

# PHYSIOLOGICAL-DRIVEN ELDERLY CARE AI ASSISTANT

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Mid-Semester Presentation

# Problem Statement

## **Problem:**

The elderly population is growing, this leads to gaps in continuous monitoring, symptom reporting, medication adherence, and emotional support. Current tools are not intelligent or flexible enough to handle real-world nursing and elderly-care needs.

## **Goal:**

Develop an AI-driven framework using Large Language Models (LLMs) to support nurses and assist elderly individuals through intelligent, conversational, and context-aware guidance.

## **Potential Applications:**

- 24/7 conversational support for elderly patients
- Medication & routine reminders
- Early detection of health risks

## **Impact:**

Improved care quality, reduced nurse workload, enhanced patient safety, and more scalable elderly-care systems.



# JMIR Aging

— Wilmink et al.

Real-World Evidence of a Digital Health Platform for Elderly Care

## **Methods**

- Participants: Residents in 9 assisted living communities (intervention vs control).
- Sensors: Wrist-worn devices tracking motion and vitals.
- System: AI continuously monitored residents' patterns, identifying deviations in sleep, gait, or activity, then notified staff to intervene.
- Duration: 24 months.

## **Results**

- 39% fewer hospitalizations.
- 69% fewer falls.
- Enhanced staff response time and individualized care.

Demonstrates effectiveness of predictive wearables and AI alerts in real-life elder care; though not fully closed-loop, it influenced real-time interventions.

# AI, LLM-powered elderly care

— Khalil et al. (2025)

A narrative interdisciplinary review combining thematic analysis, comparison with existing surveys, and challenge–solution mapping across literature on AI, LLMs, healthcare systems, and ethics.

## **Methods**

- Conducted a narrative interdisciplinary literature review on AI + elderly care.
- Used thematic analysis to categorize applications (companionship, health, cognition, independence, inclusivity).
- Performed challenge–solution mapping (privacy, bias, hallucinations, interoperability, etc.).

## **Results**

- Agentic AI can significantly improve elderly care through personalized emotional, cognitive, and health support.
- Enables independence via smart-home integration and task automation.
- Enhances clinical workflows through predictive monitoring and decision support.
- Key challenges identified: data privacy, LLM hallucinations (5–30%), bias, interoperability, security risks.

The authors find that Agentic AI can greatly enhance elderly care through companionship, health assistance, cognitive stimulation, independence, and inclusivity.

# Formative Study

## Primary objective

Evaluate whether adults **aged 50+** in India are willing to adopt AI-based healthcare assistance, and identify key usability, workload, and trust factors influencing adoption.

## Participants & Procedure

- N = 102 participants, Age 50+
- Self-administered survey (Usefulness, Usability, Trust, Privacy, Behavioral Intention)
- Responses standardized and aggregated into construct scores
- Construct reliability and correlation analysis performed

## This survey contains questions (Likert Based) like:

I am concerned about my privacy with an AI health system.

I would use an AI health system if my doctor recommended it.

An AI system for medication reminders would help me take medicines on time.

# Formative Study

## Correlations:

- Ease of Use → Intention ( $r = 0.23$ )
- Privacy Concern → Intention ( $r = -0.17$ )
- Usefulness → Intention ( $r = 0.03$ ; negligible)
- Usability ↔ Lower Workload ( $r = -0.28$ )

## Subgroup Insight:

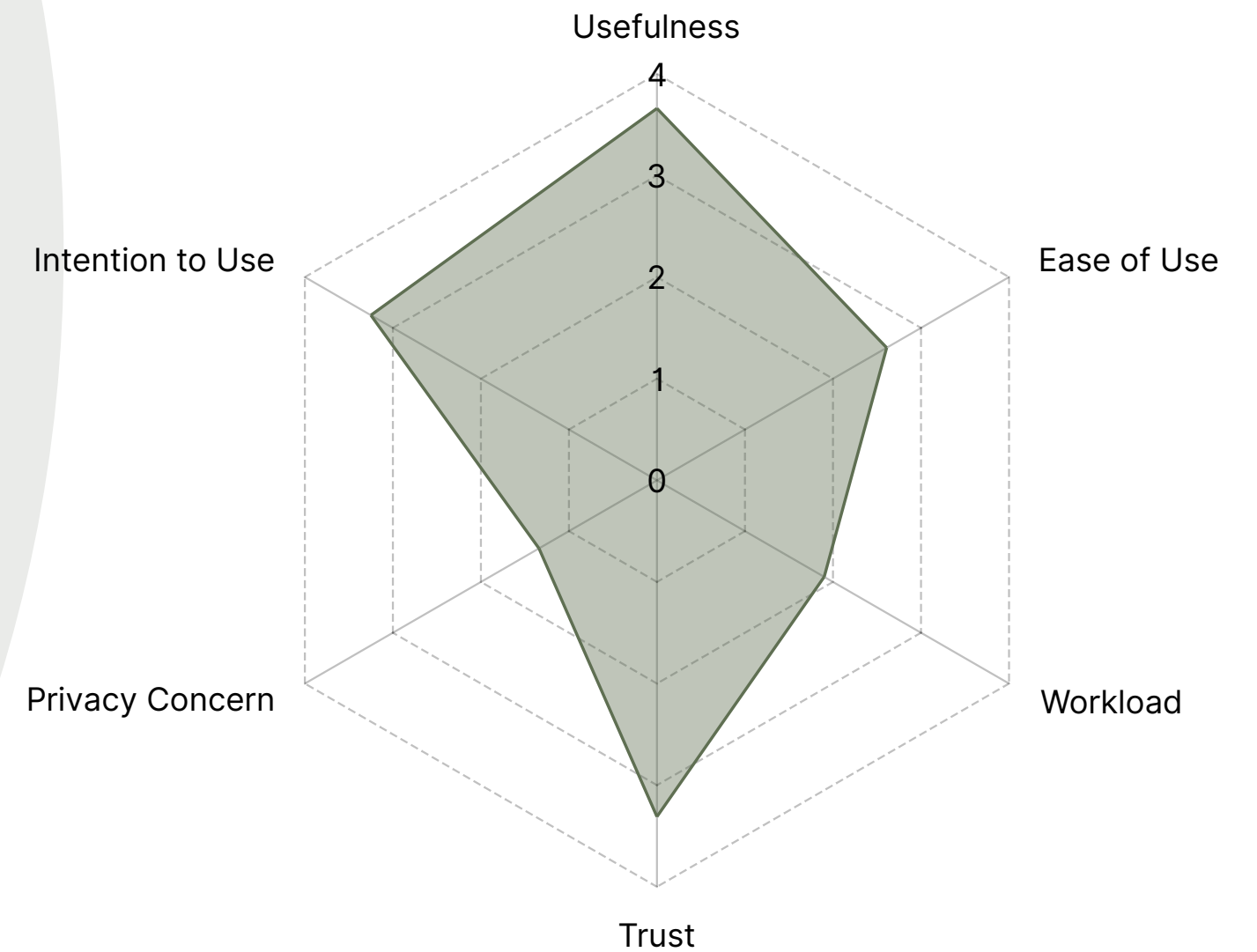
- Chronic-disease users perceive higher usefulness but are not more likely to adopt.
- Even “tech-comfortable” elders still struggle with ease of use.

## Interpretation

Elders see strong value in AI for healthcare, but poor usability and significant privacy concerns limit adoption. Improving simplicity, clarity, and data-transparency will be essential for real-world AI health care applications.

## Elderly Perception of AI Health-Care Tool

Higher the Better



# Objective & Hypotheses

## Primary Objective



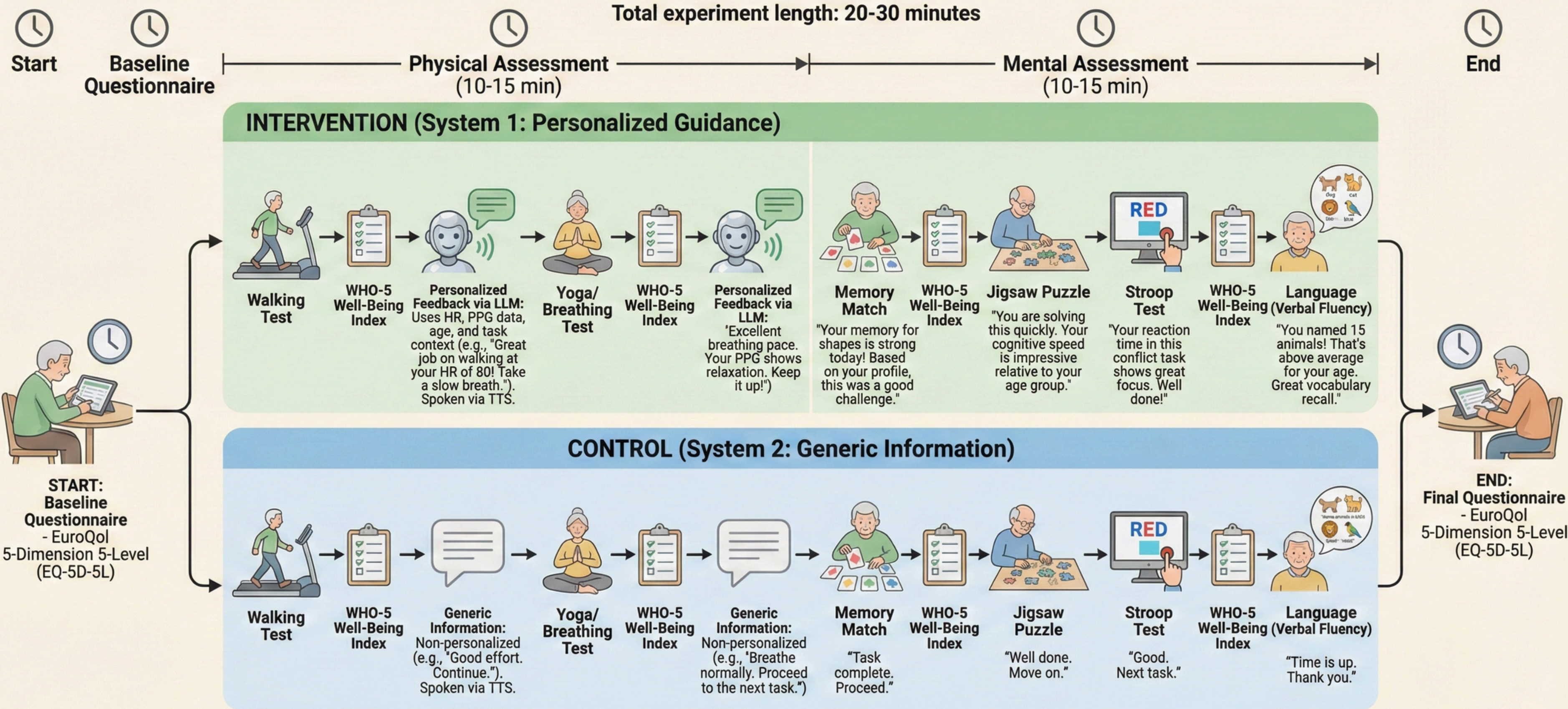
- Evaluate a real-time AI caregiving assistant using only a fitness tracker
- Delivers personalized voice/text prompts vs. generic/passive monitoring
- Within-subject crossover trial with elderly adults (N=5-10,  $\geq 60$  yrs)
- Measure impact on subjective well-being, cognitive performance, and physiological markers

## Hypotheses



- **H1:** Higher momentary well-being (WHO-5) after every task when personalized feedback is active
- **H2:** Better cognitive task performance (memory, executive function, verbal fluency) in intervention condition
- **H3:** Improved health-related quality of life (EQ-5D-5L) at the end of the session with personalized AI
- **H4:** Lower average heart rate and higher step count during physical tasks with real-time guidance

# Experiment Protocol: Intervention vs. Control in Elderly Care AI Assistant Trial

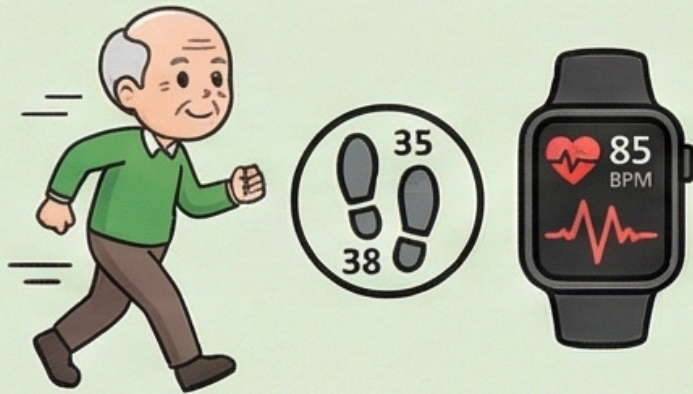


**Key Difference:** **Intervention (Green)** uses AI for personalized messages based on HR/PPG, user profile, and task performance; **Control (Blue)** provides only generic info.

# Evaluation Metrics: Quantitative & Qualitative Measures

## 🕒 Physical Assessment Metrics (10-15 min total)

### Walking Test

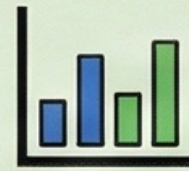
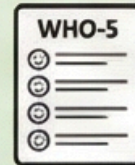


#### Quantitative

- Number of Steps
- Average Pace (steps/min)
- Average Heart Rate (HR from PPG)

#### Qualitative

Followed by WHO-5



Steps



Pace



HR Trend

### Yoga/Breathing Test



#### Quantitative

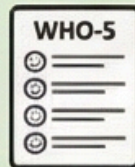
- Average Heart Rate (HR from PPG)



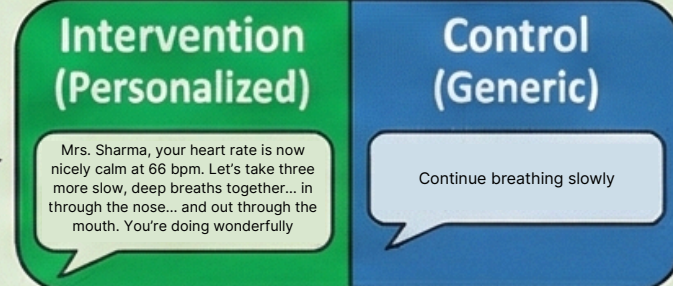
HR over Time

#### Qualitative

Followed by WHO-5



Metrics inform **Intervention feedback** (personalized via LLM) vs. **Control** (generic).



## 🕒 Mental Assessment Metrics (10-15 min total)

### Memory Match

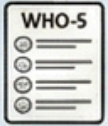


#### Quantitative

- Time to Complete (seconds)
- Accuracy : no. pairs/no. of trials

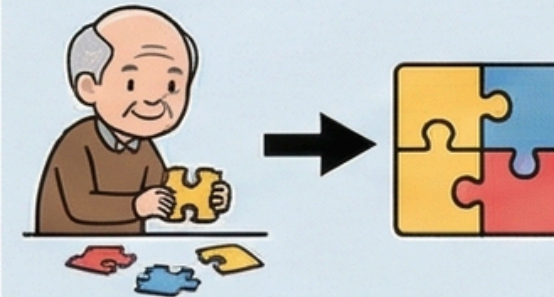


#### Qualitative by WHO-5



Accuracy (e.g., 8/10)

### Jigsaw Puzzle

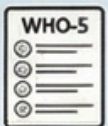


#### Quantitative

- Time to Complete (seconds)
- Accuracy : no. pieces/no. of trials

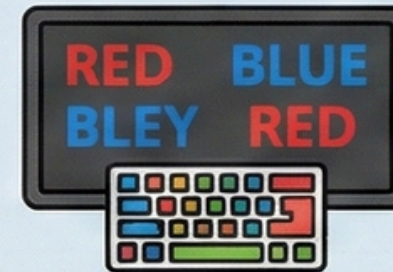


#### Qualitative by WHO-5



Completion %

### Stroop Test



#### Quantitative

- Time for Trials (seconds)
- Accuracy (correct responses / words)

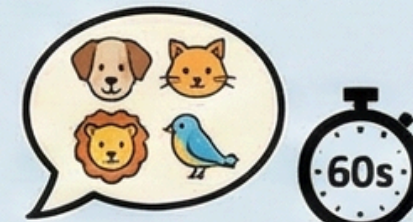


#### Qualitative by WHO-5



Accuracy (e.g., 90%)

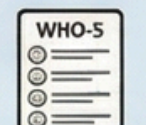
### Language (Verbal Fluency)



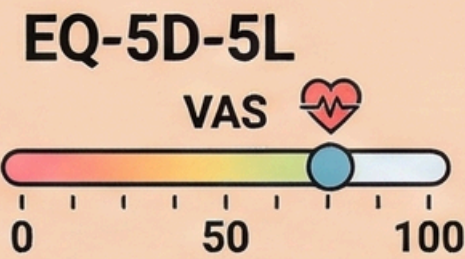
- Word Count (animals named in 60s)
- Unique Word Count

Words (e.g., 15)

#### Qualitative by WHO-5



# Qualitative Metrics: Questionnaires Overview

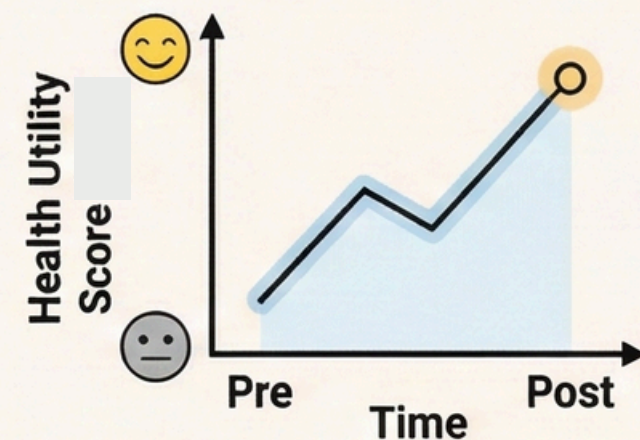
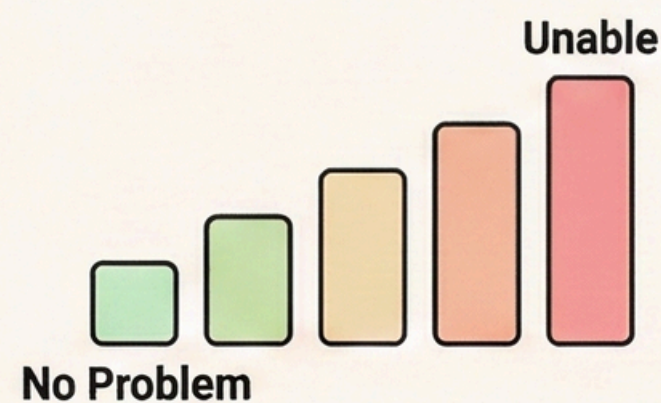


## Key Points

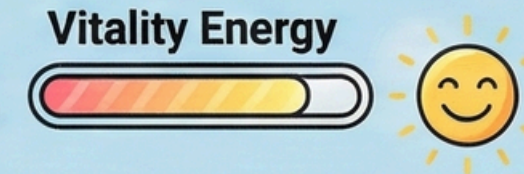
- 5 domains: Mobility, Self-Care, Usual Activities, Pain/Discomfort, Anxiety/Depression
- 5-level Likert per domain
- Visual Analog Scale (VAS) for overall health (0-100)
- Administered pre/post experiment (2-3 min)

## Why Chosen

- Gold standard for holistic health profiling in geriatrics
- Captures physical/mental shifts from interventions
- High sensitivity in short trials (validated in 5,000+ citations)



## WHO-5 Well-Being Index



## Key Points

- 5 items on positive mood, vitality, calm, energy, interest
- 6-point Likert (0-5, all/worst of time to none/best)
- Total score 0-100 (higher = better well-being)
- After each activity (1 min, EMA-style)

## Why Chosen

- Brief for repeated use without fatigue
- Sensitive to momentary intervention effects in elderly
- Validated in 500+ studies for aging populations

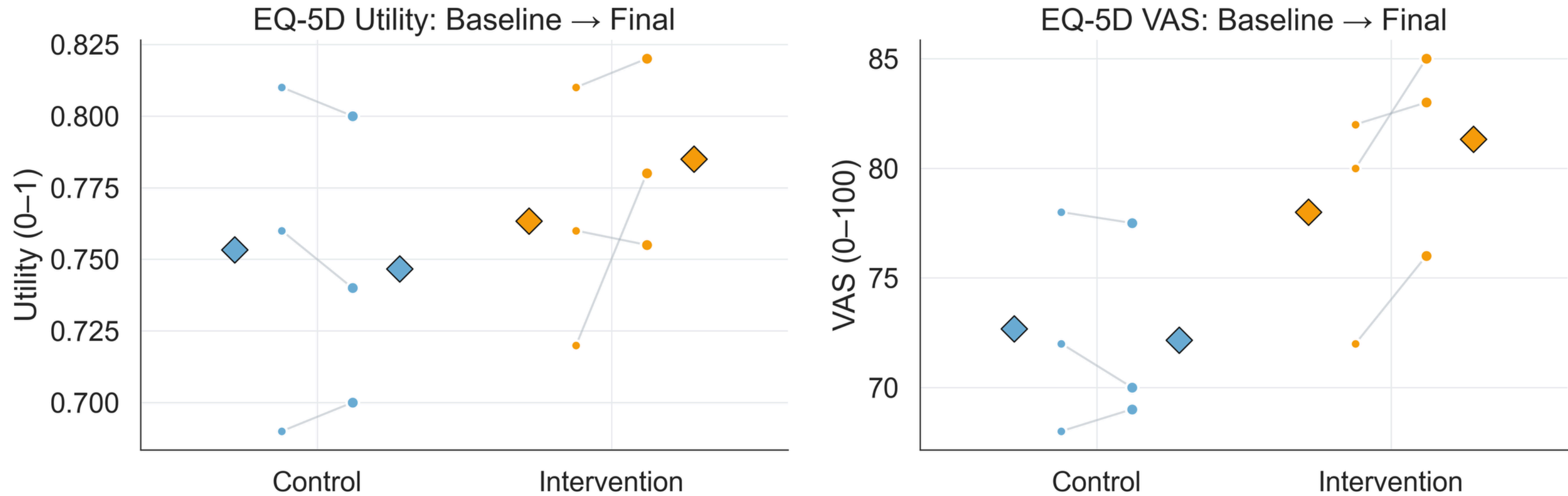


- Positive Mood
- Vitality
- Calm
- Energy
- Interest

**“These tools measure subjective well-being to compare Intervention vs. Control”**

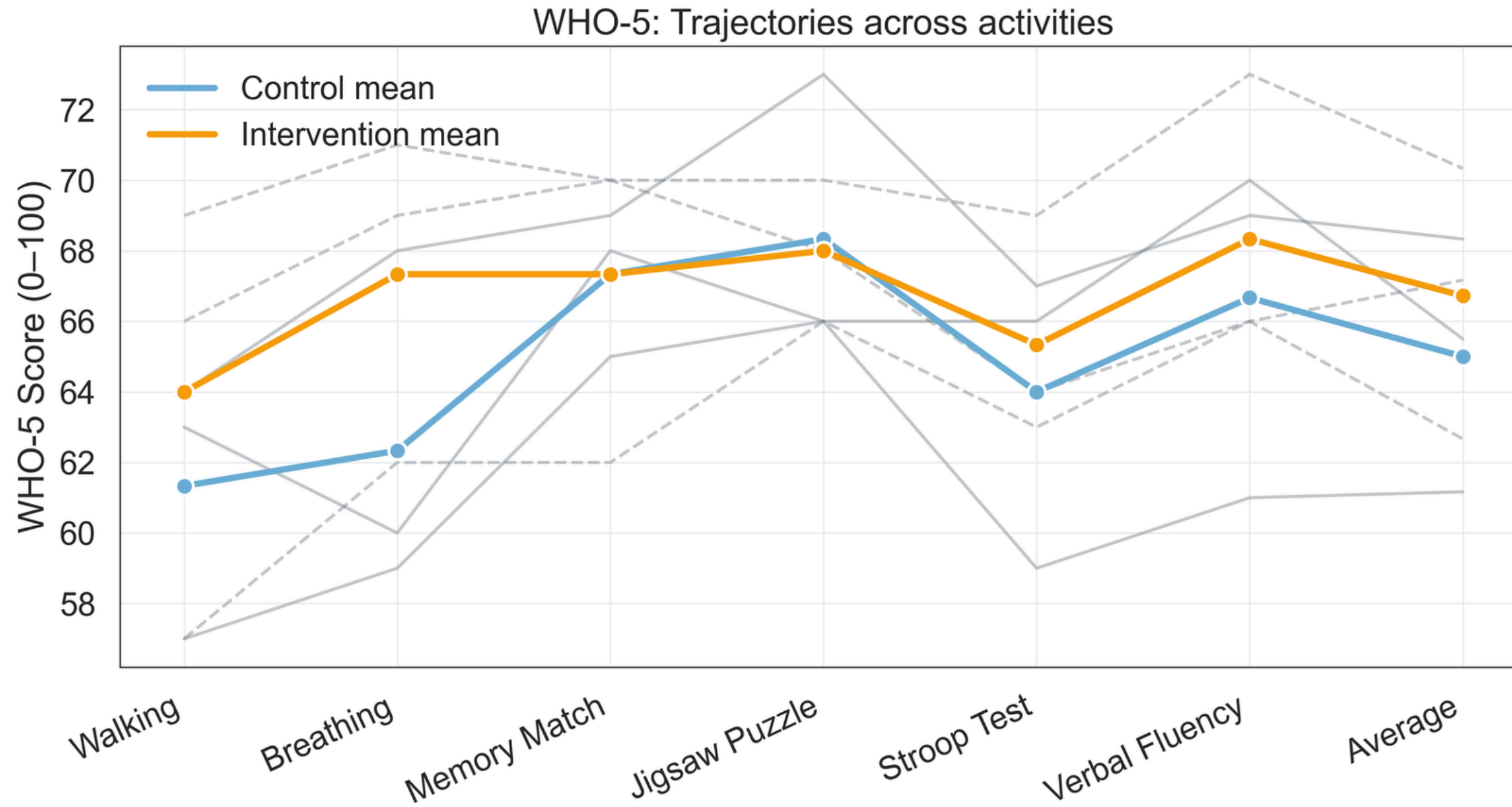
# Results: Qualitative

Paired pre→post EQ-5D (per participant)



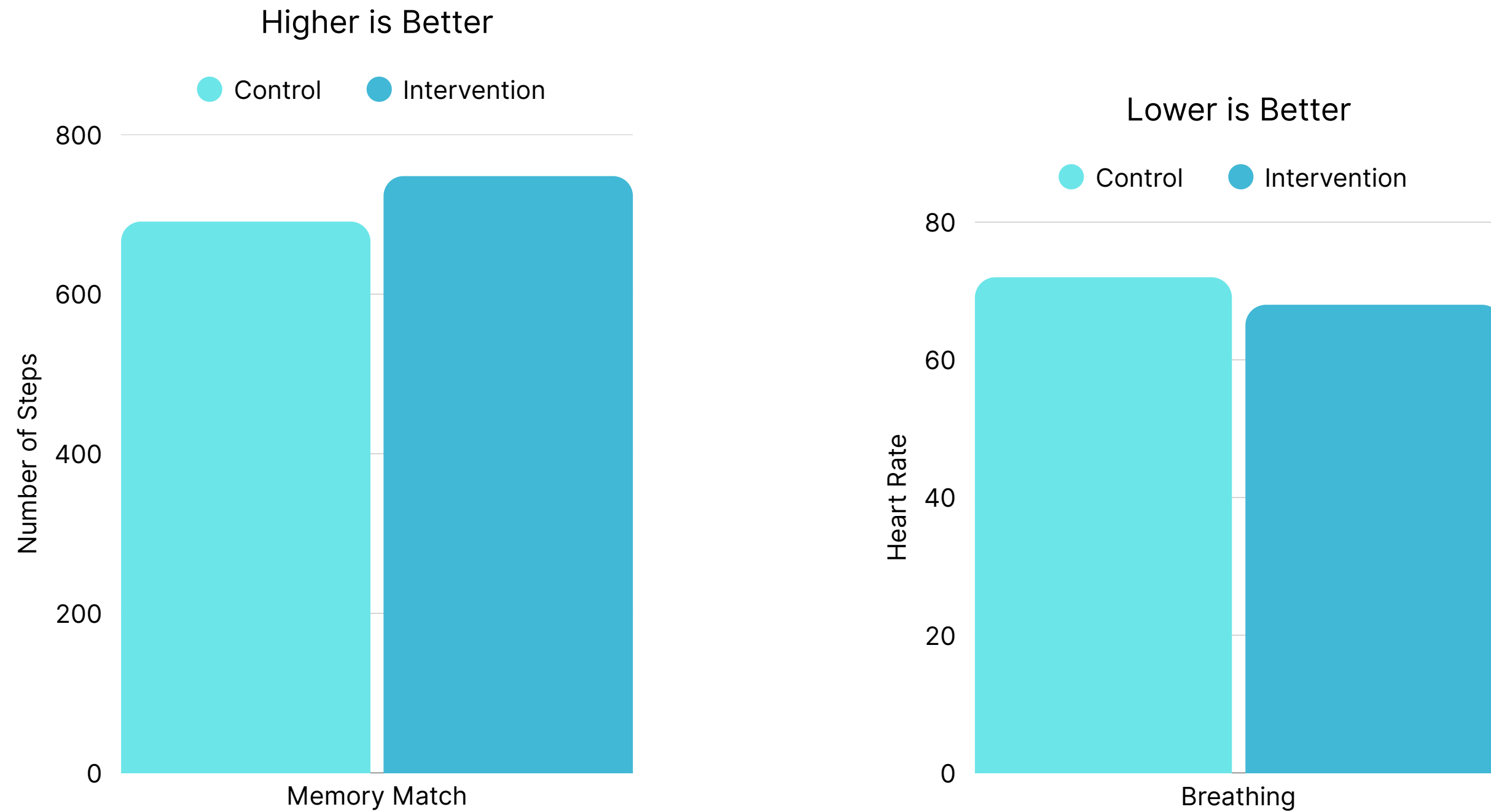
**INSIGHT** : This plot shows the qualitative performance of each participant :  
Baseline vs Final for both Control and Intervention

# Results: Qualitative



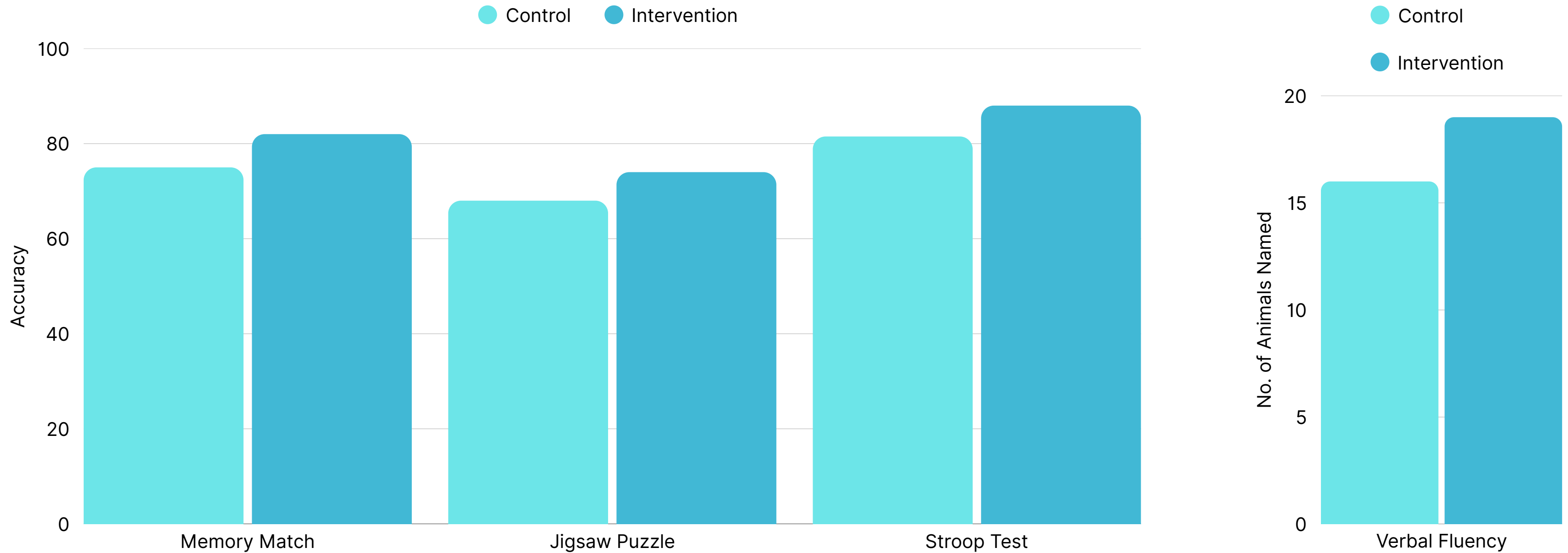
**INSIGHT :** This plot shows the WHO5 wellbeing trajectories across the various activities in the Experiment.

# Results: Quantitative



**INSIGHT :** This plot shows the quantitative comparison for various physical activities conducted for the experiment.

# Results: Quantitative



**INSIGHT :** This plot shows the quantitative comparison for various mental activities conducted for the experiment.

# Impact

## Direct impact

- Reduces nursing workload by automating routine communication and documentation.
- Improves safety through earlier detection of symptoms and timely alerts.
- Enhances elderly well-being with personalized guidance and continuous support

## Larger Implications:

- Makes high-quality care scalable despite workforce shortages.
- Empowers families and caregivers with reliable, on-demand assistance.
- Supports healthier, more independent aging through AI-driven monitoring and advice.

## Why This Work Matters:

Our results show that LLM-based assistance can increase accuracy, reduce errors, and improve patient engagement. This research demonstrates a practical path for integrating AI into real-world nursing and elderly care, potentially transforming global healthcare delivery.

## Future scope / Solution

- Improves safety through earlier detection of symptoms and timely alerts.
- Enhances elderly well-being with personalized guidance and continuous support
- Tested proof of concept with positive results, in the future we can develop this into an app

# Bibliography

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- Herdman, M., Gudex, C., Lloyd, A., Janssen, M., Kind, P., Parkin, D., Bonse, G., & Badia, X. (2011). Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation*, 20(10), 1727–1736
- <https://arxiv.org/pdf/2507.14912v1>
- World Health Organization. *Wellbeing Measures in Primary Health Care / The DepCare Project: Report on a WHO Meeting; Stockholm, Sweden, 12–13 February 1998*. Copenhagen: WHO Regional Office for Europe; 1998.

**THANK**

**YOU**



## Questionnaire

- Perceived Usefulness of AI Health Systems
  - Measures how helpful older adults believe an AI health monitoring system would be for managing their health, medications, and daily habits.
- Perceived Ease of Use
  - Evaluates how easy, intuitive, and understandable older adults feel an AI health system would be to learn and operate.
- Usability & User Experience
  - Assesses the usability of an AI health system, including simplicity, complexity, confidence in use, and need for assistance.
- Cognitive & Physical Workload
  - Measures the mental, physical, and emotional effort required to use the AI health system, along with perceived performance and frustration.
- Behavioral Intention to Use
  - Determines whether older adults are willing to use, adopt, and recommend an AI health monitoring system in the future.
- Trust & Privacy Concerns
  - Examines the level of trust in AI-generated health information and the privacy concerns associated with using such a system.