PURmgmt: A Culturally Tailored Digital Intervention for High-Purine Diet Management in China

Yibo Meng, Bingyi Liu, Zhihao Lei, Zhiming Liu, Zhefang Hu

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Abstract

Background: High-purine diets are prevalent in traditional Chinese cuisine, and excessive purine intake is strongly associated with an increased risk of gout and hyperuricemia. In China, particularly among populations with lower socioeconomic status and in coastal provinces such as Guangdong, Shandong, and Zhejiang, managing purine consumption is challenging due to low nutritional awareness and the cultural prominence of purine-rich foods like seafood, organ meats, and broths.

Objective: This study aimed to develop and evaluate a culturally tailored mobile health (mHealth) application, PURmgmt, designed to support users in regulating purine intake and reducing hyperuricemia- and gout-related risks.

Methods: The study was conducted in two phases. First, an exploratory qualitative study involving semi-structured interviews (N=110) was carried out to identify user challenges and needs, which informed the design of PURmgmt. Second, a 100-day controlled trial (N=20) was conducted to assess the feasibility, user acceptance, and preliminary efficacy of the app.

Results: Participants in the intervention group significantly reduced their average daily purine intake from 850.5 mg to 403.5 mg and showed marked improvements in knowledge related to purines and hyperuricemia. In contrast, the control group exhibited no significant changes. User feedback indicated high satisfaction with the app's usability and culturally adapted features.

Conclusions: PURmgmt demonstrates potential as an effective digital tool for purine intake management in China. The results underscore the value of culturally sensitive design and contextualized nutritional guidance in promoting sustainable dietary behavior change. Further large-scale and long-term studies are warranted to validate these findings.

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Trial Registration: Not applicable.

Keywords: purine intake; gout prevention; digital health intervention; mHealth; culturally adaptive design; hyperuricemia; China

Introduction

High-purine diets are an essential part of Chinese culinary culture, particularly in traditional dishes that include seafood, organ meats, and rich meat broths. Such diets are significantly associated with an increased risk of gout and hyperuricemia [1, 7]. The prevalence of gout in China has been rising steadily; according to a nationwide epidemiological study analyzing data from 1990 to 2019, the age-standardized prevalence rate (ASPR) of gout in 2019 reached 12.3% among adult males and 3.9% among females, both significantly higher than the global average and demonstrating a clear upward trend over time [26]. The prevalence of hyperuricemia is even higher, reaching up to 14% [25, 11].

Interviews suggest that this phenomenon is closely related to the general lack of public awareness in China about hyperuricemia and the purine content of foods. Previous data and our survey indicate that only 10% of adults understand the pathogenesis of gout, and merely 15% are aware of the connection between hyperuricemia and gout, the causes of hyperuricemia, and the health risks of

high-purine foods. Most people are unable to accurately identify commonly consumed high-purine foods [1, 21, 2].

Digital health interventions have shown promising potential in modifying dietary behaviors. For example, the Healthy Eating Advisor app in Saudi Arabia has demonstrated notable success in addressing gout- and red meatrelated health issues, resulting in increased public awareness and dietary adjustments among patients [2]. Similarly, educational mini-programs for hyperuricemia in Chinese communities have shown measurable improvements in health knowledge and behavior change among patients with diabetes [21]. Supplement tracking systems developed under USDA/NIH collaborations have bridged data gaps in nutritional guidance, offering personalized dietary health insights [13]. However, existing purine management tools are primarily based on Western dietary contexts and are limited in their applicability to Chinese users. For instance, the US app “Purity - Gout Diet Management
” [15] and the UK program “Low Purine” [22] do not include common high-purine Chinese foods such as hot pot broth and animal organs.

Moreover, these tools are often mismatched with the general lack of health literacy among the Chinese population. To address these challenges, we developed PURmgmt, a purine management application tailored specifically to the Chinese dietary context. The goal is to support sustainable purine intake regulation through personalized and culturally adaptive design, thereby reducing the risk of hyperuricemia-related conditions.

User Study

Research Objectives

This study aims to investigate the Chinese public’s (especially vulnerable populations such as those from underdeveloped regions and with limited education) understanding of hyperuricemia, gout, and high-purine diets. It also explores the challenges they face in managing purine intake and their expectations for digital health interventions.

Methods

Participants

We recruited 110 participants from various regions in China, including 53 male participants (with a nearly equal gender distribution). Ages ranged from 18 to 60 years (mean = 43.22, SD = 19.66), with a balanced distribution between urban and rural areas (52 participants from urban regions). Seventeen participants (15.45%) held a university degree or higher, aligning closely with the national average reported by the National Bureau of Statistics [16].

Procedure

Participants engaged in approximately 40-minute semi-structured interviews conducted via Zoom, Tencent Meeting, or in-person. The interviews covered their understanding of purines, perceptions of the health risks associated with high-purine diets, and personal challenges in achieving balanced eating patterns. All interviews were conducted in participants’ native languages, audio-recorded with consent, and fully transcribed. Using a top-down thematic analysis approach, we identified relevant perceptions and experiences, with a particular focus on events situated in traditional Chinese dietary culture. All interview content was translated into English for inclusion in this paper.

Findings

Low Awareness of Health Concepts

Interviews revealed limited understanding of “hyperuricemia” and “gout.” Only 11 participants demonstrated accurate knowledge, with 17 higher-educated individuals performing somewhat better (e.g., Participants 17 and 19 correctly described purines as metabolized into uric acid and identified highpurine foods such as organ meats and seafood). Misconceptions persisted; for instance, Participant 17 confused “high-purine” with “high-protein.” Even the most informed lacked awareness of long-term consequences, focusing on short-term pain rather than chronic organ damage (e.g., Participants 17, 104, 107).

Most without higher education—especially from low-income backgrounds—showed minimal understanding (≈ 67% of respondents), often mistaking gout for arthritis or injury-related conditions (e.g., Participants 7, 11, 13, 14, 23, 25, 34, 35, 67, 77, 79). Some vaguely linked diet to gout but could not articulate the mechanism (e.g., Participants 35, 47). Fifteen had never heard the terms, though some described gout-like symptoms. Others had heard of them but lacked meaningful knowledge, often due to limited medical information access. Misinformation was common; for example, Participant 102 reported drinking beer during an attack, believing it alleviated pain, despite beer being a major trigger [9].

Challenges in Reducing High-Purine Intake

Even informed participants faced three main barriers: **1) Cultural dietary norms:** Traditional high-purine foods (e.g., regional dishes, hot pot) are deeply embedded in social contexts. Avoidance may be viewed as disrespectful (Participant 21), and some believe in “eat what you lack” (Participant 67). **2) Difficulty in obtaining and interpreting information:** Many struggled to identify high-purine foods due to conflicting or unclear advice (Participant 22) and low health literacy (Participant 97). **3) Lack of personalized recommendations:** Generic advice was impractical (e.g., lychee substitution; Participant 89), while economic constraints made healthy alternatives costly. Participants from poorer areas reported frequent consumption of cheap organ meats (Participants 19, 29, 31, 33, 35, 36, 27, 55, 57, 58, 76, 78, 79, 87).

Expectations for Digital Health Tools

Most (85/110) welcomed simple, culturally relevant digital tools for identifying high-purine foods and managing diets. Participant 17 noted foreign apps lacked Chinese food items. Desired features included meal tracking and peer support. A few, mainly older adults from disadvantaged backgrounds, feared complexity and usability issues.

Design Principles

Based on the findings, we propose the following design principles for purine intake management tools in the Chinese context:

1. Visualized and simplified health information. Use intuitive explanations to communicate complex concepts related to hyperuricemia and purine metabolism.

2. Food lookup and personalized suggestions. Provide accurate, timely food evaluations and tailored recommendations based on geographic, economic, and dietary context.

3. Gradual behavioral support. Offer progressive guidance to build healthier habits without rigidly restricting cultural food preferences.

4. Social support and interaction. Create community platforms to encourage peer engagement and emotional reinforcement.

System Design

Design Objectives

Based on user research findings, we developed the PURmgmt mobile application to support users in managing purine intake and controlling blood uric acid levels through culturally tailored long-term dietary interventions. The specific goals include:
1. Cultural Adaptation: Support common Chinese dietary scenarios such as hotpot and regional cuisines.
2. Low-Barrier Interaction: Ensure accessibility for users of varying education levels, especially rural and elderly populations.
3. Personalized Support: Provide dynamic recommendations based on region, economic status, and health conditions.
4. Gamified Management: Engage users through lively and friendly interfaces.
5. Social Collaboration: Encourage peer support through community interaction.

Functional Modules

PURmgmt offers culturally adaptive, personalized, and accessible support for purine intake management through three core components: health education, dietary management assistance, and community interaction (Figure 1).

Figure 1. Main interface with core functions (health education, dietary management, community) and “Go” tutorial button.

Health Knowledge Education

This module provides accessible content on hyperuricemia and gout, including causes, risks, and their relationship (Figure 2), delivered via images, videos, and animations tailored to users’ literacy levels. A multimodal AI Q&A answers questions such as “Why does beer cause gout?” or “How can I avoid flare-ups?” To counter widespread misinformation, the “Myth Buster” feature visually debunks beliefs like “eating what ails you,” and supports dialectal inputs (Cantonese, Wu, Minnan).

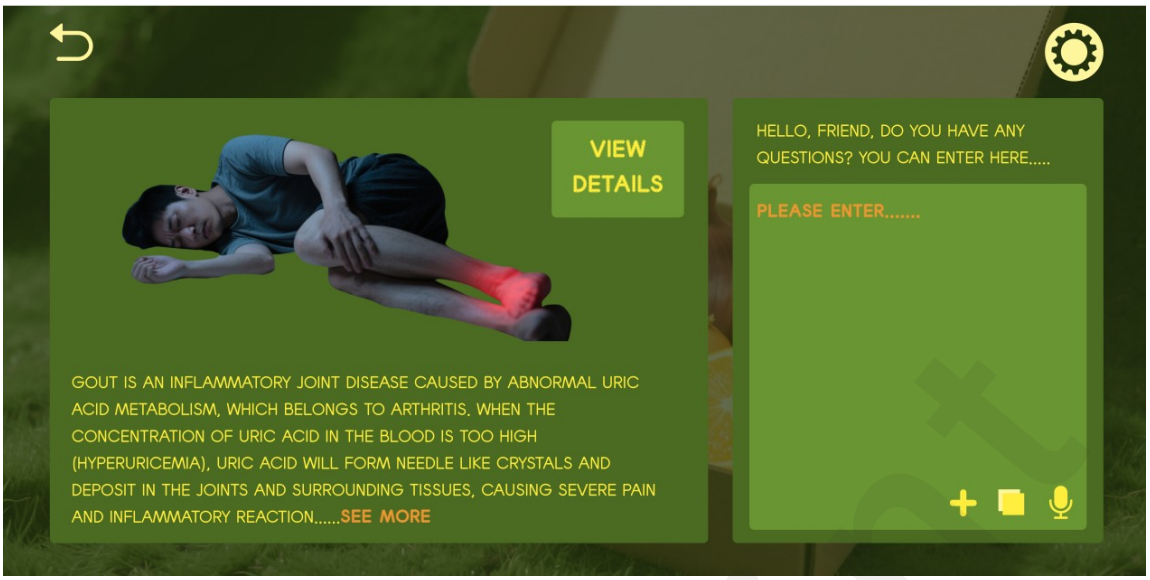

Figure 2. Health education interface showing gout symptoms (left) and AI chat for queries (right).

Dietary Management Assistance

Comprising three sub-functions: (1) High-Purine Food Recognition (Figure 3), where users input food via text, voice, or images to receive purine content per 100g, classification, and guidance. The database covers 1,000+ dishes from 23 provincial cuisines, with high-risk foods flagged in red. (2) Personalized Dietary Recommendations generate meal plans based on region, habits, and budget (Figure 4–6), accommodating cultural elements (e.g., regional substitutions, holiday dishes) and producing shopping lists. (3) Purine Intake Tracking (Figure 7) logs meals manually or via barcode/photo, calculates total intake, and flags overconsumption, visualizing thresholds from blue (< 50%) to dark red (> 100%).

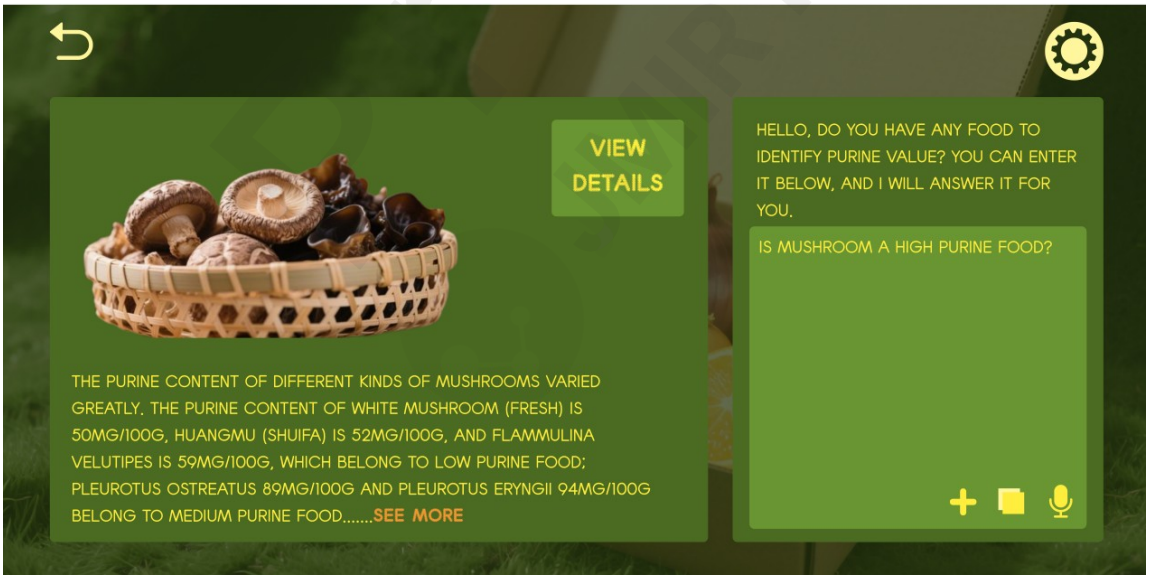

Figure 3. High-purine food identification via text, voice, or image input; example shows mushrooms.

Figure 4. User inputs details (age, gender, region, preferences) for personalization.

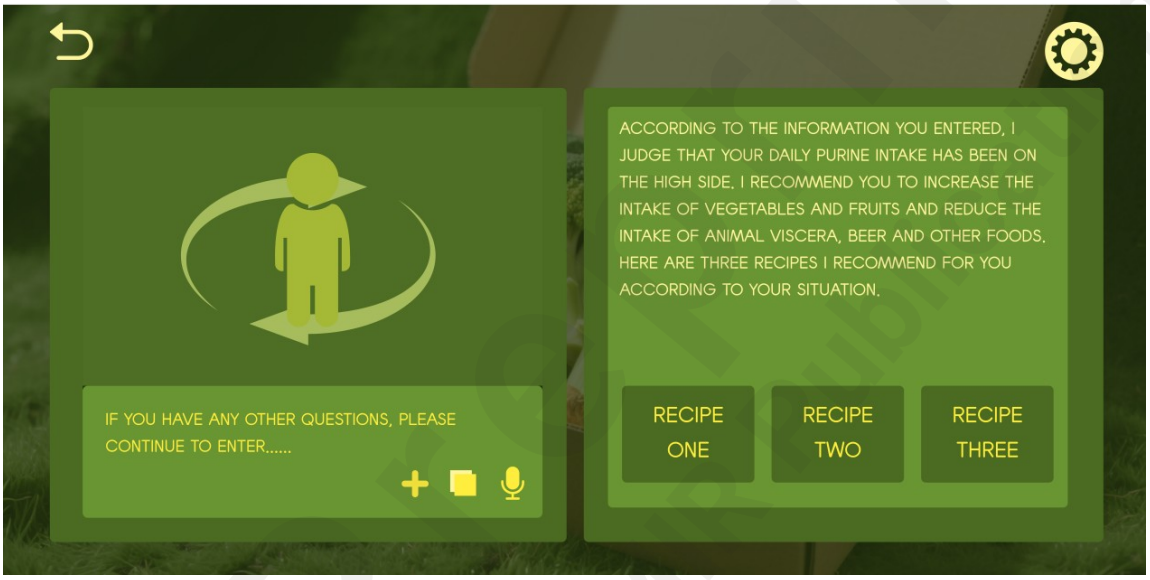

Figure 5. System provides tailored advice with three recommended meal plans.

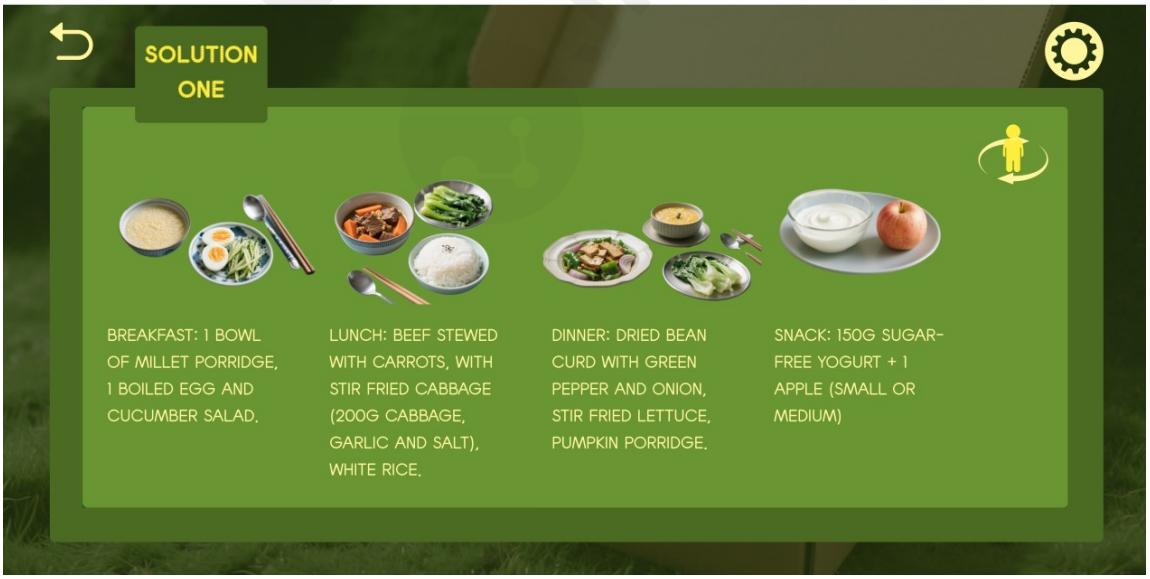

Figure 6. Users browse recipes and ask follow-up questions.

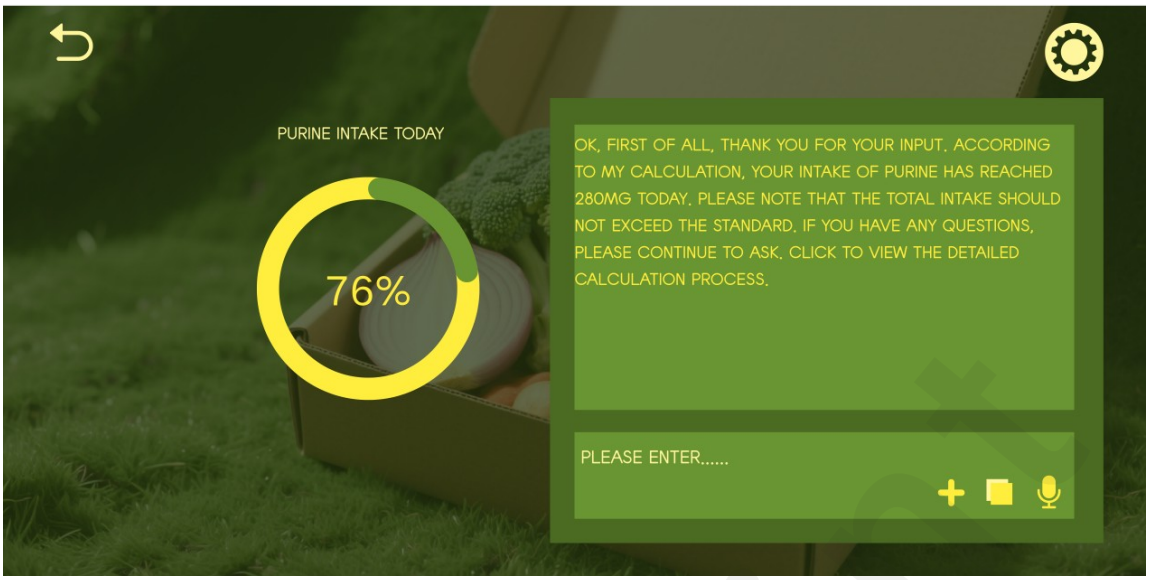

Figure 7. Purine intake tracking interface: users log meals (left) and see a circular chart of intake vs. recommended allowance.

Community Interaction

The social module (Figure 8) supports sharing dietary experiences, success stories, and custom recipes, enabling discussions and peer learning.

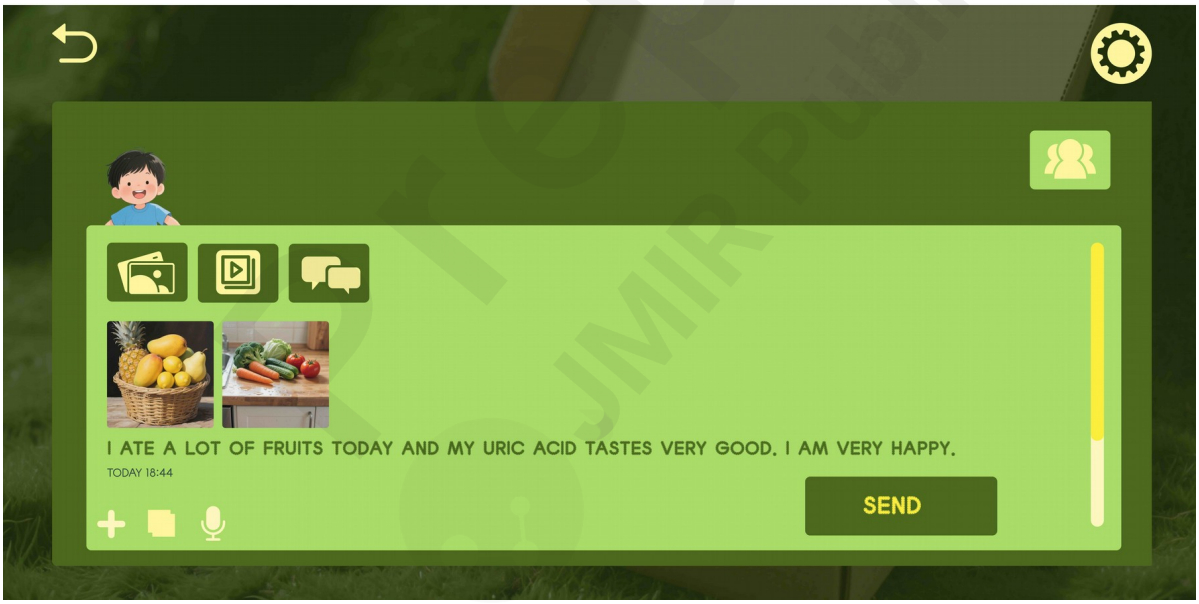

Figure 8. Social interaction interface: users share/read posts in voice, image, or text, supporting mutual engagement.

Feedback and Optimization Mechanism

PURmgmt gathers user feedback on experience, suggestions, and content. Backend metrics (e.g., retention, feature usage) guide iterative improvements to functionality and user experience.

Technical Architecture

The PURmgmt system adopts a modular design combining cross-platform frontend, hybrid backend services, and lightweight AI modules for food recognition and health Q&A. Figure 9 illustrates system components and data flows.

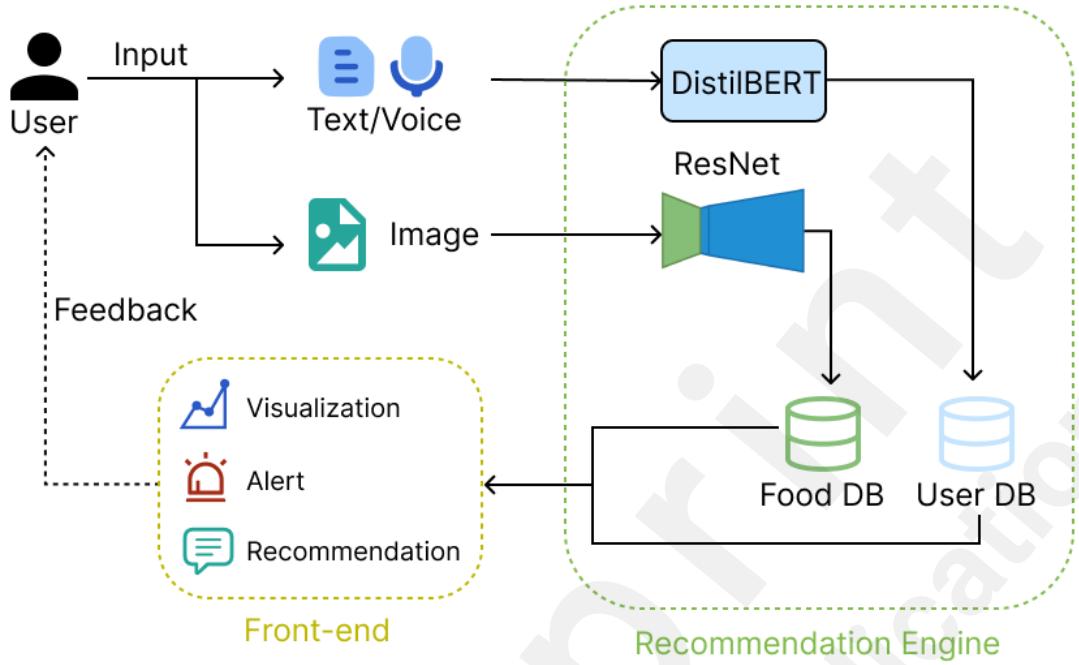

Figure 9. System architecture of PURmgmt.

Frontend–Backend Architecture and Data Storage

The frontend uses SwiftUI (iOS), Jetpack Compose (Android), and Flutter for shared components [19]. The backend combines Django (user and recommendation logic) and Spring Boot (business APIs) [6]. Structured data are stored in MySQL; logs and feedback use MongoDB [3]. Redis caches high-frequency queries to enhance responsiveness [5].

Food Image Recognition and Purine Estimation

A ResNet-based CNN [12], fine-tuned on 12,000 images of 1003 Chinese dishes, achieves 93.2% accuracy. Data augmentation simulates regional traits like Sichuan's oily red and Cantonese light tones. On-device inference via PyTorch Mobile enables real-time purine estimation per 100g. A two-stage pipeline handles compound dishes: ResNet-34 classifies the dish, then a modified Mask R-CNN segments ingredients to build a component-level purine matrix.

Natural Language Q&A and Knowledge Guidance

The Q&A module uses DistilBERT [18], adapted via a purine QA corpus and domain vocabulary. A knowledge graph boosts entity understanding, achieving 0.93 F1 on NER. A Conformer-based ASR handles dialects, with 4.7% WER on Cantonese and 7.5% on Wu. Cross-modal attention aligns visual and textual inputs, improving food recognition by 5.2%.

Personalized Recommendation Engine

A hybrid engine blends content-based (0.4), collaborative (0.3), and contextaware filtering. Cold-start users are bootstrapped by location and socioeconomic data. Similarity is computed via modified Jaccard; MMR ($\lambda = 0.7$) balances relevance and diversity. A/B tests show CTR improvement from 31.5% to 45.7%.

Knowledge Push and Stress Regulation

A reinforcement learning-based push engine adapts content and timing, with rewards based on CTR (0.7) and knowledge gain (0.3). User knowledge is modeled via item response theory ($a = 1.2$). A "Purine Anxiety Index," based on query frequency and alerts, triggers calm visualization mode when above 0.8.

Behavior Visualization and Notifications

Data processing uses Pandas, with Matplotlib/Seaborn for visualization [24]. Reminders and tips are pushed via Firebase Cloud Messaging (FCM) [10] to support behavior change.

Deployment and Security

The backend runs on Alibaba Cloud via Docker and Kubernetes [20]. Data security includes federated learning and differential privacy ($\varepsilon = 0.5$). Communications use SSL/TLS; dietary logs are AES-256 encrypted. Role-based access and OWASP audits are enforced. Weekly updates and quarterly retraining maintain model performance while preserving privacy.

Evaluation

Evaluation Objectives

We designed the evaluation with three key objectives: (1) to assess the effectiveness of PURmgmt in enhancing users' health knowledge related to hyperuricemia, gout, and high-purine diets; (2) to evaluate the system's impact on motivating users to actively regulate their purine intake; and (3) to assess usability and user experience.

Methods

A controlled trial was conducted with two groups: an intervention group using PURmgmt and a control group without intervention. The scenario of participants using our PURmgmt system is illustrated in Figure 10.

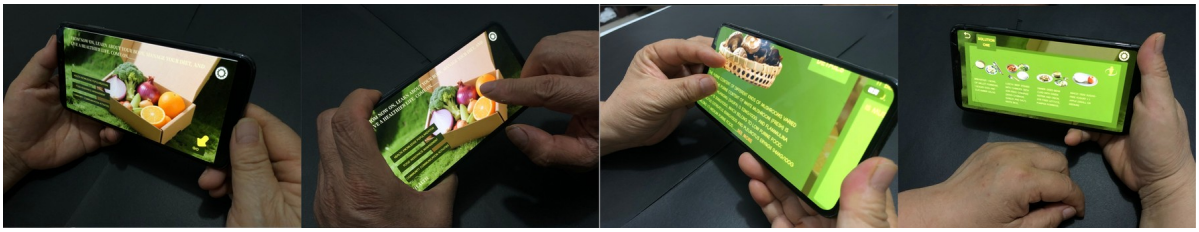

Figure 10. Interaction scenario between a user with hyperuricemia and the PURmgmt system.

Participants

Twenty individuals who regularly consumed high-purine diets were recruited, with a gender ratio of 11 males to 9 females, aged 25–55. We cooperated with the School of Medicine of Zhengzhou University, and professional doctors from Zhengzhou University conducted basic health literacy assessments on the subjects. Based on the health literacy assessments, the subjects were divided into an experimental group and a control group, with 10 people in each group, to ensure that the health literacy of the two groups was basically similar.

Procedure

1. All participants completed a purine- and uric-acid-related knowledge questionnaire (max score = 5). Based on the scores, they were divided into two groups with equal average pre-test scores. The purine and uric acid knowledge questionnaire was derived from the “Hyperuricemia and Gout Patient Knowledge Questionnaire” recommended by the Rheumatology Branch of the Chinese Medical Association. The questions in this questionnaire were modified by the cooperating doctors and translated into a language that is easier for patients to understand. Some purely medical knowledge questions that are not closely related to patients were deleted by the doctors. Finally, 20 questions were retained, namely: (1) basic knowledge; (2) dietary management; (3) treatment compliance; and (4) understanding of complications.
2. Daily purine intake and blood uric acid concentration were recorded for all participants (T0).
3. The intervention group used PURmgmt in daily life for 20 days, while the control group received no digital support.
4) At Day 20 (T1), the knowledge questionnaire, purine intake, and uric acid concentration were repeated.
5) At Day 80 (T2), the same evaluation was repeated.
6) Participants in the intervention group completed the SUS questionnaire and participated in a follow-up interview [4].

Ethical Considerations

Ethical approval for this study was obtained from the university’s ethics committee. All participants were informed of the procedures and the purpose of data collection. Data were anonymized and destroyed after analysis. No compensation was provided.

Results

Knowledge and Daily Purine Intake

Table 1. Mean ± SD at each time point for each group. SUA: serum uric acid.

Measure	Group	T0 (Baseline)	T1 (Mid)	T2 (End)
Knowledge score				
	Intervention			
		36.3±7.26	67.3±9.29	86.5±5.87
	Control			
		36.3±6.62	36.5±5.06	36.8±6.66
Purine intake (mg/day)				

	Intervention			
		1010.7±152.0	721.9±155.1	620.0±100.0
	Control			
		1007.3±149.2	996.6±169.1	1005.1±132.9
SUA (μmol/L)				
	Intervention			
		452.5±78.47	410.3±90.58	381.5±82.99
	Control			
		470.0±43.58	476.6±56.37	460.8±71.53

The results in Table 1 summarize descriptive statistics for each outcome by group and time. At baseline (T0), both groups had identical knowledge scores (Intervention: M = 36.3, SD = 7.26; Control: M = 36.3, SD = 6.62), comparable daily purine intake (Intervention: M = 1010.71, SD = 152.02 mg/day; Control: M = 1007.31, SD = 149.20 mg/day), and similar serum uric acid levels (Intervention: M = 452.53, SD = 78.47 μ mol/L; Control: M = 469.96, SD = 43.58 μ mol/L).

By Day 20 (T1), the intervention group improved markedly in knowledge (M = 67.3, SD = 9.29) and reduced purine intake (M = 721.93, SD = 155.11) and uric acid (M = 410.33, SD = 90.58), while the control group showed little change. By Day 80 (T2), the intervention group reached the highest knowledge scores (M = 86.5, SD = 5.87), lowest purine intake (M = 619.98, SD = 100.03), and further uric acid reduction (M = 381.5, SD = 82.99), with the control group remaining stable.

Table 2. Mixed-design repeated measures ANOVA results

Measure	Effect	F	p	Partial η^2
Knowledge score				
	Group			
		80.63	< 0.001	0.69
	Time			
		276.48	< 0.001	0.94
	Group×Time			
		266.04	< 0.001	0.94
Daily purine intake				
	Group			
		73.17	< 0.001	0.67
	Time			
		49.01	< 0.001	0.73
	Group×Time			
		46.61	< 0.001	0.72
Serum uric acid level				
	Group			
		50.53	< 0.001	0.58
	Time			
		11.15	0.0002	0.38
	Group×Time			

		7.34	0.0021	0.29

Mixed-design repeated measures ANOVA results (Table 2) confirmed significant main effects of Group and Time, and significant Group × Time interactions for all three measures ($p < 0.01$). This indicates that the intervention and control groups changed differently over time.

Table 3. Summary of significant pairwise t-tests (Bonferroni corrected)

Measure	Comparison	Mean diff. (95% CI)	Adj. p	Effect size
Knowledge score				
	Intervention T1 (Mid) vs. T0 (Baseline)			
		+31.0 (27.0, 35.0)	< 0.001	5.72
	Intervention T2 (End) vs. T0 (Baseline)			
		+50.2 (46.5, 53.9)	< 0.001	7.23
	Intervention T2 (End) vs. T1 (Mid)			
		+19.2 (14.3, 24.1)	< 0.001	3.36
	T1 (Mid) Intervention vs. Control			
		+30.8 (20.3, 41.4)	< 0.001	3.94
	T2 (End) Intervention vs. Control			
		+49.8 (44.3, 55.3)	< 0.001	7.58
Daily purine intake				
	Intervention T0 (Baseline) vs. T1 (Mid)			
		–288.8 (–390.1, –187.5)	< 0.001	5.82
	Intervention T0 (Baseline)			

	vs. T2 (End)			
		–390.7 (–504.7, –276.7)	< 0.001	4.75
	Intervention T1 (Mid) vs. T2 (End)			
		–101.8 (–187.8, –15.7)	0.017	1.14
	T1 (Mid) Intervention vs. Control			
		–274.7 (–470.6, –78.7)	0.004	–1.62
	T2 (End) Intervention vs. Control			
		–385.1 (–558.4, –211.9)	< 0.001	–3.14
Serum uric acid level				
	Intervention T0 (Baseline) vs. T1 (Mid)			
		–42.3 (–64.7, –19.9)	< 0.001	2.03
	Intervention T0 (Baseline) vs. T2 (End)			
		–71.0 (–91.5, –50.5)	< 0.001	2.75
	Intervention T1 (Mid) vs. T2 (End)			
		–28.7 (–46.7, –10.7)	0.002	1.62

Post-hoc Bonferroni-corrected t-tests (Table 3) revealed that, for knowledge scores, the intervention group significantly improved from T0 to both T1 and T2 ($p < 0.001$) and scored higher than the control group at both follow-ups. For daily purine intake, the intervention group significantly reduced intake from T0 to T1 and T2, with further reduction from T1 to T2, and had significantly lower intake than the control group at T1 and T2. For serum uric acid, the intervention group showed significant within-group reductions over time, although between-group differences were not statistically significant.

Overall, these findings suggest that the PURmgmt application led to substantial gains in knowledge, effective and sustained purine intake reduction, and measurable physiological improvements compared to no intervention (Figure 11-13).

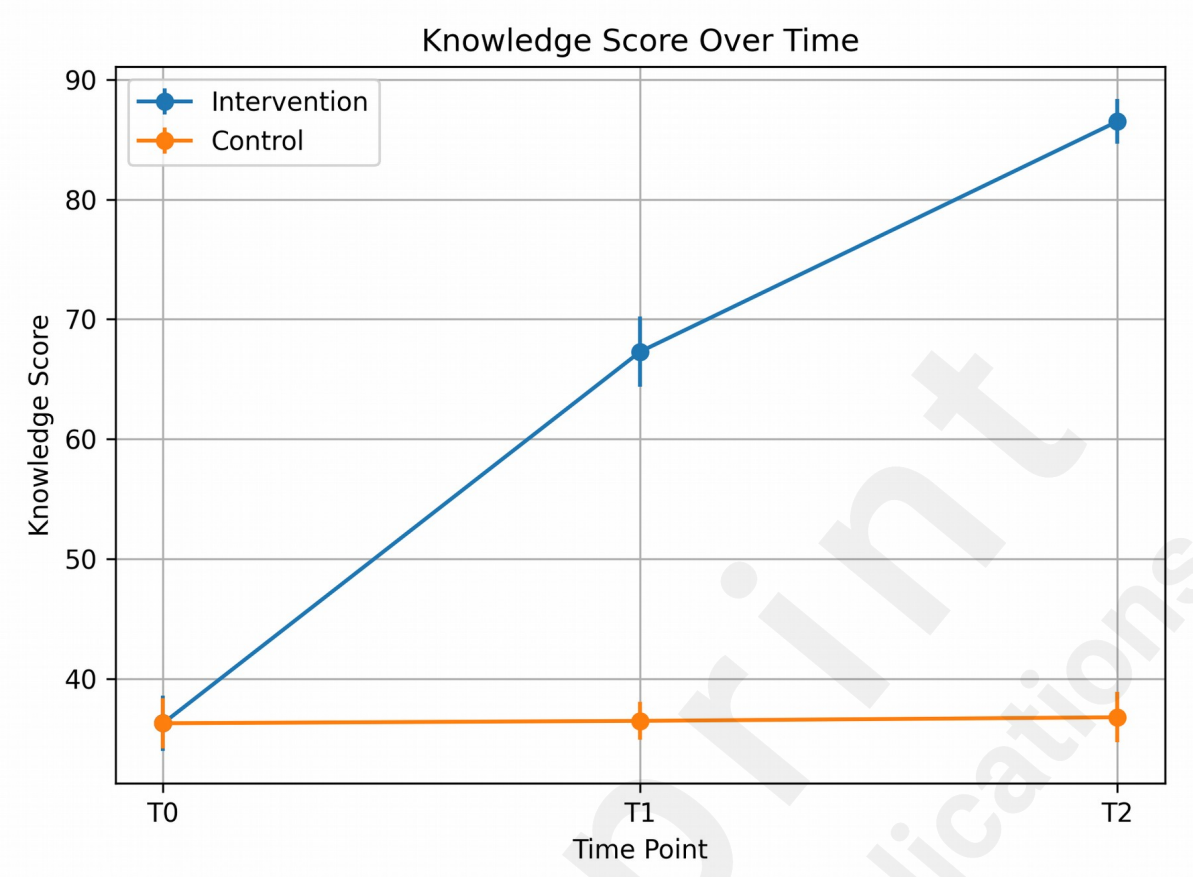

Figure 11. Change in knowledge score over time for intervention and control groups. Error bars represent standard errors.

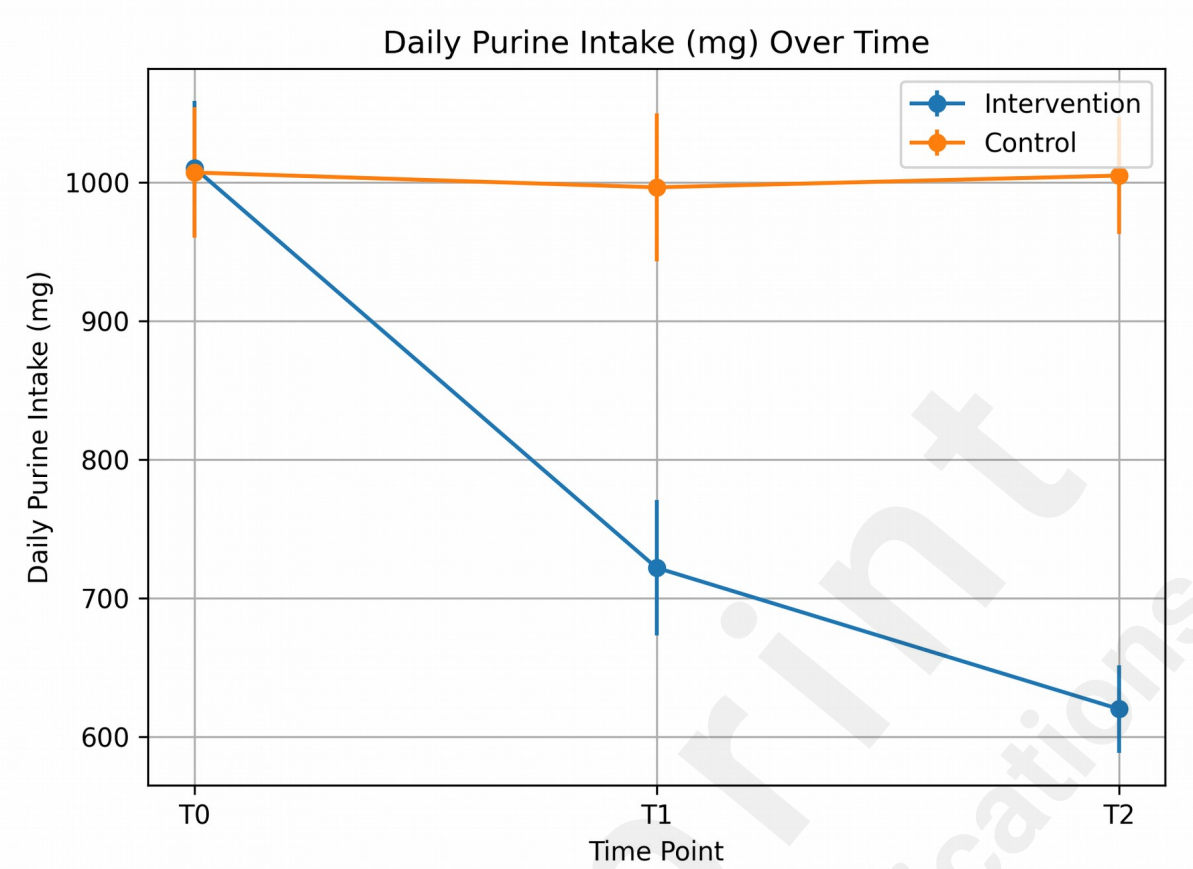

Figure 12. Change in daily purine intake over time for intervention and control groups. Error bars represent standard errors.

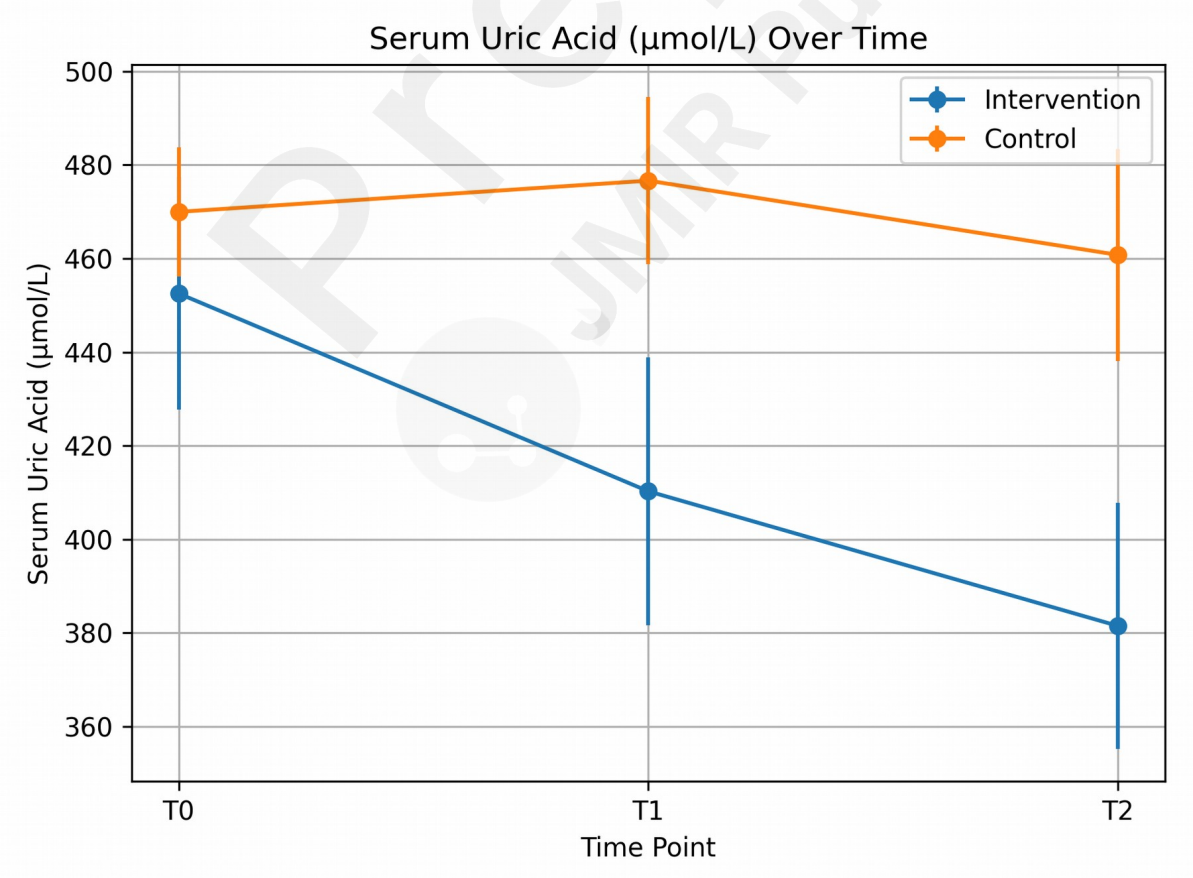

Figure 13. Change in serum uric acid over time for intervention and control groups. Error bars represent standard errors.

System Usability Scale (SUS)

Table 4. SUS scores for PURmgmt

SUS Statement	Score
I think that I would like to use this system frequently.	4.7
I found that the system was not unnecessarily complex.	4.6
I thought the system was easy to use.	4.6
I think that I would need not the support of a technical person to be able to use this system.	4.7
I found the various functions in this system were well integrated.	4.8
I thought there was not too much inconsistency in this system.	4.5
I would imagine that most people would learn to use this system very quickly.	4.7
I think this system interaction is interesting.	4.8
I felt very confident using the system.	4.8
Overall	*4.7*

At the study's end, participants completed the SUS to assess PURmgmt's usability. As shown in Table 4, the system received high ratings across aspects such as ease of use, confidence, and integration, with an average score of 4.7/5—indicating strong usability and user satisfaction.

User Feedback

Interviews showed high overall satisfaction among intervention group participants. Participants 1, 3, 4, 5, 7, 8, and 9 reported "no major flaws." Participants 3 and 4 highlighted the health education module's impact. Participant 4 said: "I really liked the 'Myth Buster' section. Honestly, it was eye-opening. I've had gout for many years, and I used to drink bone broth obsessively, thinking it would cure me. Looking back, I was just making things worse." (Note: Bone broth is high in purine and not recommended for gout sufferers.)

Participant 7 valued the dietary assistance feature: "I didn't have to search manually anymore—I just asked the system. It gave me food suggestions based on what's available in my city and what I don't dislike eating. That's really, really important to me." Participant 9 praised food recognition: "I could just take a picture, and it calculated the purine level for many dishes... For Mapo Tofu, the system already knows how to estimate the purine content of tofu, minced pork, and sauce—it would be too complicated to do all that myself."

Participants 2 and 10 noted the underdeveloped community module, likely due to the small trial group. Participant 2 said: "Since there were only ten of us in the group, the social features didn't really serve much purpose... Maybe once PURmgmt is adopted on a larger scale, it will work much better."

Participants 1 and 3 reported occasional slow responses. Participant 1 noted: "I'm pretty sure it

wasn’t a network issue—overall, the system just responded sluggishly. Once, I had to wait almost ten seconds for it to move to the next screen.”

Participants 10 and 4 also cited incomplete recipe data. Participant 10, from Tibet, said: “I wanted to know the purine content of butter tea... but I couldn’t find it in the database. I had to break it down into butter, flour, etc., and estimate the purine content manually.”

Finally, the “Daily Purine Tracker” caused stress for some users. Participant 7 said: “I kept checking the number... I felt so stressed—I was afraid to eat anything because I thought the number would just keep rising.”

Discussion

Contributions of PURmgmt

Our findings show that PURmgmt effectively supported users in managing purine intake, with improvements observed in knowledge, dietary behavior, and serum uric acid levels—consistent with prior digital health studies [2]. The app’s culturally tailored design, including a database of high-purine Chinese dishes and regional language input, addressed key barriers to dietary behavior change [17].

In particular, the “myth-busting” feature helped correct common misconceptions, demonstrating the potential of digital interventions to reshape health beliefs. The high System Usability Scale (SUS) scores and multimodal interaction features (voice, image, and text) further lowered usage barriers, especially for users with limited health literacy [23].

Limitations of PURmgmt

Observed Limitations in the Current Study

The current evaluation revealed several limitations. First, the social module saw limited engagement, largely due to the small participant pool and repetitive content [8]. Second, the short study duration (< 100 days) restricts our ability to draw conclusions about long-term behavior change [27]. Third, some users—particularly older adults—found daily food logging burdensome. Future work should explore more automated logging approaches, such as enhanced food photo recognition or voice journaling, to improve accessibility [14].

System-Level Insights from User Feedback

In addition to the observable usage limitations, in-depth feedback revealed deeper behavioral challenges. Several users expressed anxiety caused by the real-time purine tracking, indicating that constant numerical feedback could induce stress. To address this, we have optimized the recommended purine intake range based on physician input and are currently developing personalized adaptation algorithms to provide a gentler user experience.

Furthermore, we plan to introduce flexible tracking schedules (e.g., every 2 days, 4 days, or weekly) to reduce pressure and support sustainable engagement. These changes reflect a broader insight: PURmgmt should act not as a warning system, but as a supportive dietary advisor. This reframing aligns with user preferences for encouragement and autonomy over compliance enforcement.

Limitations in Experimental Scope and Generalizability. This paper presents formative research on a culturally tailored digital intervention. Given the early development stage of PURmgmt, we intentionally limited the randomized controlled trial to a small sample and short duration to prioritize safety and feasibility. While preliminary outcomes are encouraging, they require validation through broader trials.

We plan a large-scale multicenter randomized controlled trial across China, involving 500–1500 participants from diverse socioeconomic and geographic backgrounds. In addition, a one-year longitudinal study will be conducted to assess long-term indicators such as sustained health literacy gains, dietary behavior stabilization, adherence, and physiological impact. These studies aim to verify PURmgmt's effectiveness in real-world, culturally diverse environments.

Future Work

Enhancing Data Coverage and Computational Performance

According to user feedback from qualitative interviews, although PURmgmt already includes a wide range of common Chinese dishes, there remain many types of food not yet integrated into the system. This absence poses challenges for users when attempting to calculate purine content. Therefore, future iterations of PURmgmt should aim to expand its food database. Additionally, the system's computational efficiency should be improved to enable faster and smoother access for users.

Improving User Interaction and Feedback Mechanisms

Quantitative results indicate that by the end of the experiment, some participants' daily purine intake had dropped slightly below the recommended range for the general population. For instance, Participant 7 recorded a final daily intake of 532.2 mg, which is lower than the typical recommendation of 600–1000 mg/day. Although this level may still be appropriate for individuals with high-purine diets or hyperuricemia, qualitative interviews revealed that this participant was not a severe hyperuricemia case and all of his health indicators were within normal range. However, he still expressed daily anxiety about overconsumption of purines. This suggests that PURmgmt should refine its recommendation ranges and interaction strategies to prevent unnecessary stress or misinformation, especially for general users without significant health risks.

Long-Term Effectiveness Studies

We plan to conduct longitudinal studies to evaluate the long-term impact of PURmgmt on users' purine intake control and overall health status. These studies aim to capture changes in user behavior, adherence, and potential challenges that may arise during prolonged use, thereby informing ongoing system improvements.

Conclusion

PURmgmt demonstrates an effective culturally adaptive digital intervention to support Chinese users in managing purine intake. It provides a scalable approach to increasing awareness and encouraging behavioral change in the context of high-purine diets. Experimental results validate its feasibility and effectiveness in reducing purine consumption, enhancing health knowledge, and improving dietary management, while also receiving high user satisfaction.

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