptoms occurred.

MARS-5 was selected because it is brief, can be used as a self-report measure, and assesses several forms of non-adherent behaviour without requiring clinical procedures. The five behaviours are forgetting, intentionally omitting a dose, temporarily stopping treatment, taking less medicine than instructed, and altering the dose. Each item is scored from 1 to 5, ranging from the highest to the lowest frequency of non-adherence. The total score ranges from 5 to 25, with a higher score indicating better reported adherence. This manuscript does not reproduce the complete wording of the instrument so that its use continues to comply with permission requirements and the authorised language version.

Completion was assisted to reduce difficulties caused by impaired vision or limited literacy. The assistant used a neutral tone, did not praise particular answers, and did not interpret responses on the participant's behalf. MARS-5 was reassessed in the programme population

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because the characteristics of older Posyandu participants may differ from those of previous validation populations. This assessment was treated as an internal performance check in the programme sample, not as a new national validation. Pearson item-total correlation was used to assess internal validity, while Cronbach's alpha was used to assess internal consistency.

The dry blend consisted of 54.05% black tea and 45.95% powdered stevia leaves by mass, equivalent to a practical ratio of 20 g black tea to 17 g stevia. The mass percentage of the dry blend must be distinguished from the weight-per-volume concentration in the infusion. At a dose of 2 g blend per 200 mL water, the black tea mass was 1.081 g and the stevia mass was 0.919 g. When divided by the infusion volume, these values corresponded to B = 0.5405% w/v for black tea and S = 0.4595% w/v for stevia.

The blend was infused in 200 mL of water at 94 ± 5 °C for 4 ± 1 minutes and then allowed to cool to a suitable drinking temperature. A dose of 2 g per 200 mL produced total solids of 1% w/v, making the conversion from mass proportion to infusion concentration appear numerically straightforward. This equivalence applies only to this dose; at other doses, the mass of each ingredient must be recalculated in relation to the volume. The brewing instructions emphasised the dose, a practical description of hot-water temperature, infusion time, and the statement that the beverage was not a substitute for therapy.

The scientific basis of the formula was examined using the uncoded regression equation reported by Budianta and Utomo (2023): % inhibition = $14.098 + 4.56S - 0.037B - 6.54S^2 - 0.0017B^2 - 0.804SB$. The formula values of S and B were substituted to estimate alpha-amylase inhibition. The model was not reconstructed, the product was not tested in a laboratory, and the calculated result was not used as a clinical outcome. The calculation was intended to demonstrate traceability in selecting the composition, not to shift the focus of the article away from medication adherence.

Participant characteristics were presented as frequencies and percentages. MARS-5 scores were summarised using the mean, standard deviation, minimum, and maximum. Item-total correlations were assessed using Pearson's correlation; with n = 30 and a 5% significance level, the critical r value was 0.361. Internal consistency was assessed using Cronbach's alpha with a reference threshold of 0.70. The normality of pre-programme and post-programme scores was examined using the Shapiro-Wilk test because the number of participants was below 50.

Differences in scores before and after the programme were analysed using a paired t-test at the 95% confidence level. The magnitude of change was reported as the mean difference, 95% confidence interval, relative increase from the initial score, percentage of the maximum score,

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and Cohen's d. The effect size was calculated by dividing the mean difference by the standard deviation of the difference scores. The analysis was not stratified by sex, education, or disease because individual-level data for these analyses were unavailable and the number of participants was limited.

All participants received an explanation of the objectives, procedures, benefits, and their right to decline or withdraw without consequences for their services. Consent was given voluntarily before the initial measurement. Participant identities were anonymised during data processing and reporting. The programme did not alter, reduce, or replace prescribed medicines; participants with symptoms or a need for treatment adjustment were directed to consult local health professionals.

RESULT

Participant involvement and characteristics

Thirty participants met the criteria, and all completed the initial measurement, intervention, and final measurement. No paired data were missing, and no participant withdrew after entering the programme. This completeness allowed all participants to be retained in the paired analysis. However, the absence of withdrawal should also be considered a characteristic of a relatively active group connected with the Posyandu service.

There were 18 female participants (60.0%) and 12 male participants (40.0%). This composition indicates that the programme reached more older women, although the results were not analysed by sex. In terms of education, 20 participants (66.7%) had completed primary or junior secondary school. This profile informed the use of plain language, repetition, assistance during questionnaire completion, and illustrated instructions; it was not used as a basis for concluding that effects differed by education.

Diabetes mellitus was recorded as the primary condition in 20 participants (66.7%), while hypertension was recorded in 10 participants (33.3%). The predominance of diabetes made a beverage without added table sugar relevant as an educational example but did not demonstrate a metabolic benefit of the product. Results for the two disease groups were not analysed separately, and comorbidity status was not recorded. Full participant characteristics are presented in Table 3.

Table 3. Characteristics of programme participants (n = 30)

Characteristic	Category	Frequency (n)	Percentage (%)
Sex	Male	12	40.0

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	Female	18	60.0
Highest education	Primary school	6	20.0
	Junior secondary school	14	46.7
	Senior secondary school	10	33.3
Primary condition recorded	Diabetes mellitus	20	66.7
	Hypertension	10	33.3

Primary school, junior secondary school, and senior secondary school refer to the highest completed level. Comorbidity status was not recorded in the source document.

Internal performance of MARS-5

All MARS-5 items exceeded the critical r value of 0.361 at both measurement points. Pre-programme item-total correlations ranged from 0.736 to 0.866, while post-programme correlations ranged from 0.641 to 0.701; all p values were below 0.001. No item was removed, and the total score therefore continued to be calculated from all five items. These results indicate that each behaviour was associated with the total score in the assessed participant group.

Post-programme item-total correlations were lower than pre-programme correlations, although Cronbach's alpha increased slightly from 0.809 to 0.813. This pattern can occur when participants' responses shift towards higher scores and between-participant variability narrows. Reduced variability can lower correlations without necessarily indicating that the items have lost meaning. Both alpha values were above 0.80, indicating good internal consistency in the programme sample (Table 4).

Table 4. Item-total correlations and reliability of MARS-5 (n = 30)

Item/behaviour	Pre r	p	Post r	p	Interpretation
M1 - forgetting	0.801	< 0.001	0.641	< 0.001	Valid
M2 - intentionally omitting	0.837	< 0.001	0.701	< 0.001	Valid
M3 - temporarily stopping	0.814	< 0.001	0.681	< 0.001	Valid
M4 - taking less	0.736	< 0.001	0.681	< 0.001	Valid
M5 - altering the dose	0.866	< 0.001	0.642	< 0.001	Valid
Cronbach's alpha	0.809	-	0.813	-	Reliable

An item met the criterion when the calculated r value was greater than 0.361. This assessment

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was an internal evaluation in the programme sample, not a validation in a new population.

Change in adherence scores

The Shapiro-Wilk test yielded W = 0.976 with p = 0.700 before the programme and W = 0.948 with p = 0.149 after the programme. Both p values were greater than 0.05, indicating no meaningful departure from normality in the score distributions. On this basis, change was analysed using a paired t-test. Descriptive and inferential results are presented in Table 5.

The mean MARS-5 score increased from 17.47 ± 2.529 to 20.80 ± 2.538. The mean difference of 3.33 points had a standard deviation of 1.539 and a 95% confidence interval of 2.758-3.908. The paired t-test yielded t(29) = 11.865 and p < 0.001. The confidence interval did not include zero, indicating that the observed within-group change was statistically consistent.

In practical terms, the 3.33-point increase represented 19.1% of the initial score. Relative to the maximum score of 25, the mean increased from 69.9% to 83.2%. The mean item score increased from 3.49 to 4.16. The minimum score increased from 12 to 15 and the maximum from 23 to 25, showing that the shift was also evident at the lower end of the distribution.

The standard deviations before and after the programme were nearly identical at 2.529 and 2.538. This indicates that the dispersion of group scores changed little despite the increase in the mean. A Cohen's d of 2.17 was obtained by comparing the mean difference with the standard deviation of the difference scores and is conventionally considered very large. The mean, standard deviation, minimum, and maximum are visualised in Figure 2.

Table 5. Changes in MARS-5 scores and statistical test results (n = 30)

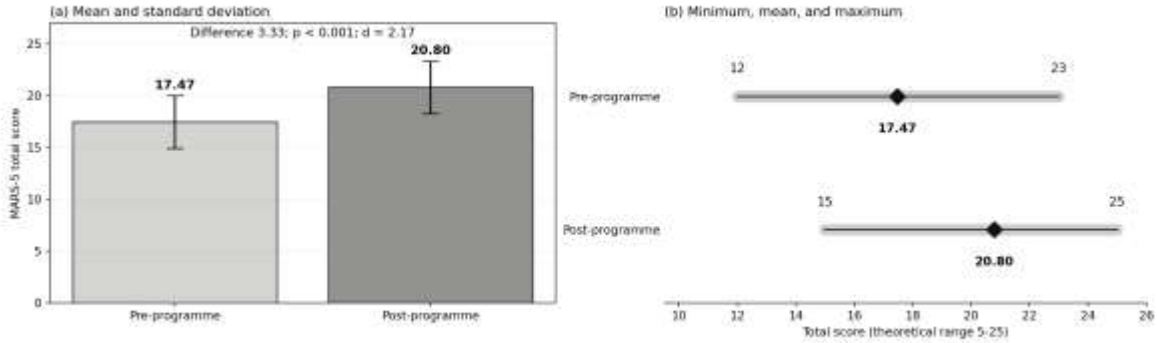
Measurement	Mean	SD	Min.	Max.	W	Normality p
Pre-programme	17.47	2.529	12	23	0.976	0.700
Post-programme	20.80	2.538	15	25	0.948	0.149
Post-pre difference	3.33	1.539	-	-	-	-

Paired t-test: t(29) = 11.865; 95% CI for the difference = 2.758-3.908; p < 0.001; Cohen's d = 2.17.
SD = standard deviation; W = Shapiro-Wilk statistic.

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Figure 2. Changes in adherence scores before and after the programme



Transparency of the formula calculation

Substitution of S = 0.4595 and B = 0.5405 into the reference equation produced an estimate of 14.5923%, rounded to 14.59%. The largest contributions came from the constant and the linear stevia term, while the quadratic stevia term reduced the response value. Each term is shown in Table 6 so that the calculation can be traced. This result was not derived from measurement of the programme product.

The value of 14.59% should be interpreted as an extrapolation because S = 0.4595% w/v exceeded the upper limit of the stevia concentration in the reference design, which was 0.33% w/v. If the mass ratio were maintained but the total dose reduced to approximately 1.44 g per 200 mL, the concentrations would become S = 0.33% and B = 0.388%. Both would lie within the model range and yield an estimate of 14.77%. This alternative strengthens the transparency of the calculation but was not used as the dose in the reported programme.

Table 6. Substitution of each term in the equation for the programme formula

Equation term	Substitution	Value
Constant	14.098	+14.0980
+4.56S	4.56 × 0.4595	+2.0953
-0.037B	-0.037 × 0.5405	-0.0200
$-6.54S^2$	$-6.54 \times (0.4595)^2$	-1.3809
$-0.0017B^2$	$-0.0017 \times (0.5405)^2$	-0.0005
-0.804SB	-0.804 × (0.4595 × 0.5405)	-0.1997
Total	Sum of all terms	14.5923

S = stevia concentration (% w/v); B = black tea concentration (% w/v). The equation was

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reported by Budianta and Utomo (2023).

Table 7. Comparison of the programme formula, alternative dose, and reference optimum

Parameter	Reference optimum	Programme formula 2 g/200 mL	Alternative 1.44 g/200 mL
Stevia (% dry blend)	56.93	45.95	45.95
Black tea (% dry blend)	43.07	54.05	54.05
Stevia, S (% w/v)	0.2379	0.4595	0.3300
Black tea, B (% w/v)	0.1800	0.5405	0.3880
Total dose	0.8358 g/200 mL	2.00 g/200 mL	1.44 g/200 mL
Estimated alpha-amylase inhibition	14.919%	14.59%	14.77%
Position relative to model range	Within range	Extrapolation	Within range

A value of 14.919% was reported in the reference source; recalculation using rounded coefficients produced approximately 14.77%. All values for the programme formula are literature-based estimates.

The programme formula contained a larger proportion of black tea than the reference optimum but followed the same compositional direction, with stevia as the principal sweetening component. The 20:17 ratio was selected for ease of measurement and replication, while the slightly greater quantity of black tea maintained the beverage's colour and aroma. Taste considerations in this article are based on formulation literature, not on a sensory acceptability test among participants. No data demonstrated successful independent preparation or consumption at home.

Summary of programme achievements

Programme achievements were summarised to show the relationship between implementation targets, the data obtained, and the limits of interpretation. All principal implementation indicators were achieved, but sustainability still requires monitoring. The summary is presented in Table 8.

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Table 8. Summary of community service programme achievements

Aspect	Indicator	Achievement	Interpretive note
Participation	Participants completed all stages	30 of 30 participants	No withdrawals
Measurement tool	Valid items and reliable instrument	5/5 items; alpha = 0.809 and 0.813	Good internal performance
Adherence score	Meaningful increase	17.47 to 20.80; +3.33; p < 0.001	d = 2.17
Extent of improvement	Lower bound shifted	Minimum 12 to 15	Not limited to high initial scores
Formula	Transparent calculation basis	Black tea 54.05%; stevia 45.95%	Estimate, not a laboratory test
Practicality	Dose can be prepared	20 g:17 g ratio and illustrated card	Independent ability was not measured
Partnership	Volunteers involved	Preparation through evaluation	Basis for follow-up

alpha = Cronbach's alpha; d = Cohen's d.

DISCUSSION

Medication adherence before the programme

The initial mean of 17.47 represented 69.9% of the maximum MARS-5 score. It was not labelled as low, moderate, or high because no category thresholds specifically referenced for the programme population were used. A safer interpretation is that participants reported following most medication-taking behaviours but still had 7.53 points of room for improvement before reaching the maximum score. The minimum score of 12 also indicates that some participants had more substantial adherence gaps than the group average.

The five measured behaviours help clarify the nature of these gaps. Non-adherence does not only mean completely stopping treatment; it also includes forgetting, intentionally omitting a dose, temporarily stopping treatment, taking less medicine, or altering the dose. Repeated minor behaviours may remain unnoticed during routine visits, particularly when the only question asked is, 'Do you take your medicine?' MARS-5 provides a structure for opening discussion of more specific behaviours without immediately blaming participants.

The characteristics of the target group explain why the materials needed to be simplified.

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Two-thirds of participants had completed primary or junior secondary education, while older age may be accompanied by impaired vision and memory. Information delivered rapidly, using unfamiliar generic names, or containing several schedules at once is more difficult to apply. Polypharmacy, adverse effects, cost, and access to medicine refills may also interact. Because these variables were not measured, they are discussed as plausible context rather than as causal factors demonstrated among the participants.

The frequently asymptomatic nature of hypertension and diabetes is also important. Patients may judge treatment according to how they feel on a particular day, whereas the benefit of preventing complications is not always immediately visible. The necessity-concerns framework explains that patients weigh their perceived need for medicine against their concerns about it (Horne & Weinman, 1999). When perceived necessity is low and concerns are high, omitting or stopping medicine becomes more likely even when instructions have been provided.

Why scores increased after the integrated intervention

The 3.33-point increase occurred after participants received a package consisting of group education, individual counselling, a demonstration, illustrated instructions, and reinforcement from community health volunteers. Group education provided a shared foundation of knowledge about the diseases, treatment objectives, and the consequences of stopping medicines. Plain language and repetition reduced the burden of understanding new information. Education alone, however, may not change behaviour when the principal barriers involve schedules, beliefs, or access.

Individual counselling complemented the limitations of group sessions. Participants could discuss frequently forgotten midday doses, confusion in distinguishing medicines, or concerns about adverse effects without disclosing personal issues in front of the group. Such conversations allowed solutions to be made more concrete, for example by linking medication times to fixed routines, using a pill box, or asking a family member to provide reminders. Motivational interviewing in chronic disease has also produced small but meaningful improvements in adherence when conversations focus on patients' reasons and readiness rather than on instruction alone (Zomahoun et al., 2017).

The programme findings are consistent in direction with the meta-analysis by Conn et al. (2009) among older adults. That review found that adherence interventions were beneficial, particularly when education was accompanied by written instructions, packaging, monitoring, and other practical components (Conn et al., 2009). A Cochrane review of older adults using multiple

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medicines also emphasised that interventions are often multifaceted and that results vary according to design and measurement (Cross et al., 2020). The similar direction supports the logic of the present programme but does not mean that effect sizes can be compared directly because the populations, duration, and outcomes differed.

In hypertension, a meta-analysis of pharmacist interventions reported improved blood pressure control through a combination of education, feedback, and medication management (Santschi et al., 2014). In type 2 diabetes, a review of randomised trials also found that pharmacist involvement could improve several outcomes when it included education, medication review, and follow-up (Pousinho et al., 2016). The Posyandu 9A programme did not measure blood pressure or glucose as change outcomes and did not match the intensity of these clinical trials. The comparison primarily reinforces the appropriateness of placing pharmacy counselling alongside chronic disease monitoring in the community.

The role of reminder tools should also be viewed proportionately. A meta-analysis of mobile telephone text messaging in chronic disease found that simple reminders could improve adherence, although effects depended on context and study quality (Thakkar et al., 2016). In the present programme, illustrated cards, pill boxes, alarms, calendars, family support, and the habit of preparing a beverage were discussed as options rather than as one mandatory tool. The data did not record which tool was actually used by each participant, so the reminder mechanism could not be tested separately.

Research on education for hypertension, hyperlipidaemia, and diabetes suggests that educational interventions tend to improve adherence, although multicomponent approaches are often needed to sustain change (Tan et al., 2019). Broader reviews of adherence interventions have likewise concluded that long-term success is difficult to achieve and that complex interventions often produce variable results (Kini & Ho, 2018; Nieuwlaat et al., 2014). The increase observed in this programme should therefore be regarded as a promising early signal, not proof that one session or one package will always produce the same change elsewhere.

Meaning of the very large effect size

A Cohen's d of 2.17 is very large according to conventional thresholds. This magnitude indicates that the mean difference was much larger than the variation in within-participant difference scores. The increase in the minimum from 12 to 15 and the nearly unchanged standard deviation support a group-level shift rather than change in only a few participants. Nevertheless, a large statistical effect size is not automatically equivalent to causal effectiveness or sustained

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clinical benefit.

Several circumstances may have amplified the change. The intervention package was delivered intensively and directly targeted the behaviours assessed by MARS-5. Initial scores left room for improvement, all participants completed the programme, and the final measurement was apparently conducted soon after the intervention period, although the exact interval was not recorded. Temporal proximity may have captured memory and motivation while they were still strong, before participants returned to long-term routines.

Additional attention from the team may have produced a Hawthorne effect, in which behaviour changes because participants feel observed. Completing the same instrument for a second time may also have increased awareness of the answers perceived as expected. Because MARS-5 is a self-report measure, social desirability bias may have led participants to report higher adherence after receiving education. Without a control group and an objective measure, the contribution of these factors cannot be separated from genuine behavioural change.

Practical meaning remains evident in the increase from 69.9% to 83.2% of the maximum score and in the increase in the mean item score from 3.49 to 4.16. It remains unknown, however, whether the self-reported change was accompanied by improved medicine availability, an objective reduction in missed doses, or better blood pressure and glucose control. Future research should retain MARS-5 while adding pill counts, prescription-refill records, or other monitoring devices. The large effect size could then be examined against outcomes that do not depend on participant perception.

Interpretation of MARS-5 measurement results

All five items showed adequate correlations with the total score and alpha values above 0.80 at both measurement points. This finding is consistent with Chan et al. (2020), who described MARS as a tool for eliciting reports of non-adherence across chronic conditions. Findings from the Indonesian version reported by Alfian and Putra (2017) also support its use among patients with diabetes (Alfian & Putra, 2017; Chan et al., 2020). In the Posyandu context, the instrument's principal advantages are its small number of items and its focus on behaviour.

The decline in post-programme item-total correlations should be interpreted alongside the change in score distribution. When more participants respond at the high-adherence end, between-participant variability decreases and correlations may decline. The stable alpha indicates that the five items continued to move consistently. Nevertheless, the sample comprised only 30 participants, making the correlation values sensitive to changes in the responses of a few

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individuals and unsuitable as a basis for broad validation.

MARS-5 also does not replace clinical conversation. Two participants with the same total score may have different barriers: one may frequently forget, while another may intentionally reduce the dose because of adverse effects. The score should therefore be used as an entry point for asking about problematic items. Routine use by community health volunteers should be accompanied by a referral pathway to health professionals so that findings do not remain merely numerical.

Role of Stevia Sweetened Tea in the programme package

Stevia Sweetened Tea had two functions that must be distinguished. The first was educational and behavioural. Preparing the beverage could serve as a routine cue, while the illustrated card provided a visual reminder. The second was a functional-food rationale derived from literature on stevia, black tea, and alpha-amylase inhibition models. Neither function constitutes evidence that the beverage improved adherence or blood glucose levels.

The formula calculation produced an estimate of 14.59%, but the formula point lay outside the stevia boundary of the reference design. The value therefore only indicates the direction of the model and must not be presented as a product-test result. An alternative dose of 1.44 g per 200 mL kept the concentrations within the range and produced an estimate of 14.77%, but it was also not tested directly. Direct alpha-amylase testing of the actual formula, composition analysis, stability and safety assessment, and sensory acceptability testing are required before product claims are developed.

Taste and ease of measurement remain relevant to programme design. Sensory research on black tea and stevia blends indicates that bitterness and consumer preferences should be considered when ingredient proportions change (Budianta et al., 2020a, 2020b; Budianta & Utomo, 2023). The ratio of 20 g black tea to 17 g stevia was selected for ease of preparation and to preserve the character of tea. However, the programme did not measure liking, consumption quantity, or the ability to prepare the product at home; none of these outcomes is therefore presented as an empirical achievement.

Most importantly, the beverage did not replace medicine. The programme did not measure changes in blood glucose, blood pressure, or enzyme activity in the distributed product. The package design also could not separate the contributions of education, counselling, and the beverage. The temporal relationship that can be stated is therefore that adherence scores increased after the full package was delivered, not that Stevia Sweetened Tea caused the increase.

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Implications for community services

The programme results support the integration of medication monitoring into Posyandu services for older adults. Blood pressure and blood glucose may currently be checked without a structured conversation about how medicines are being used. MARS-5 offers brief screening, while counselling provides an opportunity to understand the reasons behind the score. This pathway can help distinguish participants who primarily need reminders from those who require information about adverse effects or clinical referral.

Community health volunteers can contribute at stages consistent with their authority: reminding participants of monitoring schedules, helping them bring medicine packaging, reading illustrated cards, and connecting them with health professionals. Interpretation of treatment changes remains the responsibility of physicians or other authorised health professionals. Pharmacy personnel can contribute to Posyandu activities through basic medication reconciliation, medicine identification, storage advice, regularity of collection, and counselling. This division of roles keeps the programme practical and safe.

Family members can also be involved as reminders, particularly for participants with impaired vision or memory. Support should not take the form of blaming supervision but rather assistance in preparing pill boxes, ensuring medicine availability, or reminding participants of visit schedules. When participants use multiple medicines, bringing all packaging to a Posyandu session makes it easier for health professionals to identify confusion in schedules. Family involvement and number of medicines were not measured in this programme, so these recommendations represent operational directions for future implementation.

Limitations

First, the evaluation did not use a control group. Score changes may therefore have been influenced by the intervention, additional attention, repeated measurement, or other events during the programme period. The results demonstrate a temporal association within one group but are insufficient to establish causal effectiveness. Second, MARS-5 is a self-report measure. Memory, item comprehension, and a desire to provide answers perceived as favourable may increase scores without a change of the same magnitude in actual medication use.

Third, the programme involved only 30 older adults at a single Posyandu. Participants who actively attend community services may differ from older adults who rarely attend, so generalisation to other areas should be cautious. Fourth, the implementation date, session duration, and posttest interval in days or weeks were not recorded in the source document. The

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absence of this information limits assessment of intervention intensity and the durability of change.

Fifth, education, counselling, demonstration, and the beverage were delivered as one package. The contribution of each component cannot be separated, and the product cannot be described as the cause of the score increase. Sixth, the formula was calculated only from a published equation; no alpha-amylase test, content analysis, participant sensory test, or blood glucose measurement was conducted. Seventh, number of medicines, disease duration, cognitive function, access to medicines, adverse effects, and family support were not measured. These variables may explain differences in adherence and should be included in future evaluations.

Sustainability and follow-up plan

Programme sustainability can begin with MARS-5 monitoring every three months. Community health volunteers can assist with scheduling and completion, while participants with low or declining scores can be directed to individual counselling. Participants should be encouraged to bring medicine packaging so that discussion is based on the therapy actually used. Monitoring results should be recorded simply to show change over time rather than only comparing a single measurement before and after a programme.

The brewing card and medication-reminder card can be reused, but the choice of tool should be adapted to participants' habits. Family members can be involved as companions when participants agree. Replication at other Posyandu sites can retain the four-stage structure while adapting language and media to local characteristics. Evaluation at three and six months is needed to determine whether change persists after programme attention decreases.

The development of Stevia Sweetened Tea should proceed through a product-research pathway separate from the adherence evaluation. The formula requires direct laboratory testing followed by safety, stability, and sensory acceptability assessments before any claims are developed. The alternative dose of 1.44 g per 200 mL may be considered because it lies within the model range, but it should not be implemented as a new recommendation without testing. Separating these pathways keeps the adherence programme focused on the correct use of medicines.

CONCLUSION

The implementation of structured education, individual counselling, and the introduction of Stevia Sweetened Tea at Posyandu Lansia 9A Mojosongo was accompanied by an increase in

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medication-adherence scores among 30 older adults with hypertension or diabetes mellitus. The mean MARS-5 score increased from 17.47 ± 2.53 to 20.80 ± 2.54, with a mean difference of 3.33 points, 95% CI 2.76-3.91, $p < 0.001$, and Cohen's $d = 2.17$. All five items showed adequate item-total correlations and internal consistency above 0.80. The formula containing 54.05% black tea and 45.95% stevia was supported by a literature-based calculation, but the estimated alpha-amylase inhibition of 14.59% was not a laboratory result and did not demonstrate clinical benefit. The findings support the feasibility of a service model combining brief screening and counselling, while highlighting the need for controlled evaluation, objective measurement, and longer follow-up.

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