User Perceptions and Cultural Relevance of a HISS-Based Food Classification Mobile Application

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Article

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Abstract

High consumption of ultra-processed foods (UPFs) contributes to the growing burden of non-communicable disease, yet many consumers struggle to recognise and interpret levels of processing. Digital tools using artificial intelligence (AI) offer potential to support nutrition literacy and UPF awareness. This study explored user perceptions, usability and cultural relevance of a Human Interference Scoring System (HISS)-based mobile application designed to classify foods and support reflection on food quality and dietary choices. A qualitative study was conducted in New Zealand, where participants used the HISS app for three days followed by semi-structured interviews. Thirty-one participants were recruited via social media and word of mouth, including adolescents (n=13), tertiary students (n=9), and Māori and Pacific health coaches (n=9). Transcripts were analysed using inductive thematic analysis. Three evaluative categories were identified: positive user experiences (intuitive interface, perceived AI accuracy, enhanced nutrition literacy, visual feedback, inclusivity of cultural foods); challenges (technical issues, database gaps, limited depth for advanced users); and suggested improvements (expanded food database, enhanced logging, culturally tailored education, optional advanced features). Participants reported increased awareness of UPF intake and reflection on food choices. The HISS app was perceived as usable, acceptable and relevant across diverse user groups, particularly for those with lower nutrition literacy. Addressing technical limitations and expanding functionality may enhance engagement and applicability. AI-enabled, culturally responsive food classification tools such as HISS show promise as scalable health promotion approaches to support UPF awareness and dietary reflection in community and clinical settings.

Keywords: ultra-processed food (UPF); nutrition literacy; digital health tools; cultural relevance; HISS

Introduction

Ultra-processed food (UPF) consumption has increased globally, driving the growing burden of non-communicable diseases such as obesity, type 2 diabetes, and mental health disorders [1–3]. Addressing the public health challenges posed by UPFs requires innovative approaches and scalable tools that enhance nutrition literacy and empower individuals to make healthier dietary choices [4]. One promising strategy involves leveraging digital health tools to support awareness and self-monitoring, which are important precursors to behaviour change [5–9]. However, to ensure their effectiveness and accessibility, such tools must resonate with diverse user groups and accommodate cultural, social, and practical needs. While many nutrition apps focus on calorie/macronutrient tracking and some classify UPFs using barcodes and ingredient lists, fewer tools provide low-burden, photo-based feedback specifically designed to support food and nutrition literacy across diverse cultural food contexts.

In response to these challenges, researchers at Auckland University of Technology, developed a mobile application designed to classify food items. At the time of this study, the app operationalised the HISS (Human Interference Scoring System) framework [10], which represents an early-stage

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iteration of a broader programme of work focused on food processing–based dietary classification. By categorising foods into minimally processed, moderately processed, and ultra-processed/junk foods, the app provides users with insights into their dietary patterns, aiming to promote healthier choices. The underlying HISS framework was developed to address key limitations of existing food classification models, particularly the NOVA system [11–14], by integrating both processing level and health impact into a more intuitive and practical categorisation. Unlike NOVA, which rigidly classifies foods by degree of processing [15], HISS acknowledges that not all UPFs are inherently unhealthy and that some processed foods, such as wholegrain breads, yoghurts, and plant-based milks, can offer health benefits [16,17]. Rather than framing all UPFs as uniformly detrimental, HISS is intended to support practical nutrition literacy by helping users recognise patterns of discretionary, highly processed foods and shift towards minimally or moderately processed options where feasible. In addition, HISS incorporates well-established principles - widely agreed upon in nutrition science - such as categorising alcohol and confectionery as poor choices regardless of processing level. By prioritising real-world usability, HISS simplifies classification for users, recognising that expecting individuals to prepare all foods from scratch is unrealistic. This more balanced approach enhances nutrition literacy while promoting meaningful shifts toward healthier choices, rather than rigidly discouraging all processed options. Subsequent to this pilot work, the HISS framework has undergone further conceptual refinement, resulting in the CHIPS (Combining Health, Intuition, Processing and Science) framework [18]; however, the present study reports findings from the app during its HISS phase of development.

When using the app, users photograph all meals, snacks and beverages. The app then uses AI image recognition to provide HISS category classifications; it generates per-meal visual feedback in the form of a pie chart and a daily summary of category proportions. The app was developed and tested in New Zealand and was not publicly available at the time of this study. As an early-stage tool intended for broader dissemination in both research and practice, it is important to understand not only technical performance but also user experiences that may shape real-world acceptability and uptake. This qualitative companion study therefore examines user experiences to identify implementation barriers and design improvements to support equitable uptake. Accordingly, this manuscript complements the technical evaluation [19] by focusing on user perceptions, cultural relevance, and implementation considerations rather than quantitative performance testing. By doing so, it builds on evidence [5,6,8,9] that digital tools can support health literacy and self-monitoring, while identifying considerations required for equitable, real-world use.

Methods

Study design: This qualitative study explored user experiences, perceptions, and feedback on a food classification app based on the HISS framework. Participants used the app over a three-day period in December 2024, which included two weekdays and one weekend day, after which they participated in semi-structured group and individual interview sessions. Three distinct participant groups were selected based on their relevance to the study objectives. Ethical approval was granted by AUTEC, reference number 24/102 and all participants provided written informed consent prior to participation, with parental consent obtained for participants under 16 years of age.

The HISS framework: Following insights from a previous study [10] and an evaluation of limitations in classification systems like NOVA, the HISS framework was refined to improve accuracy and usability. Table 1 outlines the HISS framework applied within the app, with examples of foods in each category. Key adjustments included recognising that not all UPFs have negative health effects and moving beyond NOVA's rigid preference for homemade over store-bought in all circumstances. These refinements aimed to simplify classification for users and align with contemporary nutrition guidelines. The version of the framework described here reflects the HISS framework as implemented in the app at the time of this study. Further details on these modifications are available in Campbell et al. [19].

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Table 1. The Human Interference Scoring System (HISS) with examples of foods in each category.

Food groups and definition	Examples
1: Unprocessed and minimally processed whole foods. Raw and whole foods that were alive recently with little or no processing. Foods that are fresh, chilled, canned, frozen, or dried to enhance nutrients and freshness at their peak. Unprocessed foods are of plant and animal origin. Minimally processed foods are natural foods that are altered with removal of inedible or unwanted parts and preserved for storage.	Fruit and vegetables of all types including pure juices and pure smoothies (whether fortified or not) and dried fruit; red and white meats (beef, chicken, lamb, pork, venison) and fish including canned and smoked fish (where meat or fish are breaded or battered, count the meat/fish in group 1 plus a serving of bread coating/batter from group 2/3); eggs; all legumes (beans, chickpeas, lentils) either dried or canned; natto, tofu & tempeh; all nuts and seeds (including desiccated coconut and ground nuts/seeds but not candy coated nuts); honey; water (including soda water); herbs and spices; grains that were traditionally available to pre- industrial societies as whole kernels or groats (e.g., buckwheat groats, rye berries, millet, wheat berries, barley groats); tea, herbal tea and coffee (ground or instant but not pre-mixed sachets).
2. Processed foods Food products that were typically available for consumption in pre-industrial societies. Includes a wide variety of foods that may be domestically prepared or industrially prepared but that still resemble/ are recognisable as real foods. Foods may be processing (by culturing, preserving, heating etc.) or may be made by combining several ingredients from group 1 (e.g., lasagna- homemade or store bought). Other items that are widely regarded as being beneficial dietary supplements e.g., protein powder.	Dairy products including butter, most cheeses (hard, soft or cream cheese but not processed slices) cream, and yogurts; milk of all types (plant and animal); coconut creams; alternative dairy products such as coconut or soy yogurt; most breads including rye, brown, wholewheat, sourdough, pitta, baguettes etc. (not including cake like products such as crumpets, muffins, scones and croissants or sliced white bread/burger buns); bread coatings on e.g., meat/fish; processed grains including corn tortillas; pasta; couscous; pearl barley; rice; polenta; noodles (not instant); oats and oatmeal; muesli; granolas; simple one cereals including shredded wheat/puffed spelt or corn; kombucha; miso paste; soups; ready meals; nut and seed butters; hummus; pesto; aioli; pasta sauces; vegetable and seed oils of all types (flaxseed, sunflower etc.); animal fats (lard, butter); protein powders; processed meats (beef jerky, pastrami, ham, bacon).

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3: Ultra processed and junk foods a) Industrially prepared items that are largely manufactured and packaged ready to eat at home or at fast food outlets. Foods that have undergone high degrees of processing with little or no whole foods present. b) Cakes, biscuits, pastries, pies, confectionary and syrups whether homemade or purchased. c) Chips, fries and potato wedges/ hash browns d) All alcohol e) Processed sliced white bread and white bread cake-like products	Cakes; biscuits; confectionery (chocolate, candy, candy coated nuts); ready mixed coffee sachets and frappes; ice cream; sweetened condensed milks; jams; sugar and syrups; cake-like bread products including scones, crumpets and croissants; savoury crackers (for cheese, rice crackers etc.); packaged slices white bread including hamburger buns and hot dog rolls; pies and pastry products such as spring rolls; batter coatings (e.g., on fish); breakfast cereals that are highly coloured/flavoured/moulded into shapes where raw/constituent ingredients are not evident; processed breakfast cereal drinks; packaged snack products (e.g., crisps, pretzels etc.); chips and fries; soda (including diet soda) and energy drinks; powdered and packaged desserts; instant noodles; muesli bars; margarine; ready-to-drink alcoholic beverages; pre-prepared ready-to-heat meat products; poultry and fish 'nuggets' and 'sticks'; sausages, burgers, hot dogs, and other reconstituted meats; fast food (e.g., anything from McDonalds, Burger King, Taco Bell, KFC etc.); processed cheese slices/snacks.

App functionality and development: Participants photographed meals, snacks, and beverages within the app. The AI function analysed each image to identify the food items and assign them to one of the three HISS categories; if the identified food item was incorrect, participants could edit the food selection, after which the HISS category updated automatically. After each entry, the app displayed a visual breakdown for that meal, and entries were subsequently aggregated into a daily summary showing the proportion of logged items across the three HISS categories as percentages. Figure S1 (supplementary material) shows the app workflow and example user interface screens illustrating the image capture, food classification, and visual feedback provided to participants. Users could additionally look back at the last seven days of results to see trends in their percentage of UPFs consumed. This real-time feedback on UPF consumption patterns is designed to promote awareness and support reflection on dietary habits.

Core principles from mobile health usability research—such as simplicity, consistency, and intuitive navigation—were integrated to enhance user engagement across a wide range of age groups. During development, the research team conducted iterative testing and refinement to ensure the app's interface effectively supported the study objectives. Full details of this process are provided in Campbell et al. [19].

Participants: A total of 31 participants were recruited from the three participant groups, as follows:

Group 1: Thirteen adolescents (ages 12-18; mean age 14.5 years).

Group 2: Eight tertiary students (ages 19–25 years). These were mostly post-graduate students within the Faculty of Health and Environmental Sciences at Auckland University of Technology.

Group 3: Nine Māori or Pacific health coaches.

In all cases, participants were given a koha (gift/donation) of a $50 e-voucher following completion of the study, as is customary in New Zealand. All participants were recruited via word of mouth and social media flyers, and volunteered for the study, giving informed written consent,

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including parental consent where appropriate, prior to participating. These groups were purposively selected to capture perspectives across differing levels of nutrition literacy and lived experience: adolescents as a high-UPF-consuming group, tertiary students as digitally literate users, and Māori and Pacific health coaches for insights into cultural relevance and community application. This sampling strategy prioritised diversity of user experience over representativeness.

User testing: Participants first watched a brief instructional video about the app with minimal guidance to simulate typical user experiences outside research contexts. They then used the app for three consecutive days, logging all meals, snacks, and beverages. Each entry required an uploaded photo for automatic food classification, though users had the option to manually add any items they forgot to record.

Usability and user feedback: Following the app usage period, participants attended one of 17 online semi-structured group and individual interview sessions, with each session consisting of 1–5 participants; solo interviews were conducted when scheduling constraints prevented group participation. Interviews were conducted by researchers with prior qualitative research experience and familiarity with the app, enabling both technical probing and contextual sensitivity. The sessions were semi-structured, guided by the aims of exploring usability, perceived usefulness, engagement, and suggestions for improvement. Discussions allowed participants to share insights regarding ease of use, relevance to personal dietary habits, and app functionality. The feedback informed potential adjustments to improve user experience and educational value. The semi-structured interview guide is provided in Supplementary Material.

Qualitative analysis: All interviews were recorded and transcribed verbatim using Otter AI Pro software (Version 3.44.2-240223 - 4aa344c2), with a research team member manually verifying each transcript to ensure accuracy and fidelity to the audio. Transcripts were subjected to inductive thematic analysis, primarily conducted by one author (JLC), with two additional authors (JS and CZ) independently analysing a 20% subset to identify emergent patterns. A flexible coding framework evolved through iterative team discussions, documenting categories and their sub-themes without a formal codebook. The 20% subset was coded independently by JLC, JS, and CZ, followed by a reconciliation meeting to resolve discrepancies and finalise the category and sub-theme framework, ensuring robustness and strong inter-coder agreement (assessed qualitatively through consensus rather than statistical metrics); JLC then applied this framework to the remaining 80% of the data. Analysis occurred shortly after data collection to support timely insights, with researchers unblinded to participant context to preserve qualitative depth. Quotations in this report have been lightly edited for clarity and anonymity, with edits limited to minor grammatical adjustments and removal of identifying details.

Results

Through iterative team discussions, the data naturally fell into three evaluative categories—Positive User Experiences, Challenges, and Suggested Improvements—with sub-themes identified inductively within each. These categories summarise participant experiences with the HISS app and highlight key areas for reflection and potential development. Supporting quotes for each category are presented in Tables 2–4.

Positive user experiences: The app was widely praised across all participant groups for its ease of use, reliable AI accuracy, promotion of nutrition literacy, engaging visual features, and cultural inclusivity.

Ease of use: Participants consistently described the app as intuitive and user-friendly, particularly for beginners. School students appreciated the bold buttons and straightforward navigation, while tertiary students and health coaches valued features such as manual entry options and the ability to edit AI-recognised inputs. Some users also noted that the app required minimal instruction, with several mentioning that they could have navigated it successfully even without the introductory video.

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AI accuracy: Participants perceived the app to reliably identify food items, even in complex meals containing multiple components. Participants were impressed with its ability to recognise a wide range of foods, including culturally specific dishes such as bento boxes and hangi (traditional Māori pit-oven cooking), which are often difficult to categorise in conventional food-tracking apps. While occasional misclassifications were mentioned, the AI's overall performance was commended. The ability to manually adjust entries if needed further strengthened user confidence in the app's accuracy.

Nutrition literacy and usefulness: The app provided detailed data on UPF consumption, prompting many participants to reflect on their eating habits and consider healthier choices. Some were surprised by how processed certain foods were, particularly items such as crackers, which they had previously considered relatively unprocessed. Health coaches saw value in its use as an educational tool, especially for those with limited nutrition knowledge. Participants also noted it was the only app they had come across directly utilising photographs of food; this aspect was appreciated as novel and an improvement on other tracking apps.

Changing behaviour and engagement: The app was widely recognised for its potential to support awareness and reflection around healthier eating habits across participant groups. School students reported that its visual cues encouraged them to choose less processed options while tertiary students valued its straightforward design as an awareness-raising tool, particularly for novices (despite their own nutrition knowledge). Health coaches highlighted its role in promoting mindfulness, especially for beginners embarking on a food journey. Participants noted that the requirement to photograph meals felt "more confronting" than manual logging in other apps, often sparking immediate reflection; some health coaches even admitted they skipped eating certain foods to avoid taking a photo. This photo-driven accountability, paired with AI-enhanced features, was praised for keeping users motivated and engaged.

Visual features: The app's colour-coded pie charts and breakdowns were widely appreciated for their clarity and ability to support reflection and goal setting. The seven-day breakdown feature was particularly valued for tracking trends over time. Visual learners found the immediate feedback especially effective in reinforcing their understanding of food processing levels.

Cultural inclusivity: The app's ability to correctly identify a range of Māori and Pacific Island dishes was noted as a strength, with health coaches highlighting its relevance for diverse communities. Participants appreciated that traditional meals, such as hangi, were accurately categorised, making the app more applicable to a wider range of users. Health coaches emphasised its potential to support culturally diverse populations and promote awareness of traditional whole foods. Some also appreciated that the app was currently quite 'vanilla'—that is, neutral and simple in appearance —viewing this as a strength as it avoided alienating or offending any particular user group.

Examples of participant feedback on Positive User Experiences are provided in Table 2.

Table 2. Selected participant quotations related to Positive User Experiences.

Sub-Theme	School Students	Tertiary Students	Health Coaches
Ease of Use	*"I liked how you could manually edit, 'cause I would forget at school to add what I'm eating for lunch and morning tea and stuff like that."* *"Yeah, it was very easy to use, and I like the history*	*"I found it super easy. Like really self-explanatory."* *"I thought it was really easy to use and informative, especially for beginners."* *"Definitely the easier you make it to kind of log your food, I think you're more*	*"I have looked at apps in the past, and this one feels much easier to me. It's really clear-cut."* *"My first impression when I used it was really easy to use in terms of just being able to take a photo of the food, it*

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	thing that you can go back and look at everything you've eaten in the past days and then the summary of the last seven days, I really like that" *"I like adding the amount of grams in your serving that was also quite smart. Because in the chicken I had last night, obviously I didn't have like a whole breast. I only had like half a breast. I had to go quickly change that in my particular serving."*	*likely to use it because the principle is really good and I think a lot of people would be interested in it."*	*blew me away. The AI how it could pick up what was in there….. You know, clients would like this."* *"A lot of apps can just end up being really convoluted and time-consuming and stuff like that, and I didn't feel that this was."* *"I also found editing the food quite easy, like going back and adding something on so all of that seems really user friendly."*
AI Accuracy	*"Yeah, I think it was really good. It was very accurate with identifying the foods."* *"AI was really good at picking up what was in the photo, I was really impressed by that. That was really cool. I took a photo of my dinner and had a bunch of different things in it, and it picked up all of them."*	*"The AI is picking up the food really well."* *"I think the best positive of the app was the flexibility of it. So for example, if you took a photo in the AI, dissected the wrong thing, or missed some things, you could manually add."*	*"I thought it did an amazing job of identifying all the bits in a bento box."* *"I thought, I mean, it was very clever technology, how it could pick out, like the herbs on the pizza. And it picked up quinoa in a salad. And I thought, wow, that could have been any type of grain. So I thought it was incredibly clever."*
Nutrition Literacy/ usefulness	*"I don't know how much processed food I was actually eating until I used the app and it showed me how many not-good foods I was eating."* *"I found it useful because lately my I'm trying to watch my diet a little bit more…. just seeing that a meal was a bit more processed than it could have been and I could probably*	*"I think I learned that some things are just more processed than I thought they might have been."* *"I didn't realise white rice was so much more processed than brown rice."* *"I think it would be helpful for people who don't know much about nutrition. It's a good way to see how processed their meals are and learn what to change."*	*"I see a lot of people in the GP clinic where I work, and a lot of people say to me they feel that they eat well. Then as we talk more and more, a lot of the foods that they start talking to me about are more processed than I think they realise. This kind of app just really highlights that quite easily and visually as well."* *"The app was a good reminder of what I'm eating*

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	substitute something would be quite helpful for the future regarding the app, yeah." *"I thought that was really interesting to see. And I think it would be really helpful if you're trying to eat less processed foods."*	*"I liked the descriptions of the what foods fit into each category …. the green, the orange, the red."*	*and how I can improve my diet. It's surprising and sometimes a bit of a shock to see where some foods are categorised, even when you think you're eating well. I think it's a great tool for clients or anyone to use for a short period to raise awareness and identify areas for improvement."* *"This is a great entry level. Because that type of app like I'm thinking [app name removed] is incredibly intimidating for somebody who's at the starting level of trying to move towards eating Whole Foods."*
Changing behaviour and engagement	*"Yeah, definitely seeing that some meals that I had were quite processed would make me kinda just go oh, wow, I should probably change out something regarding in the meal."* *"I think it would [change eating behaviour], because obviously you don't always want to be eating unhealthy…. So if you're actually seeing what you're eating is unhealthy, it's probably going to change my mind to like, oh, yeah, I want to eat something more healthy."* *"I think that if I keep using it and it keeps telling me how processed something is, it would make me think, 'oh,*	*"Because generally I have such a good understanding of foods I should or shouldn't be eating… most of my food is green in orange…. but I can see how it would be helpful to people who don't have as much knowledge as me."* *"Definitely the easier you make it to log your food… the principle is really good and I think a lot of people would be interested in it. Make them more conscious of the decisions they make with food."* *"I think so [it would influence food choices]. I know [names removed] are quite conscious of that and I think this is the type of thing*	*"And in terms of your food selection, when you go to choose something.. I was more mindful. I was like, 'oh, I'm going to take a photo of this' and I'm reaching for something that's not particularly healthy when I've got a really healthy option."* *"It's that dopamine as well, taking a photo, seeing the image, seeing what it comes up with. I think is a really beautiful, simple way to start with clients that."* *"Because it's an AI thing as well. There's kind of a sort of a novelty thing to start with."*

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	what better meals can I do to make my food healthier for me?'"	*that they would definitely use."*	*"It's super useful. And it's quite neat, quite fun. You know, it's all on your phone. You're taking a photo. Oh, isn't that clever? It can work out what I'm eating. It can see it from the photo. Yeah, it's probably a bit more engaging for people."*
Visual Features	*"Yeah, so, the colour layout was cool, how you could see like a pie chart, you could see exactly how much red, orange, green."* *"I like the logo and the colour scheme. That was nice and the font and everything that was all good."* *"The colour scheme isn't important, It's always the information, how useful it is. That's pretty much it, [that determines] if I keep on using the app or not."*	*"I thought the colours, like green and red, were very clear and easy to understand for indicating the food processing levels."* *"I also liked how you could look back at the seven-day history."* *"The pie chart layout was good. It gave me a really clear breakdown of the meals I was eating and how processed they were."*	*"Because I'm a visual learner, I really like the fact that you can see very clearly the green or the orange or the purple or the red."* *"This sort of thing is very simple. And those colours really give you the feedback straight away. So I think that's going to change behaviour."* *"I liked being able to see the overall breakdown of meals over the last seven days. I think that kind of information would be really helpful for clients to track their goals each week and see if they're reducing category three foods."*
Cultural Inclusivity	*N/A*	*N/A*	*"It did really well identifying cultural foods like hangi and boil-ups."* *"So I would definitely say yeah, Māori and Pacific Islander [would benefit from the app]"* *"So it it gives you a breakdown of each food on the plate….. Most of the food in the hangi is whole food…."*

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	I would say it would still be pretty good if you're looking at a general plate of served up hangi."
	"Currently at the moment, the way you've got it is fine, it's good."

Challenges: Despite its strengths, participants identified several challenges that could impact the app's usability and effectiveness:

AI and database limitations: A few foods were misclassified, while others such as cacao and dukkah were missing from the database. Participants found that broad food categories sometimes made it difficult to specify exact items, and searching for certain foods was not always intuitive until they got used to the system. Health coaches also noted a lack of differentiation between homemade and processed versions of the same food, such as home-baked goods versus store-bought alternatives. This distinction was seen as important for users trying to improve dietary choices while still consuming familiar foods. Serving size options were also mentioned as a limitation, with some users wanting additional measurement units (e.g., grams instead of or in addition to cups) to better align with their usual portion-tracking habits.

Technical and navigation issues: A few participants reported a range of technical difficulties, including duplicate meal entries, occasional failure to save logged items, and delays in processing inputs. Some users found that navigation was unintuitive, particularly when trying to edit previous entries or return to the dashboard without losing recent logs, as the back button was a particular source of confusion. Others noted problems with time-setting for notifications, or when manually logging food or beverage items. A few participants had to restart the app periodically to resolve glitches, which detracted from the overall experience.

Suitability for advanced users: While the app was highly effective for those new to nutrition tracking, some participants felt that it lacked depth for individuals with advanced nutrition knowledge or those already eating minimally processed diets. Several users expressed interest in additional features such as macronutrient tracking or more detailed ingredient breakdowns. Others mentioned that because their diets were already largely unprocessed, they did not find the app as beneficial for their personal use, though they recognised its value for those less familiar with food classification systems.

Social and cultural contexts: Challenges related to the app's relevance to social and cultural contexts received limited feedback, and it was primarily from health coaches. They noted challenges in certain social settings, such as feeling awkward taking photos during shared meals, and highlighted that while most foods were present, the absence of some less common culturally relevant items (e.g., Samoan cacao) was a gap in cultural representation. Concerns were also raised by one health coach about accessibility for neurodiverse users, with the app's interface potentially overwhelming for some young people.

These challenges are summarised with participant quotes in Table 3.

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Table 3. Selected participant quotations related to Challenges faced when using the app.

Sub-Theme	School Students	Tertiary Students	Health Coaches
AI and Database Limitations	*"I was just trying to find a specific thing, and because they were broad, I was like, 'oh, I can't find it', but I think the more I started manually adding them easier it got. It was just at first"* *"I had a subway. I wasn't able to take a photo so I was trying to find 'Italian BLT'. And I just couldn't."* *"But one thing, the serving sizes, some of them are limited options, you know, like what you could add for [one] serving."*	*"I don't know if it's a psychological thing. If it [drop down menu for serving sizes] starts in the smallest [size] and you're eating more than that, you feel bad for eating more, because you're like inputting more than it says."* *"The measurements I noticed a lot. It's in cups, but I didn't know if you could personalise that. For me, my brain works in grams."* *"Some sauces are probably more processed than others…. it's really hard to do…but it'd be good if they could differentiate between sauces a bit better."*	*"The sizing.. I found them pretty accurate too, but only because I've had to work out how those sizes translate [when using another app]."* *"How can it differentiate between a homemade kombucha and a storebought? You know, like that's the message I impart [with clients]…. is that homemade is better than store bought. So I guess that message would have to run alongside the app..."*
Technical and Navigation Issues	"So when I'd like add a meal, I would submit it, but then I would go backwards and then it would just not go in at all." "But one thing editing. Sometimes the editing didn't go through. If the photo was a bit wrong and you know how you can edit it a bit, sometimes the edit wouldn't go through though." "A couple of things glitched out a little bit."	*"The clock was confusing though. Where you set the time for your notification. So I thought maybe if you could just manually type in the time, it may be easier."* *"I eat the same breakfast every day and I found it a bit of a hassle having to take a photo…. and putting exactly the same thing each day."* "Sometimes I'd add it, go back, and it wouldn't appear there and all of a sudden it's appeared three times."	*"My upload was the same photograph [but AI] identified a few different things every time, so I just had to kind of adjust that."* *"When I did it the first time, that first kind of screen kind of threw me off a bit…. I just found that just a bit tricky."* *"When I was entering it manually. If I clicked on the wrong button, it deleted the other entries and then I had to kind of start again."*

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Suitability for Advanced Users	N/A	"I probably wouldn't use it, just because I feel like I have a good diet anyway and I kind know what's processed and what's not".	*"I see it as a kind of a ground level getting some people to kind of recognise what it is that they're eating rather than, you know, people who are already kind of eating mostly Whole Foods anyway."* *"I think for me personally and probably even for my clients they're a step above this particular app, in terms of, they want to know the macros. They're particularly focused on building up protein and things like that."*
Social and Cultural Contexts	N/A	N/A	*"The only kind of cultural aspect that I would have found it quite difficult at a couple of the shared meals to pull my phone out and take a photo of the food."* *"For me, you know the most important thing is like for me I have cacao every morning and in Samoa it's a traditional Samoan drink, and it's not an option on there. So I think in terms of culture it's having those foods."* *"So many of the people that I work with, young people, are neurodiverse. All the words on the screen? That's too much for them."*

Suggested improvements: Participants proposed several enhancements to address the identified challenges and expand the app's functionality:

Enhanced logging features: Suggestions included adding a "copy and paste" function or a "favourites" list for recurring meals to streamline entry, particularly for users who ate the same

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breakfast or snacks daily. Some participants also requested voice input capabilities to make logging faster and more accessible.

AI and database refinements: Participants recommended expanding the food database to include less common whole foods such as cacao and dukkah, which some users found missing or difficult to categorise. Some also wanted better differentiation between homemade and processed foods, as the current classifications did not always reflect differences in preparation methods. Others suggested adding more measurement units (e.g., grams and millilitres, in addition to cups) to improve portion accuracy or having a wider range of portion size options e.g., three strawberries rather than having to specify a fraction of a cup.

Additional information and education: Participants across all groups expressed interest in enhanced educational features, including real-time suggestions for less processed alternatives when logging UPFs. School students recommended including a line graph showing long-term food trends to track changes over time. Tertiary students proposed the inclusion of a tutorial panel explaining food processing categories, a healthy average for comparison, and monthly trend insights. Health coaches suggested the ability to revisit logged meal photos for visual learners, a basic introduction to UPFs, and an onboarding questionnaire to tailor content to users' knowledge levels.

Increased engagement: Suggestions for engagement ideas varied by group. School students favoured gamification like streaks, badges, or school-wide challenges (e.g., healthiest lunchbox contests) to make logging fun and social, although some expressed concern about the potential for cheating. Tertiary students suggested features such as highlighting past healthy meals to inspire meal preparation and incorporating a virtual coach to personalise suggestions based on preferences. Health coaches proposed options such as monthly reports comparing user intake to national or healthy averages, avatar customisation, and social sharing of progress to celebrate honesty and sustain motivation, especially for users needing long-term support. One health coach did however note, that losing a streak could be very demotivating for some people, emphasising the need for careful design.

Suitability for advanced users: Some users suggested macronutrient tracking and long-term dietary trend analysis, particularly for those who were already familiar with nutrition and wanted more detailed insights. On balance however, many decided that this was better as an optional extra, rather than being integrated into the basic version of the app which already worked well for those with lower nutrition literacy.

Cultural and social aspects: School students reported that the app's usefulness and performance were the primary factors in choosing apps they regularly use, rather than stylistic elements like a flashy design. Health coaches suggested enhancing user engagement through greater cultural integration, such as incorporating Māori language greetings like "Kia ora" (hello) or "Ka pai" (very good), culturally relevant messaging tied to New Zealand's history and seasons, and a visually appealing design reflecting Matauranga Māori (Māori knowledge, wisdom, and understanding). They also proposed incorporating support for Pacific Island languages to better serve diverse communities, particularly older users with limited English proficiency.

Future use: Participants generally expressed interest in continued use, but suggested tweaks to enhance its appeal. School students indicated they would use it selectively for curiosity about certain meals or to support sports training, even without the app being modified to be more interactive. Tertiary students viewed it as a tool for checking unfamiliar foods, proposing additions like macronutrient tracking to maintain relevance. Health coaches saw it as a valuable short-term reminder, with some suggesting protein breakdowns or advanced features to justify ongoing use beyond initial novelty.

Details of these proposed improvements are outlined in Table 4.

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Table 4. Selected participant quotations related to Suggested Improvements.

Sub-Theme	School Students	Tertiary Students	Health Coaches
Enhanced logging features	*"Adding something like ChatGPT alongside within the app…. That you could just quickly go into search up* e.g., *I could go and type 'how many cups of rice is used in a [brand removed-sushi]'. That would be kind of useful I think for me."* *"I feel like it needs to be a little more obvious that you're, actually submitting it [the meal]. If there's like a loading button that you know."*	*"Could you default to a recommended serving size [in the drop-down size menu]."* *"Because a lot of people eat the same breakfast every day…. I think that it should be just like a copy button."*	*"It would be cool if you could, like I tend to be quite repetitive... So it would be cool if you could copy it from one day into another day."* *"You want your AI to have it in there, as simple as possible, 'Palusami' [traditional Samoan dish] and you click it, one portion, two portions [not adding each ingredient]."* *"I don't know if this is possible, but for those people who can't read well, if the first time they use the app and they're looking through it, the AI could read the different things aloud to them."*
AI and database refinements	*"I think if there were a thing where you can [have] a drop-down bar or something where you can change the amount.. instead of 1 cup it could be 1/2 cup… give more options."* *"The serving sizes they were good, they're helpful, but they could have the different measuring tools, the drop-down box."*	*"I was wondering if there needed to be any more like subcategories because things were quite class quite broadly"* *"I think it would be helpful to be able to change that cup to mls or grams, depending on the food of this liquid or solid type of food."* *"I wonder if it's worth making a prompt when you take a picture like 'did you use cooking oil or did you use any sauces' or something?"*	*"I think probably for me the only thing would be to have a wider range of food categories. Like for instance, the cream one that just seemed to cover all different kinds of. I don't know, it just felt a little bit, not detailed enough."*
Additional information and education	*"Maybe if someone was to get their meal placed in one of the more processed categories maybe AI*	*"I think what could be useful is potentially an*	*"I thought it could be quite cool to be able to see the picture that you took…I guess it just depends if you're a visual person*

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	could give you a substitution, instead of something that was a bit more processed in the meal." *"Maybe you could add a function where you can look at the greater history displayed on a line graph or something so you can see if for example, around the middle of the year, if you suddenly start eating more processed food or less processed food."*	*average, a healthy average that you can compare to."* *"I think the main thing was having alternative options. So if you were in the red or the orange, like something that could say 'have this instead' and it'll make it like less processed".* *"Like a monthly trend would be really good. I think that'd be really helpful. You can just see if anything significant has changed or if you've improved and you're making better choices in general."*	*or not, but I'd quite like to go back and look at the pictures of the food rather than what's on them."* *"Maybe some recommendations for like maybe there's like if there is an ultra-processed food, maybe the app could suggest something instead that would be a less processed version. That could be a cool offering."* *"With a little learning and you know 'What is Ultra processed food?' …..just maybe an educational sort of thing and there's a quick question here or something at the beginning."*
Increased engagement	*"I think something like a reward. Kind of, like, badges, you know, like in some apps, when you have a certain day streak, you get a badge or something or maybe you're just able to add your friends who are also using that app. Like, just to motivate you more a little bit to log your food."* *"I love streaks. I think that's really good because that would be really motivating. And then if there's, lots of people doing it, then you can see what their streak is."* *"Maybe you could start competitions with people like using like imessages, invite someone and*	*"To get people to improve, maybe highlighting which meals were really green for them, and suggesting that's a meal they should eat again in the future….. Because sometimes I struggle for imagination when meal prepping. If you look back and go 'oh that's a really good meal, you should eat that again.'"* *"You know the couch to 5K where it sort of has like a virtual coach. I think that could potentially be useful in terms of it [the app] learns what you like and then start suggesting… So over time you get more of a personalised plan. Highlighting really good meals and maybe like maybe*	*"Something to celebrate the fact that they've actually been honest and entered information. Celebrate that as much as possible with them……. People love dressing their avatars, right…. something along the way to help them stay engaged, because many of them are online social butterflies and love that sort of interactive approach."* *"At the moment, it's very clear-cut. So for someone who's just wanting to monitor what they're eating and they're already on a healthy drive, it's perfect. But if you're really wanting to reach out to those people who are wanting change, but they've got a long way to go, you have to have some other hook to keep them going."*

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	whoever can eat the healthier food can earn like in-game points or whatever. That could be quite cool."	*also highlighting really bad meals."*	*"You see a lot of these games like Candy Crush and stuff like that. You can link it to your Facebook and then it's like, 'here's my daily score'. It doesn't have to reveal what you're eating, but for the people that are eating well …that's something that people can be really proud of and show off to their friends. And I think that's how you make it mainstream."*
Suitability for Advanced Users		*"I think having some sort of nutritional like macros would be useful for people who track their meals. Because if you're just taking photos of the meals you have every day, and let's say you have quite a standard diet every day, you might not be learning much about the processed foods. If you're eating the same thing every day, so you might not use the app. Whereas if you're like learning more about what's in your food, like how much protein, carbs, etcetera."* *"I think it would be good if it could list the macro distribution as another layer of it. So there's the process nature and then it tells you proteins, fats, all of that."*	*"What you've got now is your entry level and you could almost have like a paid version of the app where you can break down into macros."* *"I'm not a big fan of it, but some people still do want to know their calories that they're consuming in a day. Just as an idea. Or the total macros that they're consuming in those meals."* *"I think there are so many people that get caught up in all of that side of things [macro nutrient breakdowns] that it would be better to have it [macro information] as a separate optional sort of function. Because it might dilute the purpose of what you're trying to achieve."*
Cultural and social aspects	*"I quite like the style of it. Yeah, it's easy to - it*	*"Something you could think about adding is an audio*	*"The app could potentially provide something that's relatable to Aotearoa, like in season now… what's relatable to*

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	doesn't confuse you at all. It's very clear." *"It was just good giving the information. I don't really care [about] other stuff."* *"I don't care about what it looks like in the interface… It's nice and easy to use and it looks nice."*	*aspect like being able to say to the app what you had."*	*the history of New Zealand, because a lot of apps are really universal, it would be cool if it were relatable to us."* *"I also think you would open up the app and there'd be a greeting that might say 'Kia ora' or 'Nau mai, haere mai' or some something that was welcoming you into the app each day that that made the person feel 'Oh, great', yeah……..Once they've entered their food, you could have a little thing that said 'Ka pai' [very good]. You know that those sorts of encouraging things might be useful to include."* *"I think the look is important, so if it was designed to be a cultural app I'd certainly be thinking about the appearance of it, because they want to be proud of it on their screen, have that connection, and feel this is Mātauranga Māori [Māori knowledge, wisdom, and understanding]..."* *"Some of the people that need this the most, yes Māori people but also Pacific Island.. and a lot of Pacific Island [peoples], especially the older ones, don't have great English, so something potentially incorporating different languages."*
Future use	*"That's fine how it is, and I mean I'll probably keep using it."*	*"I think I'd use it like as a safety net. So things that I wasn't too sure on, I'd use it*	*"It's not something that I would be able to do for a long period of time…. because it does require a*

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"I would [use it again], definitely not on every meal but on some like I'm curious on, ones which I'm not too sure. I'd definitely take a photo just to see". *"It would have to personally benefit me or entertain me in a way… I would use this for my [sports training] and stuff. I'd use this to track my meals and see where I need to be cutting down on or adding to my diet."*	*in that situation to educate myself."* *"I'd probably use it if there were macros"* *"If I hadn't had a background in any of this [nutrition] then it would be useful]*	*bit of work. But yeah, I think it is good to give you a bit of a reminder of what you're eating and how you can improve your diet."* *"Definitely, yeah, I definitely would [use it again]…. Although I have a really good idea of the food categories, so actually I'd be more interested in using something with the protein breakdown."*

Discussion

This study explored user experiences with a food classification app based on the HISS framework, revealing three key thematic categories: Positive User Experiences, Challenges, and Suggested Improvements. Participants found the app intuitive, engaging, and educational, with its real-time feedback and visual breakdowns playing a key role in increasing awareness of UPF consumption. While challenges were identified, the overall findings suggest promising initial impacts on awareness and reflection, rather than direct evidence of sustained behaviour change.

Importantly, this study reflects an early-stage evaluation of the app during the HISS phase of framework development. Subsequent refinement of the underlying framework into CHIPS (Combining Health, Intuition, Processing and Science) was informed, in part, by the types of usability insights and conceptual tensions identified in this study.

User engagement and potential for behaviour change: The HISS app's simplicity and focus on food processing levels, rather than the calorie-centric approach of many AI-powered tracking apps, highlight its potential as an accessible tool for users with lower nutrition literacy. This design choice not only differentiates it from existing platforms but also taps into a critical need: delivering clear, actionable health messages to those less equipped to navigate complex nutrient data. The emphasis on real-time feedback and visual aids including colour-coded breakdowns and seven-day trends, leverages behavioural science principles [20], suggesting that such features could enhance self-monitoring and motivation more effectively than traditional text-based logs. Evidence of users adjusting food choices or avoiding unhealthy options due to photographing requirements may reflect a short-term "nudge" or Hawthorne effect, raising questions about how intentional design can amplify behaviour change beyond mere awareness. This broader challenge of communicating nutrition information effectively is reflected in existing population-level tools. New Zealand and Australia's front-of-pack food labelling system, the "Health Star Rating", despite its visual cues, remains poorly understood, underutilised, and misinterpreted as a simplistic cue rather than a nutrition guide even several years after implementation, with low trust limiting its effectiveness [21,22].

Interestingly, the general preference among secondary students for functionality over aesthetics challenges assumptions about adolescent priorities, suggesting that clarity can trump style when

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delivering health tools to younger users. This finding highlights a broader principle: effective health interventions may not need to compete with entertainment-focused apps if they prioritise usability. Engagement, however, varied across user groups; tertiary students with greater nutrition knowledge often found the app lacking depth, requesting features like macronutrient tracking and long-term trend analysis. This tension reflects a broader challenge: balancing accessibility for novices with detailed insights for advanced users. While an optional advanced mode could address this, the app's primary aim is to support those with low nutrition literacy, who often have poorer diets [23] and can achieve greater improvements in diet and health, rather than catering to experienced trackers.

Challenges in food categorisation: The AI's accuracy was generally well-regarded, but some health coaches raised concerns about its inability to differentiate home-cooked from store-bought foods. This limitation was intentional, as such distinctions are not always nutritionally significant or practical (e.g., when eating out or at a friend's home), and the app prioritises usability over complexity. For instance, it distinguishes highly processed white bread from wholegrain bread, but not between homemade and store-bought lasagna as their nutrient profiles are often similar. This aligns with research showing that NOVA-style classifications can oversimplify processing impacts, with public perceptions often overvaluing home-prepared foods despite comparable industrial methods [12,24–26]. Moreover, certain industrial techniques including shock freezing or high-pressure processing, can outperform home methods in nutrient preservation and safety [24,26]. We do note however that variation exists; for example, some artisanal products may offer enhanced nutrient density or reduced processing compared to equivalent mass-produced options. While simplification is necessary for usability, future refinements could explore ways to balance ease of use with greater differentiation where it is nutritionally relevant.

Importantly, not all UPFs are uniformly harmful, just as not all less processed options are inherently beneficial [12,25,26]. Consistent with this, the HISS framework recognises that some commonly consumed products, including wholewheat and dark breads, low-sugar wholegrain cereals, and yoghurts, have been associated with positive health outcomes in large epidemiological studies [16], despite being classified as UPFs under NOVA. This recognition of nuance informed the subsequent evolution of the framework into CHIPS, which more explicitly integrates health evidence and a pragmatic lens alongside processing level [18]. However, given the high prevalence of insulin resistance —widely recognised as a central underlying pathology in the development of multiple chronic conditions [27] —the reduction or avoidance of total carbohydrate load may remain a clinical priority for some individuals, highlighting the need for nuance and avoidance of blanket rules when discussing dietary choices.

Cultural relevance in health tools: A notable strength was the app's cultural inclusivity, particularly its accurate recognition of Māori and Pacific Island foods. Health coaches praised its relevance for diverse communities, noting its potential to tackle health inequities and provide culturally responsive dietary guidance, an approach linked to better engagement and outcomes [28,29]. Suggestions for incorporating Māori language greetings and tailored messaging could further boost accessibility. Unlike region-specific nutrition apps [30], the HISS app's broad, adaptable classification system supports a wide range of cuisines, enhancing its global usability.

While the app successfully recognised many cultural foods, some less common foods such as cacao and dukkha were missing, which caused frustration for users who regularly consumed them and felt they were an important part of cultural cuisine. Expanding the food database to include a broader range of foods would ensure more comprehensive tracking for all users. Additionally, many participants across all user groups suggested providing healthier food swap recommendations, which could further support behaviour change while respecting cultural food preferences and dietary habits.

Strength and limitations: This qualitative study's strength lies in its detailed exploration of user experiences, capturing nuances beyond quantitative metrics. The diverse participant pool—secondary students, Māori and Pacific Island health coaches, and tertiary students—provided rich insights. Focusing on adolescents with high UPF consumption and Māori and Pacific Island health

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coaches enables outreach to underserved communities. Targeting secondary students is particularly relevant, as early initiatives may promote lifelong healthier habits among this group. However, the health-conscious bias among this group of tertiary students may limit insights into less aware users, and the short-term design precludes assessing sustained behaviour change. Findings may also not fully generalise to other populations or dietary contexts, particularly those with different food environments, cultural influences, or socioeconomic barriers that impact food choices. Future research should test long-term effectiveness across broader populations, considering diverse food environments and socioeconomic factors. In addition, future evaluations should assess user experiences and behavioural impacts using later iterations of the app that implement the refined CHIPS framework, to determine whether the added conceptual nuance improves user understanding, engagement, and dietary decision-making over time.

Implications for Research, Practice and Policy: Our findings demonstrate the value of mobile health tools in delivering cost-effective, accessible dietary guidance. Traditional nutrition support via expert-led interventions, such as those delivered by dietitians or other professionals, is resource-intensive and often lacks scalability, making it less accessible, especially for Māori and Pacific Island communities facing healthcare barriers [31,32]. The HISS app bridges this gap, empowering users with scalable, evidence-based tools, and it has been developed fully under dietitian oversight, in contrast to the majority of available nutrition apps [33]. Additionally, reducing reliance on in-person consultations can help alleviate strain on the healthcare system, particularly given increasing rates of GP retirement and burnout [34]). Its appeal to adolescents, high UPF consumers [35], amid rising obesity and mental health challenges tied to diet quality [36–39], is especially promising, with secondary students responding positively. More broadly, the study offers lessons for digital health initiatives. Simplicity, immediate feedback, and visual learning can support user engagement and inform the design of dietary education, front-of-pack labelling, and chronic disease prevention strategies. These insights highlight how nutrition apps can balance usability with accuracy to serve as scalable public health tools that aim to promote healthier eating behaviours across diverse communities.

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Authorship: Caryn Zinn: Conceptualised the study, secured funding, designed the study, contributed to focus groups, assisted with data analysis, provided resources, and reviewed and edited the manuscript. **Jessica L. Campbell:** Conceptualised the study, secured funding, designed the study, conducted focus groups, led data analysis, drafted the manuscript, and reviewed and edited the manuscript. **Jackson Schofield:** Contributed to focus groups, assisted with data analysis, developed software, and reviewed and edited the manuscript. **Grant Schofield:** Conceptualised the study, secured funding, designed the study, provided resources, and reviewed and edited the manuscript.

Ethical standards disclosure: This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Auckland University of Technology Ethics Committee (AUTEC), reference number 24/102. Written informed consent was obtained from all participants.

Supplementary Materials: The following supporting information can be downloaded at: Preprints.org.

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