Original Article

Examining how Nudge Theory-Based Interventions can Positively Affect Diabetes Patients on AKAP in Sikkim

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Abstract

Introduction: Diabetes mellitus, a lifestyle illness, is a major public health problem around the world, and its numbers are growing in India, and Sikkim, a northeastern state, is no exception**.** Sikkim, often known to have a pristine environment where people come for rejuvenation, also shares the same burden when it comes to the incidence of lifestyle diseases such as diabetes mellitus. Hence, effective management is very crucial, and itlargely depends on patients' awareness, knowledge, attitude, and practices (AKAP) regarding the condition.

Aim: This study aimed to examine the impact of interventions such as telephonic reminders based on nudge theory combined with ambassadors on the AKAP of diabetes patients in Sikkim.

Methods: This study selected 160 diabetes patients from Sikkim via purposive sampling (80 experimental, 80 control). Both groups were asked to complete a 5-point Likert scale questionnaire to assess the Awareness, Knowledge, Attitude, and Practices (AKAP) before any intervention. The experimental group then received an intervention in the form of whatsaap messaging, telephonic calls combined with an ambassador, while the control group did not. Both the groups re-completed the AKAP questionnaire post the intervention. Data were analysed using SPSS 25, using paired t-tests for within-group comparisons and ANCOVA to study the impact between-groups.

Results: Paired t-test results showed that there was no significant changein pre- and post-intervention AKAP scores for diabetes patients in the control group. Conversely, the treatment group showed a significant increase in their mean scores for awareness, knowledge, attitude, and practices related to diabetes from pre- to post-intervention. Aditionally, the ANCOVA results validated that the nudge theory-based intervention, combined with consultation, had a positive and significant impact on the awareness, knowledge, attitudes, and practices of diabetes patients.

Implications: This study highlights the effectiveness of using nudge theory as an approach to improve health behaviours amongst people in Sikkim, indicating that subtle cues and consultations empower patients to make better health choices. It highlights the importance of ongoing telephonic interventions combined with ambassador or consultation for improving AKAP, resulting in enhanced self-care and reduced complications. Policymakers and healthcare providers can use these nudge based results to create health initiatives that are scalable and culturally appropriate.

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Conclusion: This study shows how nudge theory-based interventions, when combined with ambassadors, can significantly improve the awareness, knowledge, attitude, and practices of diabetes patients in Sikkim. These results indicate that such interventions can act as an effective approach to improve diabetes self-care attitude and patient's health behaviour.

Keywords: Behavioural Intervention, Patient Education & Diabetes Management, Nudge Theory, Local Ambassador, Sikkim

Introduction

Lifestyle diseases are illnesses that have become linked to behavior. Health behaviors have emerged as a significant subject for investigation. Behavioral problems are causing most diseases to go worse. Nudge theory is one of the new theories that tries to change how people act without taking away their ability to choose. Diabetes is one of the diseases that can be cured by changing ones behavior. As it is a disease moving to distant regions with various cultures, like Sikkim, it is important to investigate it. Type 2 diabetes is rising quickly across the country, and the Northeast region is more vulnerable because of differences in income, culture, healthcare infrastructure, and diet and is no longer just a problem for those who live in cities or are wealthy. It is also affecting rural and tribal communities, many of which don't have access to the right information, quick diagnosis, or good management methods[1]. In Sikkim, the convergence of lifestyle changes, genetic factors, and insufficient awareness and dependence on herbal home remedies has intensified the prevalence of diabetes. Even while many people employ traditional healing methods and herbal medicines[2-4,] and some of them have been shown to help with diabetes, there is still not much scientific research on preventative healthcare[5]. Traditional wisdom, although beneficial, is also accompanied with cultural misconceptions[6] that may impede adherence to evidence-based treatment. For instance, research in comparable Northeastern settings indicates that certain tribal people depend on food taboos or herbal alternatives, frequently overlooking therapeutic interventions.[7]

Alcohol use and anexcessive non-vegetarian diet which are known contributors of lifestyle diseases are not new in Sikkim when it comes to food habits. They are part of festivities and everyday life. The 2015 National Family Health Survey (NFHS-5) shows that Sikkimese women are now ranked second while male counterparts are ranked third across the country in alcohol consumption[8].

Lifestyle diseases such as diabetes and its poor management result in consequences or complications such as retinopathy, neuropathy and cardiovascular.[9] Lifestyle patients pursue care like ophthalmic care[10] solely after the onset of vision loss, despite prior awareness of diabetic problems, highlighting a discrepancy between awareness[11] and prompt action.[12-16] This gap definitely shows how important it is to come up with new ways to share knowledge that go beyond just information dissemination. One way could be to utilize nudge-based interventions, which are behaviorally informed methods that gently push people to make healthier choices without forcing them to do so. Nudges have demonstrated efficacy in facilitating lifestyle changes, encouraging regular check-ups, and ensuring drug compliance in chronic disease management by simplifying options, reinforcing prompts, or providing timely reminders. There are evidences where interventions such as mobile phone messaging and smartphones, and sustained education and support[17-21] have been successful in managing lifestyle diseases[22-23] Conclusions were derived that lessons from behavioural economics could improve incentive-program design, thus giving scope for further research.[24] Nonetheless, their utilization within diabetic populations in North eastern India, especially in Sikkim, is still in adequately investigated.

This study seeks to fill this research gap by pursuing three distinct objectives. First, it looks at the socio-demographic characteristics of people with diabetes in the state. It is important to understand how education level and income level affect each other in order to put intervention results in context. Second, the study evaluates the effect of a nudge-based intervention combined with ambassadors on the AKAP of these patients. This is vital, as previous research indicates significant gaps in knowledge, with

rural and less educated populations exhibiting less awareness and inadequate preventive behaviors.[25-26] Third, the study examines the correlation between differences in AKAP levels and several socio-economic groups. This project aims to offer evidence-based insights into the enhancement of diabetes control in Sikkim through behaviorally informed treatments. The project seeks to merge cultural sensitivity with behavioral science to connect awareness and action, thereby enhancing public health initiatives for non-communicable disease management in Northeast India.

Need and Significance of the study

Diabetes is becoming a bigger public health problem in India, especially in places like Sikkim that don't have enough health care and information for patients. Diagnosis and access to excellent diabetes care continue to pose substantial obstacles, with a considerable percentage of cases remaining undiagnosed, particularly in rural regions.[27] To find vulnerable populations and make sure that strategies are appropriate for them, it is important to know the socio-demographic and clinical profile of diabetes patients in Sikkim. Even if treatment is available, patients typically have inadequate awareness, knowledge, attitude, and practices (AKAP), which makes it hard to manage their disease well.

This study is important because it uses a behavioral science strategy called a "nudge" to help people take better care of their diseases. Studies have often mentioned about the importance of self management in case of diabetes.[28-29] indicating that self-care activities and behavioural interventions plays an important role.[30-32] Nudge methods[33-34] are one of those methods known to help in self care and assist patients in making healthier choices about their lifestyles and treatments by quietly affecting their decision-making without limiting their options. Examining the feasibility of such an intervention provides evidence-based information regarding its potential for widespread public health applications. Interventions may include reminders, appealing nomenclatures, awareness initiatives, incentivized programs, mass media campaigns and so on.[35-36]

Additionally, by analyzing variations in AKAP levels among different socio-economic backgrounds, the study underscores health inequities and aids in the formulation of targeted, inclusive initiatives. The findings will supplement academic research and inform local health policy by providing a context-specific, cost-effective behavioral intervention to improve diabetes care outcomes in Sikkim.

Objectives of the study

1. To examine the socio-demographic profile of diabetes patients in Sikkim.
2. To assess the impact of a nudge-based intervention on the awareness, knowledge, attitude, and practices (AKAP) of diabetes patients in Sikkim using telephonic reminders as intervention.
3. To analyse variations in AKAP levels among diabetes patients across different SES groups.

Research Gap

While current research thoroughly elucidates the prevalence, risk factors, and ethnobotanical practices associated with diabetes in Northeast India, particularly in Sikkim, there is a paucity of empirical evidence investigating the synergistic impact of nudge-based interventions on the awareness, knowledge, attitudes, and practices (AKAP) of diabetes patients. Furthermore, while socio-demographic factors affecting illness prevalence have been investigated, a comparative analysis of AKAP levels across various socio-demographic backgrounds is still insufficiently examined in the context of Sikkim.

Research Methodology

This quasi-experimental study employed a quantitative approach to assess the impact of a nudge-based intervention on the awareness, knowledge, attitude, and practice (AKAP) of Diabetes patients in Sikkim. A total of 160 samples 80 in the control group (CG) and 80 in the experimental group (EG) were selected using purposive sampling. Data was collected using a self-developed questionnaire administered in both online and offline formats during pre- and post-intervention phases. Between these phases, EG received an eight-week structured nudge intervention grounded in behavioral economics. The intervention consisted of:

- SMS reminders, whatsapp messages to encourage timely blood sugar monitoring

and medication adherence. In this method, there were creative and educational messages about healthy eating, meaning of HBA1C test, importance of urine albumin test for early signs of kidney health, importance of nutritional diet and physical activity were sent via whatsapp

- Visual cues like posters reinforcing healthy eating and lifestyle tips : the same messages as above but in creative posters and short educative videos were sent
- Ambassador supported telephonic calls: Here the ambassador was a renowned doctor associated with STNM hospital which helped us to get credibility and gain trust from the patients when calls were made referring his name. Also, the messages that were sent was validated by the ambassador. As Sikkim is a small state where social ties, acquaintances and social relationships are high, being associated with such personnels made the research process slightly easier. A similar study was conducted by JPAL when researches combined with local renowned ambassador helped in reaching more population as compared to without one. Sikkim is a close-knit society where local ambassadors are valued, which is why this strategy was chosen.
- The frequency of messages were atleast once a week but aimed to sentatleastonce in every 3 days.

These nudges aimed to influence patient behavior subtly, without limiting choices or using financial incentives. Following the intervention, post-test data was collected from both groups. The data was cleaned, coded, and analyzed using frequency distribution, paired t-tests, and ANCOVA through SPSS software.

Data Analysis and Interpretation

Socio-Demographic Characteristics of Diabetes Patients (n = 160)

Table 1: Socio-Demographic Characteristics of Diabetes Patients (n = 160)

Variable wise category		CG (n=80)	EG (n=80)	Total (n=160)
Age	21–30	9 (11.3%)	13 (16.3%)	22 (13.8%)
	31–40	20 (25.0%)	16 (20.0%)	36 (22.5%)
	41–50	24 (30.0%)	23 (28.7%)	47 (29.4%)
	51–60	21 (26.3%)	20 (25.0%)	41 (25.6%)
	60+	6 (7.5%)	8 (10.0%)	14 (8.8%)
	Total	80 (100.0%)	80 (100.0%)	160 (100.0%)
Gender	Male	62 (77.5%)	63 (78.8%)	125 (78.1%)
	Female	18 (22.5%)	17 (21.3%)	35 (21.9%)
	Total	80 (100.0%)	80 (100.0%)	160 (100.0%)
Socio-Economic Status	Lower	21 (26.3%)	26 (32.5%)	47 (29.4%)
	Upper Lower	8 (10.0%)	2 (2.5%)	10 (6.3%)
	Lower Middle	39 (48.8%)	40 (50.0%)	79 (49.4%)
	Upper Middle	12 (15.0%)	12 (15.0%)	24 (15.0%)
	Total	80 (100.0%)	80 (100.0%)	160 (100.0%)
Education	Primary	15 (18.8%)	14 (17.5%)	29 (18.1%)
	Secondary	10 (12.5%)	8 (10.0%)	18 (11.3%)
	Intermediate	27 (33.8%)	26 (32.5%)	53 (33.1%)
	Graduation	12 (15.0%)	15 (18.8%)	27 (16.9%)
	Post-Graduation	10 (12.5%)	11 (13.8%)	21 (13.1%)
	Technical	5 (6.3%)	5 (6.3%)	10 (6.3%)
	Other	1 (1.3%)	1 (1.3%)	2 (1.3%)

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	Total	80 (100.0%)	80 (100.0%)	160 (100.0%)
Patient Income	< ₹15,000	28 (35.0%)	19 (23.8%)	47 (29.4%)
	₹15k–30k	26 (32.5%)	28 (35.0%)	54 (33.8%)
	₹30k–45k	13 (16.3%)	11 (13.8%)	24 (15.0%)
	₹45k–60k	5 (6.3%)	7 (8.8%)	12 (7.5%)
	₹60k–75k	0 (0.0%)	5 (6.3%)	5 (3.1%)
	> ₹75,000	0 (0.0%)	4 (5.0%)	4 (2.5%)
	No Income	8 (10.0%)	6 (7.5%)	14 (8.8%)
	Total	80 (100.0%)	80 (100.0%)	160 (100.0%)
Family Income	< ₹15,000	7 (8.8%)	2 (2.5%)	9 (5.6%)
	₹15k–30k	10 (12.5%)	9 (11.3%)	19 (11.9%)
	₹30k–45k	14 (17.5%)	9 (11.3%)	23 (14.4%)
	₹45k–60k	30 (37.5%)	25 (31.3%)	55 (34.4%)
	₹60k–75k	15 (18.8%)	13 (16.3%)	28 (17.5%)
	> ₹75,000	4 (5.0%)	22 (27.5%)	26 (16.3%)
	Total	80 (100.0%)	80 (100.0%)	160 (100.0%)
Permanent Location	Urban	19 (23.8%)	31 (38.8%)	50 (31.3%)
	Rural	58 (72.5%)	48 (60.0%)	106 (66.3%)
	Semi-Urban	3 (3.8%)	1 (1.3%)	4 (2.5%)
	Total	80 (100.0%)	80 (100.0%)	160 (100.0%)

Interpretation: The age group 41–50 years was most represented (29.4%), followed by 51–60 years (25.6%) across both groups. Males constituted a significant majority (78.1%). Nearly half the respondents belonged to the lower-middle socio-economic class (49.4%). Most had education up to intermediate level (33.1%), and only 6.3% were technically or professionally qualified. Patient income was highest in the ₹15,001–30,000 range (33.8%), and 8.8% reported no income. A large share of families earned between ₹45,001–60,000 (34.4%), with EG showing a higher concentration in the >₹75,000 category. Rural residents dominated the sample (66.3%), though urban representation was higher in the experimental group

Paired Sample T-Test: Comparing Pre- and Post-Intervention Level of Awareness, Knowledge, Attitude, and Practice Among Diabetes Patients in the Control Group (n=80)

- **H_0 1:** There is no significant difference in the awareness levels between pre- and post-intervention phases among Diabetes patients in the control group.
- **H_0 2:** There is no significant difference in the knowledge levels between pre- and post-intervention phases among Diabetes patients in the control group.
- **H_0 3:** There is no significant difference in the attitude between pre- and post-intervention phases among Diabetes patients in the control group.
- **H_0 4:** There is no significant difference in the practice levels between pre- and post-intervention phases among Diabetes patients in the control group.

Table 2: Comparing Pre- and Post-Intervention Level of Awareness, Knowledge, Attitude, and Practice Among Diabetes Patients in the Control Group (n=80)

Paired Samples Statistics[a]					Correlations		Paired Differences	
		Mean	N	Std. D	r	sig	T	Sig
Pair 1	Awareness (Pre-Intervention) Scale	1.72	80	.44	.937	.000	1.423	.159
	Awareness (Post-Intervention) Scale	1.75	80	.43				
Pair 2	Knowledge (Pre-Intervention) Scale	1.95	80	.27	.815	.000	1.423	.159
	Knowledge (Post-Intervention) Scale	1.97	80	.22				
Pair 3	Attitude (Pre-Intervention) Scale	1.68	80	.46	.971	.000	1.000	.320
	Attitude (Post-Intervention) Scale	1.70	80	.46				
Pair 4	Practice (Pre-Intervention) Scale	1.86	80	.41	.963	.000	1.000	.320
	Practice (Post-Intervention) Scale	1.87	80	.40				
a. Respondents = Control Group								

Interpretation:

- **Pair 1 –Awareness:** The mean awareness score increased marginally from 1.72 ± 0.44 (pre-intervention) to 1.75 ± 0.43 (post-intervention). A very strong positive correlation was found between the two time points ($r = .937$, $p < .001$), indicating consistency in responses. However, the t-value = 1.423 and $p = .159$, which is greater than the 0.05 significance threshold. Thus, the result is not statistically significant, and H_0 1 is accepted, indicating no significant difference in awareness levels pre- and post-intervention in the control group.
- **Pair 2 –Knowledge:** The average knowledge score rose slightly from 1.95 ± 0.27 to 1.97 ± 0.22 after the intervention. The correlation between the scores was strong ($r = .815$, $p < .001$), yet the t-value = 1.423 and $p = .159$, again exceeding the 0.05 threshold. Hence, the change is statistically insignificant, and H_0 2 is accepted, confirming no significant improvement in knowledge within the control group.
- **Pair 3 – Attitude:** Attitude scores showed a minor increase from 1.68 ± 0.46 to 1.70 ± 0.46. A very strong correlation was observed ($r = .971$, $p < .001$), but the t-value = 1.000 and $p = .320$ are not statistically significant. Therefore, H_0 3 is accepted, suggesting no significant change in attitude due to the intervention among the control group participants.
- **Pair 4 –Practice:** Practice levels increased slightly from 1.86 ± 0.41 to 1.87 ± 0.40. The correlation was again very strong ($r = .963$, $p < .001$), but the t-value = 1.000 and $p = .320$ indicate no statistical significance. Consequently, H_0 4 is accepted, meaning no significant improvement in practice scores post-intervention.

Summary

Across all four AKAP dimensions, the control group demonstrated very high correlations between pre- and post-intervention scores, indicating consistent responses. However, none of the differences were statistically significant, as all p-values exceeded 0.05. Therefore, all null hypotheses (H_0 1 to H_0 4) were accepted, confirming that the in the absence of intervention there is no significant impact on awareness, knowledge, attitude, or practice among diabetes patients in the control group.

Paired Sample T-Test: Comparing Pre- and Post-Intervention Level of Awareness, Knowledge, Attitude, and Practice Among Diabetes Patients in the Experimental Group (n=80)

- **H_0 1:** There is no significant difference in the awareness levels between pre- and post-intervention phases among Diabetes patients in the experimental group.
- **H_0 2:** There is no significant difference in the knowledge levels between pre- and post-intervention phases among Diabetes patients in the experimental group.

- **H_0 3:** There is no significant difference in the attitude between pre- and post-intervention phases among Diabetes patients in the experimental group.
- **H_0 4:** There is no significant difference in the practice levels between pre- and post-intervention phases among Diabetes patients in the experimental group.

Table 3: Comparing Pre- and Post-Intervention Level of Awareness, Knowledge, Attitude, and Practice Among Diabetes Patients in the Experimental Group (n=80)

Paired Samples Statistics[a]					Correlations		Paired Differences	
		Mean	N	Std. D	r	Sig	T	sig
Pair 1	Awareness (Pre-Intervention) Scale	1.75	80	.46	.105	.353	34.723	.000
	Awareness (Post-Intervention) Scale	3.97	80	.38				
Pair 2	Knowledge (Pre-Intervention) Scale	1.92	80	.26	.021	.854	32.944	.000
	Knowledge (Post-Intervention) Scale	4.03	80	.51				
Pair 3	Attitude (Pre-Intervention) Scale	1.63	80	.48	-.098	.385	31.145	.000
	Attitude (Post-Intervention) Scale	4.01	80	.43				
Pair 4	Practice (Pre-Intervention) Scale	1.82	80	.38	.035	.761	31.011	.000
	Practice (Post-Intervention) Scale	4.11	80	.55				
a. Respondents = EG								

Interpretation:

- **Pair 1 – Awareness:** The mean awareness score significantly increased from 1.75 ± 0.46 (pre-intervention) to 3.97 ± 0.38 (post-intervention). The correlation between pre- and post-scores was weak (r = .105, p = .353), indicating low linear consistency, likely due to the marked improvement. The t-value = 34.723 and p = .000, which is well below the 0.05 threshold, demonstrate a highly significant difference. Therefore, H_0 1 is rejected, confirming that the intervention had a statistically significant effect on improving awareness.
- **Pair 2 – Knowledge:** Participants' knowledge levels increased from 1.92 ± 0.26 to 4.03 ± 0.51. The correlation was very weak (r = .021, p = .854), possibly reflecting a substantial shift in responses post-intervention. The t-value = 32.944 and p = .000 confirm this improvement is statistically significant. Hence, H_0 2 is rejected, indicating a significant gain in knowledge due to the intervention.
- **Pair 3 – Attitude:** The attitude score rose from 1.63 ± 0.48 to 4.01 ± 0.43, reflecting a substantial shift in perception. The correlation was slightly negative and non-significant (r = –.098, p = .385), suggesting variable response patterns. However, the t-value = 31.145 and p = .000 show a strong statistically significant difference. Therefore, H_0 3 is rejected, indicating a significant positive change in attitude post-intervention.
- **Pair 4 –Practice:** Practice scores improved from 1.82 ± 0.38 to 4.11 ± 0.55, indicating enhanced health-related behavior. The correlation between scores was negligible (r = .035, p = .761), but the t-value = 31.011 and p = .000 reveal a statistically significant difference. Hence, H_0 4 is rejected, confirming a significant improvement in practice among participants after the intervention.

Summary

All four variablesawareness, knowledge, attitude, and practiceshowed statistically significant improvements in the experimental group, as indicated by high t-values and p-values < .001. Despite weak or insignificant correlations, the intervention produced substantial gains across all domains. Therefore, all null hypotheses (H_0 1 to H_0 4) are rejected, establishing that the nudge-based intervention was highly effective in enhancing AKAP among diabetes patients in the experimental group.

Analysis of Covariance (ANCOVA): Awareness, Knowledge, Attitude and Practice of Diabetes Patients of 4 Socio- Economic Status (SES) Groups

- **H_0 1:** There is no significant difference between adjusted mean scores of Awareness of Diabetes Patients of 4 SES Groups by considering their Awareness Score (pre-intervention) as covariate.
- **H_0 2:** There is no significant difference between adjusted mean scores ofKnowledge of Diabetes Patients of 4 SES Groups by considering their Knowledge Score (pre-intervention) as covariate.
- **H_0 3:** There is no significant difference between adjusted mean scores of Attitudes of Diabetes Patients of 4 SES Groups by considering their Attitude Score (pre-intervention) as covariate.
- **H_0 4:** There is no significant difference between adjusted mean scores of Practices of Diabetes Patients of 4 SES Groups by considering their Practice Score (preintervention) as covariate.

Table 4: Awareness, Knowledge, Attitude and Practice of Diabetes Patients of 4 Socio- Economic Status (SES) Groups

Variable	Socio-Economic Status	Mean ± SD	F	Sig.	Partial Eta Squared
Awareness (Post)	Lower Class (n=26)	3.58 ± 0.64	7.361	.000	.227
	Upper Lower Class (n=2)	4.00 ± 0.00			
	Lower Middle Class (n=40)	4.15 ± 0.58			
	Upper Middle Class (n=12)	4.42 ± 0.51			
	Total (n=80)	4.00 ± 0.66			
Knowledge (Post)	Lower Class (n=26)	3.92 ± 0.39	.629	.599	.025
	Upper Lower Class (n=2)	4.00 ± 0.00			
	Lower Middle Class (n=40)	4.03 ± 0.53			
	Upper Middle Class (n=12)	4.17 ± 0.72			
	Total (n=80)	4.01 ± 0.52			
Attitude (Post)	Lower Class (n=26)	3.88 ± 0.43	1.990	.123	.074
	Upper Lower Class (n=2)	4.50 ± 0.71			
	Lower Middle Class (n=40)	4.05 ± 0.39			
	Upper Middle Class (n=12)	4.08 ± 0.51			
	Total (n=80)	4.01 ± 0.44			
Practice (Post)	Lower Class (n=26)	3.88 ± 0.52	9.061	.000	.266
	Upper Lower Class (n=2)	4.00 ± 0.00			
	Lower Middle Class (n=40)	4.13 ± 0.46			
	Upper Middle Class (n=12)	4.75 ± 0.45			
	Total (n=80)	4.14 ± 0.55			

Interpretation:

- **Awareness (Post-Intervention):** The ANCOVA results revealed a **statistically significant difference** in the adjusted mean scores of *awareness* among the four SES groups after controlling for pre-intervention awareness scores (**F = 7.361**, **p = .000**, **Partial Eta Squared = .227**). This suggests that socio-economic status had a considerable effect on patients' awareness levels post-intervention. Specifically, the mean ± SD scores increased with higher SES: Lower Class (3.58 ± 0.64), Upper Lower Class (4.00 ± 0.00), Lower Middle Class (4.15 ± 0.58), and Upper Middle Class (4.42 ± 0.51). Since $p < .05$, **H0 1 is rejected**, indicating a significant difference in awareness across SES groups.
- **Knowledge (Post-Intervention):** There was **no statistically significant difference** in the adjusted mean knowledge scores

among the SES groups (**F = 0.629**, **p = .599**, **Partial Eta Squared = .025**) after controlling for pre-intervention knowledge. The post-intervention mean ± SD scores were: Lower Class (3.92 ± 0.39), Upper Lower Class (4.00 ± 0.00), Lower Middle Class (4.03 ± 0.53), and Upper Middle Class (4.17 ± 0.72). As the p-value is greater than .05, **H0 2 is accepted**, meaning socio-economic status did not significantly influence knowledge scores after the intervention.

- **Attitude (Post-Intervention):** For *attitude*, the ANCOVA results showed **no statistically significant difference** in the adjusted mean scores among SES groups (**F = 1.990**, **p = .123**, **Partial Eta Squared = .074**) when pre-intervention attitude scores were controlled. The mean ± SD scores were: Lower Class (3.88 ± 0.43), Upper Lower Class (4.50 ± 0.71), Lower Middle Class (4.05 ± 0.39), and Upper Middle Class (4.08 ± 0.51). Although slight differences in mean scores exist, especially with the Upper Lower Class scoring highest, the difference was not statistically significant. Therefore, **H0 3 is accepted**.
- **Practice (Post-Intervention):** The analysis revealed a **statistically significant difference** in the adjusted mean practice scores among the SES groups (**F = 9.061**, **p = .000**, **Partial Eta Squared = .266**) after controlling for pre-intervention scores. Mean ± SD scores were: Lower Class (3.88 ± 0.52), Upper Lower Class (4.00 ± 0.00), Lower Middle Class (4.13 ± 0.46), and Upper Middle Class (4.75 ± 0.45). The increasing trend in mean scores from lower to upper SES groups indicates that patients from higher SES backgrounds adopted better practices after the intervention. Since $p < .05$, **H0 4 is rejected**, confirming a significant difference in practice across SES groups.

Conclusion

The experimental group that received the nudge-based intervention, had big improvements in all four areas(AKAP) that were examined. At first, both the control and experimental groups had similar AKAP ratings. After the intervention was given, however, the two groups showed different patterns. The control group, which did not receive any nudge, had minimal to no variation in their AKAP levels following the intervention, indicating that the behavioural signals built into the intervention worked to raise awareness of diabetes and encourage better behaviours. It supports the idea that people with lifestyle diseases like diabetes may not change their health-related attitudes and behaviors over time unless they are given specific behavioural triggers or informational reinforcement. When nudges fit nicely into the daily job of important decision-makers, they are more likely to work.[37]

These results indicate that low-cost, scalable interventions, as simple as telephonic calls and reminders in the form of subtle nudges, might significantly enhance illness self-management, particularly in areas like Sikkim where health infrastructure and outreach may be constrained but social ties are very strong. The findings are consistent with behavioral science literature that endorses the utilization of nudges to affect decision-making by gradually modifying the choice environment while preserving individual autonomy.

Additionally, the study explored the influence of socio-economic status (SES) on the intervention's impact. While knowledge and attitude did not significantly differ across SES categories, the analysis revealed meaningful disparities in awareness and practice. Participants from higher socio-economic backgrounds demonstrated relatively more improvement in these two areas, potentially due to better access to health resources, stronger health literacy, and greater environmental support. Taken together, the study confirms that behavioral interventions have the capacity to create measurable improvements in lifestyle disease management. However, to maximize their impact, such efforts must be context-sensitive and responsive to the lived realities of different population subgroups. These insights offer valuable guidance for policymakers, public health practitioners, and healthcare providers aiming to develop behaviorally informed and equity-centered diabetes management programs. However, in this study, it is vital to stress that research conducted on an individual basis may encounter trust issues and operational challenges. The same studies conducted in collaboration with a recognized local figure, dignitary, or expert might facilitate confidence and ease in the study process. However, to choose this strategy, it is also vital to know how the group does things culturally.

Implications

The study's findings have important effects on many people who are active in diabetes care and policy implementation in Sikkim:

1. Health Authorities: Nudge programmes can help diabetic patients become more aware, knowledgeable, and positive about their condition and change their behavior. Public health departments should add these behavioural tactics to community-based health programs while considering social and economic status to ensure better results.
2. Healthcare Providers: Behavioral nudges, like reminders, visual cues, and individualized counsel can be adopted by healthcare providers to help patients maintain healthy practices. Customizing communication according to the patient's socio-economic background can enhance outcomes by rendering the intervention more relatable and actionable.
3. Policymakers: The study underscores the significance of behavioral science in public health planning. Policy makers can also use behavioral nudges to help people achieve better health outcomes. Programs should be funded and designed with an equity lens to address their varied impacts on different socio-economic groups.
4. NGOs and Community Organizations: Local non-profit organizations can also contribute in bringing these interventions to the people who need them most. Community health workers can be taught to effectively implement nudges, especially in poor areas where notable gaps in awareness and practice have been identified.
5. Researchers and Academics: This study paves the way for new researchers in this field. Collaborations with skilled and trained specialists can help researchers gain credibility in their work by identifying ground problems.
6. Patients and their caregivers: Knowing how well behavioral cues work might help patients and caregivers make tiny changes to their routines that help them better control their diabetes.

Recommendations

The study suggest the below recommendations to enhance diabetes awareness and management among patients in Sikkim:

1. Develop and disseminate culturally appropriate health education materials in local languages to increase awareness, symptoms and prevention strategies, in rural and semi-urban areas.
2. Leverage existing community health initiatives like ASHA and ANM outreach to include regular diabetes screening and counselling as part of routine visits.
3. Organize regular community-based workshops in collaboration with local NGOs and healthcare institutions to promote healthy eating, exercise and stress management.
4. Improve the availability of affordable diagnostic and treatment services in primary health centres and district hospitals, particularly for underserved populations.
5. Use mobile applications, social media, and SMS alerts to provide reminders for screening, medication adherence, and healthy lifestyle tips targeting younger and tech-savvy populations.
6. Conduct periodic training sessions for health professionals and frontline workers to update their knowledge and improve diabetes counselling skills.
7. Encourage family-based and peer-support interventions to improve adherence to diabetes management practices.

Limitations and Future scope of study

This study was constrained by its cross-sectional design, which limits causal inferences, and its dependence on self-reported data that may be subject to recall or social desirability bias. Subsequent research may implement a longitudinal design to evaluate temporal changes, investigate intervention-based models to enhance diabetes knowledge and practices, broaden the sample to encompass additional northeastern states for greater generalizability, and analyse the influence of digital tools in diabetes awareness and management. This research was structured as an experimental, single-site study executed over a brief period and a smaller

sample size, hence constraining the generalizability of the findings. The findings offer significant preliminary insights into behavioural determinants and their associated effects; nonetheless, they should be regarded as hypothesis-generating rather than definitive. Changes in behaviour and health typically happen over time, and the short follow-up period in this study may not show all the long-term impacts. Subsequent research utilizing multi-site methodologies with bigger samples and prolonged follow-up durations is essential to corroborate and enhance these findings, as well as to evaluate the durability of the reported behavioural and health consequences. It is also crucial to highlight that the effect of the study without the ambassador has not been researched.

Informed Consent: Informed consent was taken from all participants included in the study, where they were informed about the purpose of the research, confidentiality of their responses, and the right to withdraw from the study without any consequences.

Ethical Clearance: Ethical Clearance was obtained from the Institutional Ethics Committee of Sikkim University as well as from the study area. The study was conducted within the guidelines of the institutional ethics committee. *Prof Satyananda Panda Member secretary ,IEC committee 19/11/2025 No.SU/ REG/F-1/103/2019/Vol- II/782; STNM hospital Health and Family welfare department30/10/2025 730/STNM/ Adm-2025*

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