



Maternal Nutrition Monitoring Behavior Through COM-B: A Simulation-Based Digital Intervention Framework

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Article Info:

Article history:

Received: September 19, 2026

Revised: October 19, 2026

Accepted: October 21, 2026

Available Online: October 27, 2026

Keywords:

Behavior Change;

Child Nutrition;

COM-B;

Digital Intervention;

Intake Monitoring;



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Abstract

Background: Child nutrition depends not only on food choices but also on parents' ability to monitor portion sizes, feeding frequency, dietary variety, and actual food consumption. The gap between understanding healthy feeding principles and consistently monitoring children's food intake may limit the provision of appropriate nutritional care.

Objective: This article applies the Capability, Opportunity, Motivation-Behavior (COM-B) framework to identify determinants of maternal food-intake monitoring behavior and translate them into requirements for a digital behavior-support intervention concept.

Methods: A descriptive qualitative simulation was conducted using 12 hypothetical maternal profiles representing caregivers of children aged 1-5 years. Scenario statements were deductively mapped to COM-B dimensions and analyzed thematically. No interviews with human participants were conducted; therefore, this exercise demonstrates an analytical framework rather than estimating empirical prevalence.

Results: The simulated analysis identified three recurring categories of mechanisms: capability limitations in estimating portion sizes and recording food intake; opportunity constraints related to time availability and coordination among multiple caregivers; and a motivation gap in which concern for children's health does not automatically translate into routine monitoring. In this article, "knowing" refers to understanding healthy eating principles and portion-size concepts, whereas "doing" refers to the repeated practices of recording and reviewing children's actual food intake and acting on the information obtained.

Conclusion: Within this simulation, COM-B provides a structured approach to translating behavioral diagnosis into digital intervention requirements, including simple portion-size guidance, rapid food-intake logging, caregiver coordination, feedback, and progress tracking. The framework should be empirically validated with real caregivers before any claims regarding intervention effectiveness are made.

To cite this article: Gunadi, H. (2026). Determinants of maternal behavior in monitoring child nutritional intake based on the Com-B framework: A qualitative study for the development of digital interventions. *Equivalent: Jurnal Ilmiah Sosial Teknik*, 8(5), 2016-2027. <https://doi.org/10.59261/jequi.v8i5.482>

INTRODUCTION

Globally, inadequate child diets remain a major public health challenge because early feeding patterns influence growth, development, and long-term health (Koletzko et al., 2019; Martín-Rodríguez et al., 2022). Digital and family-based interventions have expanded, but evidence indicates that improving information alone does not consistently change feeding practices (Erlinawati, 2026; Vanwinkelen et al., 2026). In Indonesia, child nutrition remains a multidimensional problem involving undernutrition, micronutrient deficiencies, and excess weight, despite progress in reducing stunting (UNICEF Indonesia, 2026). Accordingly, efforts to improve children's nutritional status should not focus solely on food availability; they must also address daily consumption patterns, feeding practices, and caregivers' ability to monitor what

children actually consume (Rindiani et al., 2025).

Appropriate feeding practices involve not only the types of food given to children but also the adequacy of portion sizes, dietary variety, feeding frequency, food safety, and the suitability of food for children's nutritional needs and developmental stages. The World Health Organization (2023) emphasizes that early childhood is a critical period for establishing dietary patterns that can influence long-term food preferences and consumption habits. Thus, parents' ability to understand and monitor children's actual food intake is an important component of decision-making regarding the fulfillment of their nutritional needs.

Parents play a strategic role because decisions regarding food selection, food provision, feeding patterns, and the development of children's eating environments are largely influenced by the family. Tomayko et al. (2021) show that parental involvement is an important component of various interventions related to diet, physical activity, and the prevention and management of childhood obesity. However, such involvement is insufficient if it is limited to knowledge of healthy foods. The next challenge is translating this knowledge into consistent behaviors in everyday parenting practices.

These problems can be framed as a knowing-doing gap, with the term used operationally rather than rhetorically. In this article, "knowing" refers to caregivers' stated understanding of healthy food groups, appropriate feeding frequency, and basic portion-size principles. "Doing" refers to observable or scenario-defined monitoring actions: estimating portion sizes, recording actual food intake, reviewing consumption patterns over time, coordinating records across caregivers, and using those records to adjust feeding decisions. A gap is considered present when knowledge indicators suggest adequate understanding, but one or more monitoring actions are absent or inconsistent. Because the present dataset is simulated, this operationalization defines what future empirical interviews and observations should examine rather than estimating the prevalence of the gap.

In the context of behavior change, the Capability, Opportunity, Motivation-Behavior (COM-B) framework conceptualizes behavior as the product of capability, opportunity, and motivation (Michie et al., 2011). Park et al. (2023) demonstrate how COM-B can be used to identify barriers and facilitating factors in health behavior, while Haque et al. (2026) illustrate its recent application to caregiver feeding practices. However, COM-B-based explanations remain context-dependent Rockliffe et al. (2022), making empirical validation essential before findings from a simulated mapping are generalized to real-world contexts.

In addition to behavior-change approaches, social marketing is relevant because it aims to encourage the adoption of behaviors that benefit individuals and society. Roger et al. (2023) show that social marketing approaches can support health behavior change when interventions account for audience characteristics, segmentation, value exchange, and barriers to behavioral adoption.

The sustainability of behavior change is also related to habit formation. Singh et al. (2024) show that health habits do not develop within a uniform period but are influenced by repetition, behavioral characteristics, contextual stability, and individual factors. Thus, interventions should extend beyond awareness-raising and initial trials to encourage repeated behaviors until they become part of everyday routines.

Previous research has addressed parental involvement in child nutrition, health behavior change, social marketing, habit formation, and digital interventions, but four interrelated gaps remain. The theoretical gap is that parental feeding practices, behavior-change mechanisms, and habit formation are often examined separately rather than integrated into a single diagnostic pathway. Empirically, limited attention has been given to the specific monitoring behaviors that connect nutrition knowledge with records of portion sizes, feeding frequency, and actual food consumption. The implementation gap concerns translating knowledge into routine action under time constraints and in contexts involving shared caregiving responsibilities. Finally, the application gap concerns how a COM-B diagnosis can be translated into specific digital requirements without prematurely assuming that a particular application will be effective. These gaps motivate the development of a simulation-based framework that can be tested with real users in subsequent research.

The novelty of this article lies not in claiming to provide new user-experience evidence, as no interviews with actual users were conducted, but in specifying a transparent diagnostic

translation pathway for future empirical research: Hypothetical Behavioral Evidence → COM-B Diagnosis → User Need → Candidate Behavior-Change Function → Digital Requirement. This approach differs from prior digital nutrition reviews that evaluate intervention effectiveness or parental feeding outcomes by explicitly operationalizing intake-monitoring behavior as the target behavior and demonstrating how each COM-B barrier can be translated into a design requirement. The article therefore contributes a framework for subsequent development and testing, which requires validation with actual caregivers.

METHOD

This article used a descriptive qualitative simulation to demonstrate how maternal child-intake monitoring could be analyzed using the Capability, Opportunity, Motivation–Behavior (COM-B) framework. No human participants were interviewed. Twelve hypothetical caregiver profiles were constructed to represent mothers of children aged 1–5 years from diverse educational and occupational backgrounds. The profiles and scenario statements served as analytical exemplars rather than sampled observations. A semistructured interview guide was developed for future empirical validation but was not administered in the present study. The simulated material was analyzed thematically through repeated review, coding, category grouping, and mapping to capability, opportunity, and motivation.

The capability domain covered knowledge of healthy foods, portion-size estimation, practical measurement, and consumption recording. The opportunity domain covered available time, family support, caregiver involvement, access to technology, and the ease of the monitoring process. The motivation domain covered perceived benefits, reasons for monitoring, concerns about child health, willingness to maintain records, and the extent to which monitoring had become habitual.

The simulated material was analyzed using a transparent thematic mapping procedure. First, scenario statements were coded according to the actions or barriers they represented. Second, the codes were grouped into practical monitoring categories. Third, the categories were mapped deductively to the COM-B framework. Fourth, the mapping was checked for consistency with the operational definition of the knowing–doing gap. The analysis therefore combined inductive categorization of the hypothetical statements with deductive COM-B classification. The resulting matrix served as an analytical demonstration and was not interpreted as evidence of theme frequency in a real population.

RESULTS AND DISCUSSION

Results

Characteristics of Simulated Informants

Table 1

Characteristics of Simulated Informants

Code	Mother's Age	Child's Age	Education	Jobs
I1	29	2 years	S1	Private employees
I2	32	3 years	High School	Housewives
I3	27	1.5 years	D3	Employees
I4	34	4 years	S1	Entrepreneurship
I5	30	2.5 years	High School	Housewives
I6	28	1 year	S1	Teacher
I7	35	5 years	High School	Entrepreneurship
I8	31	3 years	S1	Private employees
I9	26	1 year	D3	Housewives
I10	33	4 years	S1	Administrative Clerk
I11	29	2 years	High School	Housewives
I12	36	5 years	S1	Entrepreneurship

The simulation generated three analytical theme categories corresponding to COM-B: limitations in practical monitoring capability, opportunity constraints arising from routines and

shared caregiving, and a distinction between motivation to protect child health and motivation to monitor intake consistently. These categories are not empirical frequencies; they are the outputs of the hypothetical coding exercise and are used to demonstrate how a future qualitative dataset could be organised.

Capability: Nutrition Knowledge Is Not Always a Monitoring Ability

The results of the interview simulation showed that 10 out of 12 informants had understood the basic principles of healthy food, such as the importance of protein, vegetables, fruits, and food variety. However, 9 out of 12 informants still determined food adequacy based on visual estimates, children's satiety, or daily habits.

I2 explained:

"I know that children must have protein, vegetables, and fruits. But if I ask you how many grams to eat, I don't know. Usually, I just look at whether it's enough or not."

I5 said:

"If my portion is just a feeling. If the food looks quite a lot and the child doesn't want it, I think it's enough."

Meanwhile, I8 stated:

"I often see information about children's portions on Instagram, but in practice sometimes I get confused too. For example, how many spoons of protein, how many vegetables, it's not always clear."

Only 3 out of 12 informants in the simulation had ever tried to record their children's diet regularly.

I3 stated:

"I once tried to record the time when the child had difficulty eating, but only for a few days. After that, I forgot because it was unusual."

The findings suggest that the main obstacle lies in psychological capability. Informants have general knowledge about nutrition, but have difficulty translating that knowledge into practical skills for determining portions, recording consumption, and evaluating intake.

These findings expand on the results of Tomayko et al. (2021) who emphasized the importance of parental involvement. This study shows that involvement does not automatically result in monitoring skills.

The gap in capability aspects can be formulated as:

Knowing healthy food $\neq$ knowing how much the child actually eats.

Opportunity: Monitoring Is Not Easy to Integrate into Routine

In the opportunity dimension, the simulation showed that 8 out of 12 informants considered recording activities as additional work if they had to be done at every mealtime.

I1 said:

"If every meal has to be weighed and recorded, it's a bit heavy for me. In the morning, I'm in a hurry to work, and sometimes I'm tired."

I10 also said:

"If it's just a click or a photo, maybe I still want to. But if I have to fill in a lot of data, maybe two or three days will have stopped."

In addition to time, the involvement of several caregivers is an important issue. As many as 7 out of 12 informants stated that children are not always fed by mothers.

I6 said:

"I work until the afternoon. In the afternoon, children usually eat with their grandmother. Sometimes I know the menu, but I don't know how much."

I4 said:

"If I was the one who gave me food, I still remember, but if I was the babysitter, sometimes I was just told that the child had eaten. I don't know the details."

In COM-B, these findings are related to physical opportunity and social opportunity. Monitoring activities require time and supporting facilities, and must be able to be used in parenting structures that involve several people.

These findings suggest that interventions should not add to the user's administrative

work.

Interventions need to reduce behavioral friction by creating monitoring activities:

- fast;
- simple;
- can be done by multiple caregivers;
- can be integrated into the eating routine.

Motivation: Caring for Children Does Not Automatically Result in Monitoring

In the simulation, all informants stated that children's health was a priority. However, only 4 out of 12 informants considered monitoring or recording as an activity that needed to be done regularly.

I7 explained:

"If the child is healthy and has gained weight, I usually don't think too much about the details of eating. I start to be very concerned if I suddenly find it difficult to eat."

I3 said:

"As long as my child is active, I feel safe. But if the weight doesn't go up, then I start to think about what to eat."

The findings show a difference between motivation toward outcome and motivation toward behavior.

Motivation for high outcomes:

"I want a healthy child."

But motivation for behavior is not necessarily the same:

"I have to keep a record of my child's food every day."

Some informants said that the benefits of monitoring need to be seen.

I11 said:

"If after taking notes, for example, this week there is less protein or enough vegetables, maybe I am more enthusiastic."

I12 also said:

"If I just want to make a record, it might be lazy. But if there's something I can see, I know what it's worth."

In COM-B, this condition shows that reflective motivation for children's health is high, but monitoring is not fully perceived as an important behavior.

In addition, automatic motivation is still low because monitoring has not become a habit

Knowing-Doing Gap

The simulation results show a gap between what is known and what is done.

I8 explained:

"I know that children's food must be complete, but every day usually the focus is on the child wanting to eat first. I rarely count the exact amount."

I5 also stated:

"The important thing is that usually the children eat. If I have eaten rice, side dishes, and vegetables, I feel that it is enough, even though it has never been counted."

The findings show that:

Knowledge ≠ Behavior

New knowledge has the potential to produce behavior when there are:

Capability + Opportunity + Motivation.

This condition reinforces the use of COM-B because monitoring behavior cannot be explained only through the level of knowledge.

Synthesis of results based on COM-B

Table 2

Illustrative Thematic Coding and COM-B Mapping Matrix

Dimensions	Simulation Findings	Barriers	Need	for
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				Intervention
Capability	Basic knowledge is sufficient	Difficulty determining portions		Visual portion guide
Capability	Forecast-based monitoring	No practical reference		Applicable education
Opportunity	Limited time	Recording is considered a hassle		Quick Logging
Opportunity	Many caregivers	Fragmented consumption data		Shared caregiver
Motivation	Caring for children's health	Monitoring is not yet considered necessary		Feedback
Motivation	Monitoring is carried out when there is a problem	Reactive behavior		Progress insight
Behavior	Monitoring is not routine	COM-B barrier combination		Habit support

From COM-B Diagnosis to Digital Intervention

The results show that intervention design should not begin with the question:

"What features to create?"

But:

"What behavioral barriers do users experience?"

Once the diagnosis is made, the intervention can be adjusted to the dimensions of COM-B.

Capability: Make It Understandable

Obstacles: 1) do not understand the portions; 2) information is too technical; 3) difficulty interpreting consumption.

Interventions: 1) Visual Portion Guide; 2) micro-learning; 3) sample menu by age; 4) personalized meal plan.

Opportunity: Make It Easy

Obstacles: 1) limited time; 2) complicated record-keeping; 3) many caregivers.

Interventions: 1) quick logging; 2) photo-based recording; 3) flexible reminders; 4) shared caregiver; 5) History.

Motivation: Make It Valuable

Obstacles: 1) the benefits of monitoring are not immediately visible; 2) behavior is carried out only when a problem arises.

Interventions: 1) weekly insight; 2) feedback; 3) progress tracking; 4) achievement; 5) personalized recommendation.

Thus:

Capability → capability

Opportunity → easy

Motivation → Mau

↓

Behavior

Sporky Maxi Position

Sporky Maxi is treated in this manuscript solely as a proposed digital product concept used to illustrate how the COM-B diagnosis could be translated into candidate features. It is not an evaluated application, validated prototype, or intervention whose effectiveness is established by the present analysis.

Sporky Maxi should not be positioned from the beginning as a solution that is definitely right.

The platform is more appropriately positioned as the context for the implementation of behavioral diagnosis results.

The plot is:

User data → COM-B Diagnosis → Needs → Intervention Design → Sporky Maxi Implementation

With this approach, the features developed have an empirical basis and not just the developer's assumptions.

Sporky Maxi is conceptually proposed to become a behavioral support system through three stages:

Understand → Act → Sustain

In the Understanding stage, users receive education and portion guidance.

At the Act stage, users are given a simple monitoring mechanism.

In the Sustain stage, users get feedback, progress, reminders, and habit-building support.

Social Marketing as a Support for Intervention

The "One Feed Determines the Future" campaign is more appropriately placed as part of social marketing than simply a product promotion.

Roger et al. (2023) show that social marketing has the potential to result in behavioral change when interventions not only use persuasive communication, but also consider the barriers and values perceived by the target audience.

In this study, communication is not enough to say:

"Mom needs to keep track of the child's food."

Interventions also need to ensure the target audience: 1) able to perform behavior; 2) have a chance; 3) benefit; 4) have a reason to maintain behavior.

The approach changes from:

Product-oriented marketing

Apps → features → use → transactions

become:

Behavior-oriented intervention

Problems → diagnosis → action → repetition → habits → benefits.

Habit Formation

Changes in monitoring behavior can be understood through the following stages:

Awareness → Trial → Repetition → Habit → Maintenance

At the awareness stage, mothers understand the importance of knowing the actual consumption of children.

In the trial stage, behavior needs to be made very simple.

At the repetition stage, the system helps the user perform actions consistently.

At the habit stage, monitoring begins to become part of the routine.

At the maintenance stage, the system helps maintain behavior.

Singh et al. (2024) show that the time of habit formation differs between individuals. Therefore, interventions should not promise that monitoring will become a habit in a given time.

Focus should be on the following: 1) repetition; 2) consistency; 3) context stability; 4) feedback; 5) Reduction of Barriers.

Gamification

Gamification can be used to support the repetition phase.

Nishi et al. (2024) show that gamification in health apps has the potential to have a positive influence on some behavioral outcomes, although its effectiveness depends on the characteristics of the intervention.

Therefore, rewards are not used just to increase clicks or usage time.

Rewards need to be associated with target behaviors, such as: 1) complete monitoring; 2) maintain consistency; 3) completing education; 4) achieve behavioral targets.

In the long run, motivation needs to shift from external rewards to intrinsic benefits.

Theoretical Implications

Research shows that knowledge about nutrition is not enough to explain monitoring behavior.

The theoretical contribution of the research lies in the application of COM-B to show how:

Capability + Opportunity + Motivation

interact in shaping intake monitoring behavior.

The research also expands the orientation of nutrition care from:

Knowledge-based parenting

Directions:

Behavior-based monitoring.

Practical Implications

The results of the study provide several implications.

First, education must be more applicative.

Second, the monitoring system must be simple.

Third, the intervention needs to consider the involvement of several caregivers.

Fourth, the benefits of monitoring must be made visible through feedback.

Fifth, gamification should support behavior, not just engagement.

Sixth, the Sporky Maxi feature needs to be developed based on the diagnosis of user needs.

Research Limitations

The research uses a qualitative approach so that the findings are not intended to be statistically generalized.

The characteristics of a mother's experience can also differ based on education, occupation, socioeconomics, number of children, and parenting patterns.

In addition, the study focused on behavioral determinants and intervention designs so that the effectiveness of the Sporky Maxi feature has not been tested.

Subsequent research can do: 1) quantitative surveys; 2) experiments; 3) usability testing; 4) randomized controlled trial; 5) longitudinal studies.

Follow-up research can also test the relationship between COM-B, feature usage, monitoring intensity, habit strength, retention, and changes in consumption patterns.

Discussion

The results of the study show that maternal behavior in monitoring children's nutritional intake is complex and cannot be sufficiently explained by knowledge of healthy foods alone. Most informants already have a basic understanding of the importance of protein, vegetables, fruits, and dietary variety, but they still experience difficulties in determining portion sizes, estimating the amount of food consumed, and maintaining consistent records. This finding indicates that increased knowledge does not necessarily translate into changes in feeding practices. Gomes et al. (2021), in a systematic review and meta-analysis of web-based interventions for parents, similarly showed that changes in feeding practices require more specific behavior change strategies, such as instruction, behavioral demonstration, and self-regulation, rather than information delivery alone.

The findings regarding the capability dimension reveal a gap between understanding the principles of healthy eating and the practical ability to monitor food intake. This distinction is important because consumption recording requires the ability to identify foods, estimate portion sizes, and interpret recording results. Although food-recording applications have the potential to facilitate this process, their accuracy and ease of use remain important considerations. Zhang et al. (2021) showed that dietary recording applications have the potential to support dietary intake assessment; however, intake estimates generated through these applications may differ from those obtained using conventional assessment methods. These findings reinforce the need for a simple monitoring design that does not require users to perform overly technical calculations or estimates.

Regarding the opportunity dimension, time constraints and the involvement of multiple caregivers emerged as prominent barriers. Monitoring activities may be difficult to sustain if users must enter extensive amounts of data each time their children eat. This finding indicates that the success of digital interventions depends not only on the quality of the information provided but also on the extent to which the intervention fits into family routines. Thomas et al. (2022), in a COM-B-based study of mobile phone-based lifestyle support for families with young children, demonstrated that the implementation of health technology is influenced by users' capabilities,

opportunities, and motivations, as well as those of other individuals involved in its use. The study also highlighted the importance of behavioral recording and feedback features that can be integrated into family health activities.

Accordingly, a child food-intake monitoring system should be designed to minimize the burden of recordkeeping. Features such as quick logging, photo-based logging, consumption histories, and shared access for multiple caregivers may help reduce these barriers. Aguiar et al. (2022) found that mobile health (mHealth) applications incorporating behavior change techniques to support data reporting can employ strategies such as self-monitoring, reminders, feedback, and goal setting to increase user engagement in health reporting. Therefore, the design of Sporky Maxi should not simply increase the number of features but should prioritize mechanisms that make repeated logging easier to perform and sustain.

Regarding the motivation dimension, the study found that concern for children's health was relatively high, but this motivation was not always translated into monitoring behavior. Mothers may want their children to grow up healthy without feeling the need to record their food intake regularly, particularly when no health or growth problems are apparent. This finding indicates that the benefits of monitoring need to be made more tangible to users. Krukowski et al. (2024) identified feedback as an important component of interventions involving self-monitoring. Feedback can help users understand the implications of their recorded behaviors, support goal setting, and sustain engagement, although its effectiveness may vary across interventions.

The framework extends previous research on digital nutrition interventions by shifting the unit of analysis from general nutrition education or overall application effectiveness to the specific behavior of monitoring dietary intake. Whereas Prowse & Carsley (2021) reported heterogeneous effects across digital nutrition interventions, the present simulation identifies specific reasons why a monitoring tool may need to reduce the burden of logging, facilitate coordination among caregivers, and provide interpretable feedback before its effectiveness can reasonably be expected. This contribution represents an extension rather than a confirmation of previous findings: the framework specifies behavior-level mechanisms that can be tested and potentially falsified through subsequent empirical research.

Technology should be treated as a support mechanism rather than a substitute for behavior change. Reviews of digital nutrition resources for parents indicate that intervention effectiveness depends on behavior change content, usability, and user engagement rather than information delivery alone (Zarnowiecki et al., 2020). Self-monitoring and tailored feedback can produce modest improvements in dietary behaviors, although substantial heterogeneity has been reported across interventions (Teasdale et al., 2018). Recent evidence on digital health interventions for parents of preschool-aged children also reinforces the potential value of nutrition-monitoring tools when they strengthen parental nutrition literacy and provide actionable feedback (Ropitasari et al., 2025). Collectively, these studies support the empirical testing of the proposed digital requirements rather than the assumption that the requirements will necessarily improve outcomes.

Overall, the study's findings suggest that the knowing-doing gap in child food-intake monitoring arises from a combination of limited practical skills, barriers associated with parenting routines, and insufficient motivation to monitor intake consistently. Based on the COM-B framework, effective interventions need to address all three dimensions simultaneously. Capability can be strengthened through visual portion-size guidance and practical education; opportunity can be enhanced through rapid, simple, and collaborative recording mechanisms for caregivers; and motivation can be reinforced through feedback, visualizations of child growth and development, and relevant recommendations. Accordingly, Sporky Maxi can be developed as a behavioral support system that bridges nutritional knowledge and daily monitoring practices rather than serving merely as an information source or food-recording application.

CONCLUSION

The first objective was to identify the determinants of maternal monitoring of children's food intake through the COM-B framework. Within the simulation, capability-related barriers involved portion-size estimation and systematic recording; opportunity-related barriers involved time pressure, recording burden, and the participation of multiple caregivers; and motivation-

related barriers involved the gap between general concern for children's health and a sustained commitment to monitoring their food intake. The second objective was to translate this diagnostic analysis into digital intervention requirements. The framework maps capability to practical guidance, opportunity to rapid and collaborative logging, and motivation to feedback and progress indicators. These outputs are conceptual results derived from hypothetical profiles, not empirical findings regarding the prevalence of particular caregiver behaviors.

The study's contribution is a transparent pathway linking an operationally defined knowing-doing gap to a COM-B-based diagnosis and, subsequently, to candidate digital intervention requirements. Sporky Maxi serves solely as an illustrative product concept and has not been evaluated as an intervention. Future research should administer the proposed interview guide to actual caregivers, develop a coding matrix based on real interview transcripts, apply appropriate intercoder reliability procedures or reflexive analytical approaches, and subsequently evaluate usability and behavioral outcomes before making claims about effectiveness. The framework can therefore guide empirical instrument design and prototype development while maintaining a clear distinction between conceptual recommendations and empirically validated results.

ACKNOWLEDGEMENT

The author expresses his gratitude to those who have provided academic support, input, and thought contributions during the process of preparing this research. Appreciation is also expressed to the academic environment of Universitas Ciputra who have supported the process of developing ideas and preparing manuscripts. All responsibility for the analysis, interpretation, and final content of the article remains with the author.

AUTHOR CONTRIBUTION STATEMENT

Heru Gunadi is responsible for the conceptualization of the research, the preparation of the theoretical framework, the design of the methodology, the development of research instruments, the analysis and interpretation of hypothetical simulation material, the mapping of findings using the Capability, Opportunity, Motivation–Behavior (COM-B) framework, the formulation of digital intervention recommendations, the preparation of the initial draft of the manuscript, and the review and editing of the final manuscript. The author has read and approved the final version of the manuscript and is responsible for the entire content of the article.

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