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Integrating Health Belief Model and Theory of Planned Behavior to Explain Complementary Therapy Use in Type 2 Diabetes: A Cross-Sectional Study in Denpasar, Indonesia

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ABSTRACT

Introduction: Complementary therapy (CT) is widely practiced among individuals with type 2 diabetes mellitus (T2DM) in Indonesia. However, the psychosocial determinants influencing CT adoption and its safe integration into biomedical care remain insufficiently understood. This study aimed to determine the prevalence and psychosocial determinants of CT use among patients with T2DM using an integrated Health Belief Model (HBM) and Theory of Planned Behavior (TPB) framework. We hypothesized that stronger psychosocial constructs specifically self-efficacy, subjective norms, and positive attitudes would be positively associated with CT use, whereas higher levels of CT-specific rational knowledge would be inversely associated with CT adoption.

Methods: A cross-sectional survey of 300 adult outpatients with T2DM was conducted at four community health centers in Denpasar, Indonesia, selected through multistage cluster sampling from May to July 2025. Interviewer-administered questionnaires collected sociodemographic and clinical characteristics, CT-specific rational knowledge, and HBM/TPB constructs. Data were analyzed using chi-square and Mann–Whitney U tests for bivariate comparisons, and backward stepwise binary logistic regression to identify independent predictors of CT use.

Results: CT use within the past six months was reported by 43.3% of participants. Usage was significantly associated with treatment type (χ^2=9.458, p=0.024) and check-up consistency (χ^2=5.999, p=0.014). CT users demonstrated higher scores across all HBM and TPB constructs (all p<0.001) but lower rational knowledge (p<0.001). In multivariate analysis, self-efficacy (OR=13.46, p=0.002), subjective norms (OR=9.20, p=0.005), and attitudes (OR=3.86, p=0.021) independently predicted CT use, while rational knowledge was inversely related (OR=0.395, p<0.001).

Conclusion: CT use among patients with T2DM was prevalent and predominantly influenced by psychosocial rather than demographic or knowledge-related factors. Strengthening culturally tailored communication, CT-specific health literacy, and provider readiness is crucial to promote safe, integrative diabetes management.

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a highly prevalent disease that affects the global population significantly. T2DM is responsible for 90% of diabetes worldwide. By 2045, this number is expected to continue increasing, reaching 783 million people (1,2). T2DM is a disease that is prevalent in Indonesia as well, affecting 19.4 million individuals and responsible for 6.5% of deaths in the nation. The annual cost of this disease is USD 1.27 billion (3,4).

In conjunction with T2DM, Complementary Therapies (CT), including *jamu* (plant-based medicines), acupuncture, cupping, and spiritual healing, offer alternative and adjunctive options for treating chronic illnesses. The use of CT is most common in Southeast Asia. For this reason, it is no surprise that out of the region, 64% of those who suffer from chronic illnesses use CT (5). Recently, a study showed that in Indonesia, 27.1% of individuals with chronic illnesses use CT, with the most common use of CT among those who suffer from diabetes (33.6%) (6). These practices are deeply rooted in Indonesian cultural traditions. However, unregulated CT use poses serious risks such as drug herb interactions, toxicity, misuse, and non-adherence**,** which are often compounded by non-disclosure to clinicians and fragmented care pathways (7). In Bali, CT use is strongly tied to Hindu and Balinese cultural traditions, yet systematic data on its prevalence in Denpasar remain limited, despite the city reporting one of the highest burdens of T2DM in the province.

Though CT is gaining popularity, the behavioral foundations of its use remain poorly understood, especially in medically pluralistic environments like Indonesia. Previous research has documented the role of cultural acceptability, dissatisfaction with biomedicine, and natural healing beliefs as facilitators of CT use (8–11). Most of the available literature has focused on descriptive aspects (e.g., patterns, prevalence, and demographics) and has almost completely ignored the psychosocial factors that influence CT decision-making. This gap between descriptive and explanatory literature suggests the need for comprehensive behavioral models to address how CT use is influenced by beliefs, norms, and perceived behavioral control.

The Health Belief Model (HBM) and the Theory of Planned Behavior (TPB) are both useful tools for exploring health-related behaviors. HBM focuses on perceptions of susceptibility, severity, benefits, and barriers, whereas TPB focuses on attitude, subjective norm, and perceived behavioral control (12). Even though both models have been used in studies on diabetes, researchers tend to use them in isolation. For example, one study in Indonesia implemented the HBM to study CT use among patients. In contrast, the TPB was utilized in a study on the same CT use behaviors in Yazd, Iran (14). While the HBM and TPB models of diabetes have been used in isolation for CT decision-making, their integration can help eliminate the cognitive and social contextual explanatory deficiencies. The integrated models can help explain the constellation of personal beliefs, normative social pressures, and perceived behavioral control in relation to their CT decisions. The integration of the HBM and TPB models has been examined by only a handful of researchers. Even fewer have examined the conceptual framework of self-efficacy in HBM and perceived behavioral control in TPB. Little has been done to address the limitations of singular theoretical models and the complexities of health-related behaviors, such as CT use.

This study fills this gap by attempting to establish an integrated HBM–TPB framework to understand the psychosocial and contextual factors influencing CT use among T2DM patients in Denpasar, Indonesia. We explore the prevalence of CT use, the demographic and behavioral predictors, and the relationships among self-efficacy, subjective norms, attitudes, and CT adoption, positing that rational knowledge is inversely related. The originality of this work lies in its theoretical integration and contextualization, which contribute to understanding behavioral mechanisms beyond the rationalist perspective. The findings contribute to the behavioral change theory and deepen the understanding of culturally adaptable, patient-centric, and integrated health policy approaches in low- and middle-income countries (LMICs).

METHODS

Study Design and Setting

A quantitative, cross-sectional study was conducted to examine the prevalence and determinants of complementary therapy (CT) use among patients with type 2 diabetes mellitus (T2DM) in Denpasar, Indonesia. Data collection took place from May to July 2025 at four randomly selected community health centers representing each subdistrict of Denpasar, which has one of the highest T2DM burdens in Bali Province.

Participants and Sampling

Eligible participants were adults aged 18 years or older with a confirmed T2DM diagnosis, actively registered at the selected centers in 2025, and able to provide written informed consent. Patients with cognitive impairment, severe illness preventing participation, or who declined consent were excluded. Sampling followed three stages (1) Cluster selection: One community health center (puskesmas) per subdistrict was selected via simple random sampling; (2) Proportional stratified sampling: Using diabetic registries (N = 1,182), proportional quotas were allocated to each site based on the number of eligible patients; and (3) Consecutive recruitment: Within each site, patients were approached consecutively during routine diabetes clinic sessions using a consistent time-location framework. Recruitment procedures were standardized across all centers through fieldworker training, structured schedules, and daily monitoring to ensure methodological uniformity and replicability.

Sample Size Determination

Sample size was calculated using the WHO single-population proportion formula with Z = 1.96, expected prevalence (P) = 0.26, and margin of error = 0.05. The minimum requirement of 296 was increased to 300 to anticipate non-response. All 300 respondents completed the survey and were included in the analysis.

Variables and Operational Definitions

The dependent variable was CT use, defined as any non-biomedical practice for diabetes management including *jamu* (packaged herbal products and self-prepared remedies), acupuncture, massage, yoga, or spiritual healing within the past six months. It was measured with a single question ("*Have you used any CT for your diabetes management in the past 6 months*?"), coded Yes=1 and No=0. Independent variables comprised HBM constructs (perceived susceptibility, severity, benefits, barriers, self-efficacy, cues to action) and TPB constructs (attitudes, subjective norms, perceived behavioral control, behavioral intention), each captured by multi item 5 point Likert scales. CT specific rational knowledge was assessed with 14 true/false/don't-know items on safety, legality, and efficacy (score 0–14). Additional covariates were sociodemographic (age, sex, education, occupation), clinical (duration of diabetes, complications verified in records), and patient engagement with health care (type of medical treatment: oral, insulin, combination, none; and check-up consistency: regular vs. irregular attendance at scheduled visits).

Instrument Development and Validation

The questionnaire was developed from validated HBM and TPB instruments and adapted for cultural relevance. Content validity was reviewed by a panel of seven experts in public health, behavioral psychology, pharmacology, and complementary medicine. Items were retained if CVR ≥0.62 and I-CVI ≥0.79, resulting in high scale validity (S-CVI/Ave ≥0.90). Reliability was confirmed with Cronbach's alpha (0.827–0.975), Composite Reliability (0.885–0.981), and AVE (0.569–0.912). Cognitive interviews and pilot testing (n=100) were conducted to ensure clarity and cultural appropriateness. Although exploratory and confirmatory factor analyses were not conducted, the instrument demonstrated strong psychometric properties, supported by expert-reviewed content validity and convergent reliability indices exceeding recommended thresholds (15,16).

The final questionnaire consisted of four sections: (1) sociodemographic, clinical characteristics and patient engagement with health care, (2) rational CT knowledge, (3) HBM constructs, and (4) TPB constructs. Trained interviewers administered the questionnaire during clinic visits using standardized protocols to minimize interviewer bias.

Bias Control

Selection bias was minimized through stratified multistage sampling and in clinic recruitment. Measurement bias was reduced by interviewer training, standardized procedures, and pretesting of the questionnaire. Expert panel validation minimized conceptual underrepresentation.

Data Management and Statistical Analysis

All responses were coded before entry into SPSS version 27 with double-entry verification. CT use was coded 1/0. HBM/TPB constructs were scored as composite sums (higher scores = stronger agreement). Rational knowledge was the total correct (0–14). Sociodemographic, clinical, and engagement variables were categorized a priori. Descriptive statistics summarized characteristics. Bivariate analysis used chi-square tests for categorical variables and Mann–Whitney U tests for non-normally distributed continuous variables. Effect sizes were calculated as $r = |Z| / \sqrt{N}$ to interpret magnitude (small = 0.10, medium = 0.30, large = 0.50).

For multivariable analysis, independent predictors of CT use were identified using backward stepwise selection and binary logistic regression. Initial models included all theoretical constructs of the scientific study, including bivariate analysis variables with $p < 0.05$. Results were expressed as odds ratios (ORs) and 95% confidence intervals (CIs). Study robustness and model assumptions were evaluated through multicollinearity, discrimination, calibration, and sensitivity. Multicollinearity was calculated using the Variance Inflation Factor (VIF). Discrimination was calculated using the area under the receiver operating characteristic (ROC) curve (AUC). Multicollinearity values of 5 or below were considered acceptable, and calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test and the Brier score. Firth's penalized logistic regression (implemented in R with the logistf package) was also carried out to assess the stability of the coefficients and to reduce the effects of small sample size or biased data separation. Model fit was summarized using AUC, overall classification accuracy, and the Nagelkerke R^2 statistic. All results were considered to be statistically significant with p values lower than 0.05, and all estimates were calculated with two-tailed arguments. All point estimates for the models were accompanied by 95% confidence intervals (CIs).

Ethical Considerations

Ethical approval for this study was granted by the Research Ethics Committee of Universitas Udayana (Approval No. 1686/UN14.2.2.VII.14/LT/2025). All participants provided written informed consent. Data confidentiality was ensured by de-identification and secure storage. The study adhered to the Declaration of Helsinki and International Council for Harmonisation – Good Clinical Practice (ICH-GCP) guidelines.

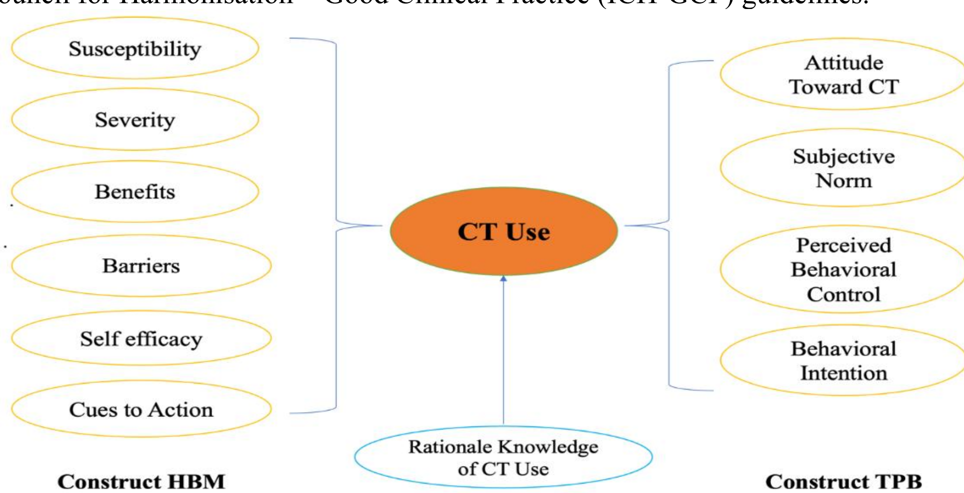

Figure 1. Integration of the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB) used as the theoretical framework in this study.

RESULTS

A total of 321 patients with T2DM were identified from the registries of four community health centers in Denpasar. After excluding 12 individuals who declined participation and 9 who were uncooperative**,** 300 participants were successfully interviewed and completed the questionnaire**,** with all responses included in the final analysis.

Prevalence of Complementary Therapy Use

The period prevalence of CT use in the past six months was 43.3% (Table 1). Prevalence was highest among middle-aged patients (48.5%) compared with younger (30.8%) and older adults (41.6%). Educational attainment showed a gradient, with the highest CT use among junior high school graduates (63.3%) and the lowest among those with no formal schooling (18.8%). Occupation also played a role: labourers (69.2%) and civil servants (55.0%) had higher CT prevalence than private employees (33.3%). Clinically, CT use was more common among patients without complications (47.2%), those receiving combination therapy (75.0%) or no medication (66.7%), and those with irregular check-up attendance (60.5%). These patterns suggest that CT use is shaped more by health care engagement and perceived needs than by basic demographic factors.

Table 1. Prevalence and distribution of complementary therapy use by demographic and clinical characteristics

Variable	Category	n (%)	CT use n (%)	No CT use n (%)
Age	≤44 years	13 (4.3)	4 (30.8)	9 (69.2)
	45–59 years	97 (32.3)	47 (48.5)	50 (51.5)
	≥60 years	190 (63.3)	79 (41.6)	111 (58.4)
Sex	Male	133 (44.3)	60 (45.1)	73 (54.9)
	Female	167 (55.7)	70 (41.9)	97 (58.1)
Education	No schooling	16 (5.3)	3 (18.8)	13 (81.3)
	Primary school	69 (23.0)	27 (39.1)	42 (60.9)
	Junior high school	30 (10.0)	19 (63.3)	11 (36.7)
	Senior high school	95 (31.7)	41 (43.2)	54 (56.8)
	Tertiary	90 (30.0)	40 (44.4)	50 (55.6)
Occupation	Labourer	13 (4.3)	9 (69.2)	4 (30.8)
	Trader/entrepreneur	47 (15.7)	23 (48.9)	24 (51.1)
	Civil servant	20 (6.7)	11 (55.0)	9 (45.0)
	Private employee	36 (12.0)	12 (33.3)	24 (66.7)
	Retired	85 (28.3)	36 (42.4)	49 (57.6)
	Unemployed/housewife	99 (33.0)	39 (39.4)	60 (60.6)
Duration of diabetes	≤5 years	178 (59.3)	76 (42.7)	102 (57.3)
	6–10 years	65 (21.7)	28 (43.1)	37 (56.9)
	11–15 years	19 (6.3)	8 (42.1)	11 (57.9)
	>15 years	38 (12.7)	18 (47.4)	20 (52.6)
Complications	Yes	124 (41.3)	47 (37.9)	77 (62.1)
	No	176 (58.7)	83 (47.2)	93 (52.8)
Medical treatment	Oral	233 (77.7)	102 (43.8)	131 (56.2)
	Insulin injection	47 (15.7)	14 (29.8)	33 (70.2)
	Combination	8 (2.7)	6 (75.0)	2 (25.0)
	No medication	12 (4.0)	8 (66.7)	4 (33.3)
Check-up consistency	Regular	257 (85.7)	104 (40.5)	153 (59.5)
	Irregular	43 (14.3)	26 (60.5)	17 (39.5)
Total		**300 (100)**	**130 (43.3)**	**170 (56.7)**

Note: CT = *Complementary Therapy*. CT use was defined as the use of any non-biomedical practice for diabetes management in the past six months, including herbal medicine, massage/reflexology, acupuncture, yoga, or spiritual healing

Bivariate Associations with CT Use

Bivariate analyses (Table 2) confirmed that medical treatment type (χ^2=9.458, p=0.024) and check-up consistency (χ^2=5.999, p=0.014) were significantly associated with CT use, while age, sex, occupation, diabetes duration, and complication status showed no statistical significance. Education approached significance (p=0.053), suggesting a possible but inconclusive link. Overall, these findings highlight that behavioural interaction with the health system, rather than demographic or clinical profiles, better explains CT adoption.

Table 2. Associations between sociodemographic and clinical variables and complementary therapy use (n=300)

Variable	df	χ^2	p-value
Age	2	2.110	0.348
Sex	1	0.308	0.579
Education	4	9.367	0.053
Occupation	5	7.385	0.194
Duration of diabetes	3	0.295	0.961
Complications	1	2.538	0.111
Medical treatment	3	9.458	*0.024
Consistency of check-up	1	5.999	*0.014

Note: df, degrees of freedom. *p<0.05.

Psychosocial Determinants and Rational Knowledge Scores

Comparisons of HBM and TPB construct scores between CT users and non-users (Table 3) showed significant differences across all constructs (Mann–Whitney U tests, all $p < 0.001$). Within the HBM framework, CT users reported higher perceived benefits, self-efficacy, and cues to action, as well as lower perceived barriers. Other HBM constructs, including perceived susceptibility and perceived severity, also differed significantly but demonstrated smaller effect sizes these are therefore presented **Supplementary Table S1** to enhance clarity and interpretability.

In TPB, most users had more positive attitude, stronger subjective norm, higher perceived behavioral control, and greater intention to behave. Attitude, perceived benefits, and subjective norm were most different and each had large effect sizes ($r \geq 0.80$), illustrating importance in CT use. This shows that CT positive appraisal, strong belief in CT, and social support from family and friends are statistically and practically important. This shows that focusing attitude change and social support would be needed in the culturally integrated health systems.

CT users displayed markedly lower rational knowledge scores than non-users, suggesting that CT adoption took place alongside a less substantial evidence-based rationale. This phenomenon illustrates the paradox of knowledge behavior, where belief-driven motivations outweigh rational knowledge in influencing CT adoption.

Table 3. Comparison of HBM and TPB construct scores and rational knowledge between complementary therapy users and non-users.

Construct	Direction of Association (CT Users vs. Non-Users)	Effect Size (r)	p-value
Attitude (TPB)	Higher	0.82	<0.001
Perceived Benefits (HBM)	Higher	0.81	<0.001
Subjective Norms (TPB)	Higher	0.80	<0.001
Cues to Action (HBM)	Higher	0.78	<0.001
Self-efficacy (HBM)	Higher	0.77	<0.001
Behavioral Intention (TPB)	Higher	0.76	<0.001
Perceived Behavioral Control (TPB)	Higher	0.73	<0.001
Perceived Barriers (HBM)	Lower	0.69	<0.001

Construct	Direction of Association (CT Users vs. Non-Users)	Effect Size (r)	p-value
Rational Knowledge of CT	Lower	0.51	<0.001

Note: CT = Complementary Therapy; HBM = Health Belief Model; TPB = Theory of Planned Behavior. Direction of association is based on mean rank comparison between CT users and non-users: "Higher" indicates significantly greater mean rank scores among CT users, and "Lower" indicates significantly lower scores. Effect size calculated as $r = |Z| / \sqrt{N}$ (N = 300). Full statistical results are available in Supplementary Table S1.

Multivariate Predictors of CT Use

Several psychosocial factors, as described in Table 4, were identified as independent predictors of CT use in patients with T2DM using binary logistic regression analysis. Based on the adjustments to the theoretical constructs, self-efficacy, subjective norms, and attitudes were found to be strong positive predictors of CT use. On the other hand, rational knowledge demonstrated a positive, inverse association with CT adoption. More specifically, patients with a greater self-efficacy were over 13 times more likely to use CT (OR = 13.46, p = 0.002); patients with greater subjective norms were nearly 9 times more likely (OR = 9.20, p = 0.005); and patients with a greater positive attitude were almost 4 times more likely (OR = 3.86, p = 0.021), to be positive CT users. In contrast, greater rational knowledge regarding CT was associated with decreased positive use of CT (OR = 0.40, $p < 0.001$). On the other hand, the perceived severity of the situation was associated with a positive trend that was not considered statistically significant (OR = 4.32, p = 0.091).

The overall model showed good explanatory power and model discrimination and was able to provide excellent classifying power and good calibration (Nagelkerke $R^2 = 0.935$, Hosmer–Lemeshow p = 0.280, 97% classification accuracy, and VIF = 1.07-3.83). The model showed no multicollinearity and independent predictors. The model discriminates CT/non-CT users, achieving excellent discrimination power (area under the ROC curve (AUC) = 0.988, 95% CI 0.977–0.999). Firth's penalized logistic regression provided estimates (with the same direction and significance) confirming the model's robustness and resistance to small-sample or separation bias. In the single-site, cross-sectional sample context, the model's overall performance showed that there is no possibility of underfitting. While multiple diagnostic checks and sensitivity analyses were undertaken to reduce the risk, the low ranges shown for the self-efficacy domain indicate a need to validate the test in independent/longitudinal studies.

This study shows that psychosocial factors such as self-efficacy and subjective norms have a greater influence on the formation of CT behaviors than knowledge. The negative relationship between rational knowledge and CT behavior indicates a knowledge paradox: people are more influenced by their beliefs and the social environment than by a knowledge-based rationale.

Table 4. Predictors of Complementary Therapy Use among Patients with Type 2 Diabetes Mellitus (Binary Logistic Regression)

Variable	B	SE	Wald	df	p-value	OR (Exp B)	95% CI for OR
Severity	1.464	0.867	2.853	1	0.091	4.324	0.791–23.640
Self-efficacy	2.600	0.821	10.038	1	0.002*	13.463	2.695–67.243
Attitude	1.351	0.586	5.321	1	0.021*	3.862	1.225–12.172
Subjective norm	2.220	0.786	7.975	1	0.005*	9.203	1.972–42.944
Rational knowledge of CT	-0.929	0.214	18.790	1	<0.001*	0.395	0.259–0.601

Note: CT = Complementary Therapy. Model statistics: Nagelkerke $R^2 = 0.935$; Hosmer–Lemeshow p = 0.280; AUC = 0.988 (95% CI 0.977–0.999); classification accuracy = 97.0%; all VIF < 5; *Significant at $p < 0.05$.*

DISCUSSION

This study applied a combined HBM-TPB framework to analyze psychosocial and contextual factors related to CT use among T2DM patients in Denpasar, Indonesia. 43.3% of patients with T2DM in Denpasar, Indonesia, had used CT in the last 6 months either as a stand-alone therapy or in combination with conventional treatment. Reports from the global north and south show a CT use range of 30% to 70% (5,9). CT use among patients in Southeast Asia is high due to its integration with the region's cultural and spiritual belief systems (17).

The primary CT user demographic was middle-aged (45-59 years). This could be attributed to concerns about the long-term complications and negative impacts of traditional methods (13,18,19). Although some studies show a disparity in CT use between the sexes, in this study, CT use was greatest in men. This was surprising, given the evidence that CT use is predominantly female (8,18,20). This indicates that in urban Indonesia, the health-seeking behavior of men and women has merged, or, at most, the combination of the health system and a culturally therapeutic system has narrowed the breadth of health-seeking behavior.

CT usage correlates with education and occupation. Those with the lowest level of education, junior high school, report the highest usage of CT (63.3%) while those with no education report significantly lower usage (18.8%) (10,21). This shows that low CT usage is not only related to basic CT literacy. CT usage among laborers and civil servants is higher than in the private sector and among the unemployed, reflecting the implications of socioeconomic and contextual factors (18,22).

This study identified a correlation between treatment type and the frequency of medical check-ups and CT scans among T2DM patients. The results of this study align with the literature's explanation of dissatisfaction with traditional treatment methods, safety concerns, and the perceived benefits of CT (20,23). The treatment approach of combining herbal or other alternative therapies with either oral or insulin therapies appears to meet perceptions of safety and effectiveness (18,24). The use and subsequent engagement in CT have been a concern in other studies, and delays in its use may result in diminished treatment adherence and poor glycemic control (25,26). Patients with higher health literacy levels tend to use CT more purposefully and are more likely to participate in follow-up activities (27). To improve diabetes management, the safe and standardized use of CT should be implemented alongside the other outlined areas to ensure improvement.

The study, in addition to clinical aspects, has uncovered significant psychosocial and behavioral disparities between CT users and non-CT users, as framed by the HBM and the TBP. Among CT users, a significant difference ($p < 0.001$) was observed in the psychosocial dimension, suggesting that psychosocial factors were the predominant motivator for CT. Users showed particularly low rational understanding of CT and exemplified knowledge-behavior paradoxes in which motivating beliefs outweigh rational counter-evidence. This adds to the theory by critiquing rational-choice and information-deficit models, which assume optimal decisions are made rationally given complete information. Aligning with critiques of inelastic information behavior and suboptimal behavior (28), we argue that CT is not emotionally socially constructed and, culturally, is known for its safety or efficacy. This is consistent with prior studies that emphasize the influence of narrative and context on behavior, regardless of the content (29). Assessing health information through a culturally constructed cognitive framework subverts the information-centered approach and the culturally constructed decision-making model (30). Previous studies validate the cross-cultural cognitive theory, culturally integrated theory, and culturally integrated health belief theory. Perceived health risk (susceptibility and severity) and health-related self-efficacy (self-efficacy) jointly bolster the adoption of CT (13,31). The positive assessment of CT's effectiveness and safety also includes self-efficacy (10,20). Family and social network recommendations are behavioral catalysts that promote the adoption of CT (18,21). Moreover, sociodemographic factors such as older age, presence of complications, and higher health literacy were shown to reinforce these tendencies (32,33).

Self-efficacy proved to be a robust predictor of CT use, remaining significant in the multivariate analysis. Patients who describe themselves as self-efficacy CT users are 13 times more likely than self-efficacy CT non-users. Previous studies have underscored self-efficacy as a predictor of CT use, either consistently or methodologically, in context, due to the myriad of measurement instruments (34). Besides self-efficacy, CT use is predicted by perceived social norms and attitudes. Social recognition and positive reinforcement are crucial in effecting behavior change in a health context (35). Therefore, the traditional HBM and the revised TPB should provide a framework for CT adoption.

A key finding of the study was a negative relationship between rational knowledge and the use of CT. The more knowledgeable the patients were about the safety, efficacy, and regulation of CT, the less they used CT. This confirmed the knowledge behavior gap (9,27). Health literacy (HL) is especially paramount for the use of CT. CT-specific HL includes knowledge regarding the interactions of drugs and herbs, the appropriate dosage, and contraindications (7). Several interventions, such as BeeSAFE and the CT Health Literacy Model (36–38), have been shown to improve decision-making. Unsafe risk-increasing behavior is correlated with poor HL.

In Indonesia, where CT is often accessed informally, HL interventions should prioritize culturally resonant, community-based, peer-led approaches and digital models (39). Furthermore, Indonesia's pluralistic health system, in which patients frequently combine biomedical and traditional practices, poses risks in the absence of standardized protocols and adequately trained providers(40,41). Reforming medical curricula to include CT knowledge is therefore essential for equipping providers to guide patients safely in pluralistic care contexts.

Implications for Public Health and Policy

The current study analyzed the social and psychological aspects of the use of CT. This study indicates that CT users would benefit from interventions that go beyond assisting CT users with controlling their thoughts and beliefs and behavioral self-efficacy. Culturally sensitive interventions that promote shared decision-making may also be beneficial. Increasing CT-specific health literacy may lead to the decrease of risky CT practices, especially in the case of informal CT practices in Indonesia. The Indonesian system of medical pluralism, which incorporates all forms of biomedicine and CT, may benefit from policies designed to regulate CT, including the incorporation of CT into the referral system and the training of health workers in CT and health literacy. For instance, CT could be incorporated into Puskesmas in order to screen all patients for diabetes and then use the risk stratification CT to counsel and refer patients to clinicians, thereby integrating CT into the overall patient care process.

The potential for an integrated approach to public health is significant. Empowering patients through education, trust, and informational narratives and improving the quality of culturally sensitive, credible, and accessible narratives may be an important step. Collaborative biomedicine and CT practitioners can create culturally safe and clinically appropriate pathways for the management of diabetes.

Strengths, Limitations, and Future Directions

The present study has proven the success of the HBM-TPB integrated framework model in predicting the use of CT by patients with T2DM, with a model fit of Nagelkerke $R^2 = 0.935$, thus, affirming the model's complexity in dealing with health behavior. However, there are limitations to consider. Due to the use of a cross-sectional design, no causal inference can be made. Self-reported data are subject to recall and social desirability bias. Recruitment from a singular urban site provides a limited generalization to the rest of the Indonesian population or to low- and middle-income countries (LMICs). It is suggested that future studies employ longitudinal and mixed-methods designs to capture the temporal and contextual nuances of CT use. Contextually comparative studies in CT use determinants across LMICs can also be conducted. Additionally, incorporating cultural and literacy dimensions into a behavioral framework will increase the relevance of integrated, patient-centered health policy globally.

CONCLUSION

This study investigated the psychosocial determinants of complementary therapy (CT) use among patients with type 2 diabetes mellitus (T2DM) in Denpasar, Indonesia, and aimed to explain CT adoption through an integrated Health Belief Model (HBM) and Theory of Planned Behavior (TPB) framework. The findings demonstrated that 43.3% of participants had used CT within the past six months. Self-efficacy, subjective norms, and positive attitudes were the strongest predictors of CT use, while rational knowledge showed an inverse association, highlighting a knowledge behavior paradox. Engagement with healthcare, including the type of medical treatment and regularity of check-ups, also influenced CT adoption.

Notably, this study provides novel evidence that psychosocial and contextual factors play a more dominant role than demographic characteristics or knowledge in shaping CT behavior. These results underscore the importance of enhancing CT-specific health literacy, promoting culturally sensitive communication, and integrating CT competencies into provider training to support safe, evidence-based diabetes care.

While this study offers valuable insights into behavioral mechanisms underlying CT use, several limitations should be acknowledged, including its cross-sectional design, reliance on self-reported data, and recruitment limited to one urban setting. Future research should employ longitudinal or mixed-method approaches to explore causal relationships and cultural variations in CT adoption, thereby strengthening theoretical understanding and informing integrative health policy and patient-centered diabetes management.

AUTHOR CONTRIBUTION STATEMENT

Ni Made Umi Kartika Dewi contributed to conceptualization, methodology, investigation, formal analysis, and drafting of the manuscript. Luh Seri Ani was responsible for funding acquisition, data curation, and manuscript review. Dinar Saurmauli Lubis provided supervision, validation, and critical revisions. Agung Wiwiek Indrayani contributed to supervision, project administration, resources, and manuscript review. Pande Putu Januraga provided supervision and participated in manuscript review. All authors read and approved the final version of the manuscript.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest in relation to this study.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors affirm that no generative AI tools were used to create, analyze, or interpret data in this manuscript. This article was prepared with language editing assistance from ChatGPT (OpenAI), used solely for grammar and structural refinement, and all content was verified by the authors.

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BIBLIOGRAPHY

1. Yu M, Zhan X, Yang Z, Huang Y. Measuring the global, regional, and national burden of type 2 diabetes and the attributable risk factors in all 194 countries. J Diabetes. 2021;13:613–39. https://doi.org/10.1111/1753-0407.13159
2. Khusna RP, Pangastuti HS, Wicaksana AL. Dietary adherence and associated factors among Indonesian patients with type 2 diabetes: what should we be concerned about? Front Nurs. 2023;10:427–36. https://doi.org/10.2478/fon-2023-0045.
3. Mulyanto J, Wibowo Y, Ernawati DA, Lestari DWD, Kringos DS. Exploring inequalities in the use, quality, and outcome of the diabetes management program of Indonesian national health insurance. Health Equity. 2023;7:644–52. https://doi.org/10.1089/heq.2023.0025.
4. Negara SBSMK, Octavia DR, Utami PR. Comparison of actual cost to case-mix of type 2 diabetes mellitus inpatient in Pandan Arang Boyolali Hospital. Pharm Educ. 2021;21:269–74. https://doi.org/10.46542/pe.2021.212.269274.
5. Alzahrani AS, Price MJ, Greenfield SM, Paudyal V. Global prevalence and types of complementary and alternative medicines use among adults with diabetes: systematic review and meta-analysis. Eur J Clin Pharmacol. 2021;77:1259–74. https://doi.org/10.1007/s00228-021-03097-x.
6. Pradipta IS, Aprilio K, Febriyanti M, Ningsih YF, Pratama MAA, Indradi RB, et al. Traditional medicine users in a treated chronic disease population: a cross-sectional study in Indonesia. BMC Complement Med Ther. 2023. https://doi.org/10.1186/s12906-023-03947-4.
7. Jatau AI, Sha'aban A. Health literacy in complementary and alternative medicine. In: Health Literacy in Medicines Use and Pharmacy. Elsevier; 2025. p. 225–36. https://doi.org/10.1016/B978-0-12-824407-4.00024-6.
8. Alghamdi S. The use and potential interactions of herbal medicines among diabetic patients in Saudi Arabia: a cross-sectional study. J Pharm Res Int. 2021;33:226–34. https://doi.org/10.9734/JPRI/2021/v33i53A33655.

9. Owusu S, Gaye YE, Hall S, Junkins A, Sohail M, Franklin S, et al. Factors associated with the use of complementary and alternative therapies among patients with hypertension and type 2 diabetes mellitus in Western Jamaica: a cross-sectional study. BMC Complement Med Ther. 2020;20:314. https://doi.org/10.1186/s12906-020-03109-w.
10. Rafi MA, Azad DT, Bhattacharjee M, Rahman N, Mubin KA, Rahman MA, et al. A hospital-based study on complementary and alternative medicine use among diabetes patients in Rajshahi, Bangladesh. BMC Complement Med Ther. 2020;20:219. https://doi.org/10.1186/s12906-020-03021-3.
11. Almogbel ES, AlHotan FM, AlMohaimeed YA, Aldhuwayhi MI, AlQahtani SW, Alghofaili SM, et al. Habits, traditions, and beliefs associated with the use of complementary and alternative medicine among diabetic patients in Al-Qassim Region, Saudi Arabia. Cureus. 2022;14:e33157. https://doi.org/10.7759/cureus.33157.
12. Ajzen I. The theory of planned behavior: frequently asked questions. Hum Behav Emerg Technol. 2020;2:314–24. https://doi.org/10.1002/hbe2.195.
13. Joeliantina A, Anugrahini HN, Proboningsih J. Health beliefs of patients with type 2 diabetes mellitus who use herbs as a complement to self-care. Int J Public Health Sci. 2021;10:265–71. https://doi.org/10.11591/ijphs.v10i2.20729.
14. Yamani Ardakani B, Bahrevar V, Zareipour M, Fattahi Ardakani M, Nabimeybodi R. Psychometrics of the questionnaire on intention to use medicinal plants in patients with type 2 diabetes based on the developed theory of planned behavior. J Educ Health Promot. 2025;14:1–7. https://doi.org/10.4103/jehp.jehp_1465_23.
15. Madadizadeh F, Bahariniya S. Tutorial on how to calculate content validity of scales in medical research. Perioper Care Oper Room Manag. 2023;31:100315. https://doi.org/10.1016/j.pcorm.2023.100315.
16. Harmoinen M, Niiranen V, Munnukka J, Suominen T. Reliability and validity of a further tested appreciative management scale. J Nurs Meas. 2021;29:66–79. https://doi.org/10.1891/JNM-D-19-00047.
17. Zainab ZA, Nor NMAR, Mohamed F, Syed MR, Mohd EA. Traditional and complementary medicine (T&CM) use and its association with diabetic control among diabetic patients in a tertiary centre, Kuantan, Pahang. IIUM Med J Malays. 2021;20(1). https://doi.org/10.31436/imjm.v20i1.1787.
18. Radwan H, Hasan H, Hamadeh R, Hashim M, Abdulwahid Z, Gerashi MH, et al. Complementary and alternative medicine use among patients with type 2 diabetes living in the United Arab Emirates. BMC Complement Med Ther. 2020;20:1–12. https://doi.org/10.1186/s12906-020-03011-5.
19. Mori Y, Daikuhara H, Oshima T, Suzuki H, Okada S, Miyatake N. Use of complementary and alternative medicine and its relationship with health-related quality of life in patients with type 2 diabetes mellitus. Epidemiologia. 2023;4:53–9. https://doi.org/10.3390/epidemiologia4010005.
20. Meraya AM, Ahsan W, Albratty M, Alhazmi HA, Najmi A. Perception of individuals with diabetes about efficacy and safety of complementary and alternative medicines in the Jazan Region, Saudi Arabia. Evid Based Complement Alternat Med. 2022;2022:2104056. https://doi.org/10.1155/2022/2104056.
21. Yaghmour KA, Abu Sadi R, Badroun F, Alali R, Almubarak F, Alabbad Z, et al. Complementary and alternative medicine use among patients with diabetes mellitus in Saudi Arabia: a community-based cross-sectional study. Cureus. 2023;15:e45792. https://doi.org/10.7759/cureus.45792.
22. Almogbel YS, Alnomasy SF, Alharbi SF, Alrasheedi AA. Patterns and predictors of complementary and alternative medicine use among adults with diabetes in Saudi Arabia. BMC Complement Med Ther. 2022;22:56. https://doi.org/10.1186/s12906-022-03580-x.
23. Meshesha SG, Yeshak MY, Gebretekle GB, Tilahun Z, Fenta TG. Concomitant use of herbal and conventional medicines among patients with diabetes mellitus in public hospitals of Addis Ababa, Ethiopia: a cross-sectional study. Evid Based Complement Alternat Med. 2020;2020:4871459. https://doi.org/10.1155/2020/4871459.
24. Alzahrani M, Alsiary K, Khan M, Bushnaq A, Alzahrani B, Salama M, et al. Perception of herb use in treating diabetes among patients attending specialized polyclinics of National Guard Health Affairs, Jeddah. J Family Med Prim Care. 2023;12:270–5. https://doi.org/10.4103/jfmpc.jfmpc_1155_22.
25. Rahem A, Athiyah U, Setiawan CD, Hermansyah A. Risk of combined use of herbal and conventional medicines in diabetic patients. Pharm Educ. 2023;23:185–8. https://doi.org/10.46542/pe.2023.234.185188.

26. Mosleh R, U'wais A, Hamdan A, Ghanim M, Jarrar Y. Assessment of alternative medicine use, costs, and predictors of medication adherence among diabetes mellitus patients in Palestine. Endocr Metab Immune Disord Drug Targets. 2024;24:441–54. https://doi.org/10.2174/1871530322666220523114806
27. Özkan İ, Taylan S, Eroğlu N. Relationship between health literacy and the use of complementary and alternative medicine in patients with type 2 diabetes. Afr Health Sci. 2023;23:519–29. https://doi.org/10.4314/ahs.v23i2.60.
28. Khalil EL. The information inelasticity of habits: Kahneman's bounded rationality or Simon's procedural rationality? Synthese. 2022;200:343. https://doi.org/10.1007/s11229-022-03815-7
29. McCall B, Shallcross L, Wilson M, Fuller C, Hayward A. Storytelling as a research tool used to explore insights and as an intervention in public health: a systematic narrative review. Int J Public Health. 2021;66:1604262. https://doi.org/10.3389/ijph.2021.1604262
30. Korsah KA. The use of religious capital as a coping strategy in self-care by type 2 diabetes patients in a Ghanaian hospital. J Relig Health. 2023;62(6):4399–4416. https://doi.org/10.1007/s10943-022-01722-2
31. Almaqhawi A, Hayim EA, Amer FAA, Almuhanna S, Khteeb NAA, Khwajah SHA. Use of complementary and alternative medicines among diabetic patients in Al Ahsa, Saudi Arabia: a cross-sectional study. Mater Sociomed. 2023;35:256–63. https://doi.org/10.5455/msm.2023.35.256-263.
32. Al-Luwaym AH, Al-Quwaidhi AJ, Al-Ghadeeb RB. Prevalence and factors associated with using complementary medicine among adults with type 2 diabetes in primary healthcare centers of Al-Ahsa, Eastern Saudi Arabia. Cureus. 2024;16:e67953. https://doi.org/10.7759/cureus.67953.
33. Özkan İ, Taylan S, Polat Dünya C. Relationship between complementary alternative medicine use and illness perception in patients with diabetic foot ulcer. J Tissue Viability. 2022;31:637–42. https://doi.org/10.1016/j.jtv.2022.08.005.
34. Tehrani H, Dadashi N, Movahedzadeh D, Khorasani EC, Jafari A. Predictors of complementary and alternative medicine use among type 2 diabetes patients based on the health belief model. J Diabetes Metab Disord. 2022;21:285–92. https://doi.org/10.1007/s40200-022-00971-y.
35. Ardakani BY, Mobarakian M, Bahrevar V, Zareipour MA, Kazemi S, Ardakani MF. Determinants of use acceptance of herbal medicine: a theory of planned behavior investigation among type 2 diabetes. Iran J Diabetes Metab. 2024;24:92–101
36. Shreffler-Grant J, Nichols EG, Weinert C. Community-based skill building intervention to enhance health literacy among older rural adults. West J Nurs Res. 2021;43:668–76. https://doi.org/10.1177/0193945920958014.
37. Weinert C, Nichols E, Shreffler-Grant J. Be Wise: a complementary and alternative medicine health literacy skill-building programme. Health Educ J. 2021;80:327–36. https://doi.org/10.1177/0017896920974060.
38. Chang H, Mao P, Huang C. Nurse-led shared decision-making on complementary therapy use by patients with diabetes: a participatory action research. J Clin Nurs. 2023;32:6310–21. https://doi.org/10.1111/jocn.16718.
39. Meherali S, Punjani NS, Mevawala A. Health literacy interventions to improve health outcomes in low- and middle-income countries. Health Lit Res Pract. 2020;4:e251–66. https://doi.org/10.3928/24748307-20201118-01.
40. Weydmann N. The recovery of healthcare: a case study of Javanese medical practices and related discussions about pluralism in healthcare. Vis Sustain. 2020;14:66–82. https://doi.org/10.13135/2384-8677/4561.
41. Liem A. "I've only just heard about it": complementary and alternative medicine knowledge and educational needs of clinical psychologists in Indonesia. Medicina (Kaunas). 2019;55:333. https://doi.org/10.3390/medicina55070333.