



# Preliminary Study on Dialogue Analysis Using a Health Consultation –Agent Case studies targeting obesity–

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**Abstract :** This study examines the impact of a health consultation agent combined with a digital twin model on behavior change in older adults with obesity risk. Sixty participants interacted with avatars representing their predicted health status based on body composition, diet, and physical activity. The digital twin, powered by machine learning, simulated future BMI and weight under various lifestyle scenarios. Conversations were conducted using a VRM-based agent with prompts about obesity risks, exercise burden, and improvement suggestions. After three days, 95% of participants reported increased motivation to improve health habits. These findings indicate that personalized simulation and empathic dialogue can support health behavior change. Future directions include long-term trials and applications to other conditions such as pregnancy-related diseases.

**keyword :** PHR、 Healthcare, Disease Prediction, Digital Twin

## 1. Background

In Japan and other developed countries, the progression of population aging has made obesity and its associated secondary health risks a pressing social concern. Physical inactivity and poor dietary habits among older adults often lead to muscle loss and functional decline, thereby increasing the risk of cardiovascular disease, diabetes, and sleep apnea. Moreover, the added stress on joints due to weight gain exacerbates conditions such as osteoarthritis and joint pain, significantly reducing the quality of life (QOL) in the elderly.

In recent years, advancements in predictive models using healthcare data and artificial intelligence have accelerated research on digital twins. These models aim to simulate an individual's physiological and behavioral characteristics in a virtual space to forecast long-term health outcomes. By inputting

data such as body composition, dietary intake, and exercise habits, digital twins can predict future body weight and obesity risk under current lifestyle conditions. Furthermore, scenario-based simulations—e.g., “what if exercise time increases?”—enable the identification of optimal intervention strategies and allow for personalized behavioral recommendations [1].

Meanwhile, it has been reported that promoting behavior change requires more than simply presenting numerical data; continuous feedback through dialogue is also effective. Interactive agents using avatars have been shown to enhance user engagement and facilitate empathetic communication, thereby supporting motivation and the development of self-efficacy [2]. In this study, we investigated the impact of combining digital twin-based health prediction with an avatar functioning as a health consultation agent on individuals' willingness to improve their

health habits.

## 2. Method

Sixty subjects participated in conversations and questionnaires with their own avatars predicted by digital twins.

### 2.1 Subjects and Data Collection Methods

A preliminary three-day experiment was conducted with 60 older adults residing in Gunma Prefecture (mean age:  $68.4 \pm 5.7$  years; gender ratio: 1:1; no known medical history). On the first day, body composition measurements were taken for each participant to obtain data on muscle mass, body fat percentage, and basal metabolic rate. Participants also completed questionnaires regarding their daily dietary intake and exercise habits, which were used to estimate their total daily caloric intake and average number of steps. Additionally, participants wore simple activity monitors to record step counts and activity intensity over the three-day period. The study was conducted under the approval of the Medical Ethics Review Committee for Human Subjects at Gunma University, as part of the research project titled “Development of a Health Consultation Agent and Fundamental Evaluation of Its Impact on Behavior Change.”

### 2.2 Digital Twin

Based on body composition measurements and self-reported data, we constructed a digital twin model that virtually simulates each participant's metabolic characteristics and health status. For prediction, we employed an ensemble machine learning model trained on previously collected data from individuals in the same age group, estimating future body weight and BMI at 1, 3, and 5 years. During the experiment, participants' activity monitor data and dietary logs were re-entered each morning to update the simulation results. This enabled scenario analysis, such as estimating a 2 kg weight reduction after one year if daily physical activity were increased by 20 minutes. Figure 1 shows the interface of the digital twin system.

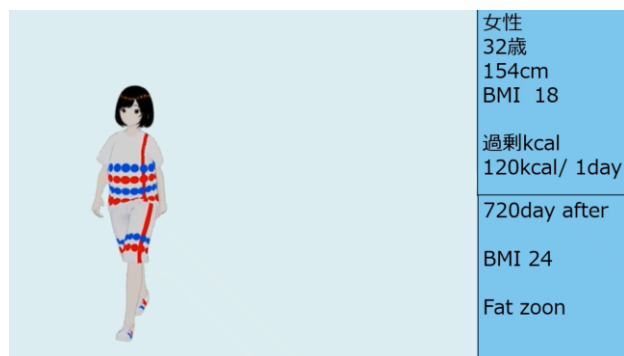


Fig.1 interface of the digital twin system

### 2.3 Health Consultation Agent

The health consultation agent was developed using the VRM format, and the dialogue system was implemented with the AI Tuber Kit. Elderly participants engaged in conversations with the constructed agent, and the interaction process was analyzed. The agent's dialogue was triggered by three main prompts from the avatar, addressing: (1) the risks of obesity and related comorbidities, (2) the burden of maintaining exercise habits, and (3) advice for lifestyle improvement. Figure 2 shows a screenshot of the dialogue interface.

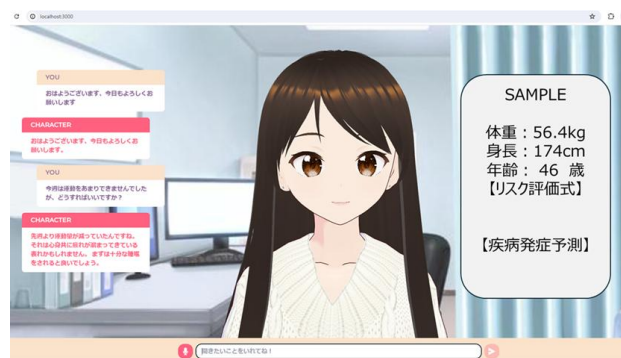


Fig.2 Health Consultation Agent

## 3. Consideration

In this experiment, all 60 participants successfully completed avatar-based dialogues over the three-day period, demonstrating a high level of engagement. Survey results indicated that 57 participants (95%) expressed a desire to improve their health habits, while the remaining 3 were classified as low-risk individuals. These findings suggest that personalized digital twins combined with empathetic avatar interactions may enhance motivation for behavior change.

In particular, the specificity of risk communication appeared to aid participants' understanding. For example, the explanation of weight gain led to episodes of behavioral change, such as “deciding to use the stairs.” Topics such as exercise burden and obesity risk were relatable to older adults and contributed to increased health awareness [3].

Future studies should extend this work into long-term intervention trials to quantitatively evaluate changes in weight and clinical indicators. Enhancing the data infrastructure and incorporating large language models (LLMs) are also expected to improve dialogue quality. By collaborating with physicians and dietitians, AI agents may serve as supportive tools in community-based integrated care.

While this study focused on obesity and exercise habits, we are also developing digital twins and health consultation agents targeting pregnancy-related conditions. By combining predictive algorithms with evidence-based data, we aim to provide reliable feedback to pregnant individuals.

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### Consideration

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