Using smartwatches to track daily symptoms in individuals living with multimorbidity

Syed Mustafa Ali

Research assistant – health informatics

Background

Multimorbidity (or multiple long-term conditions)

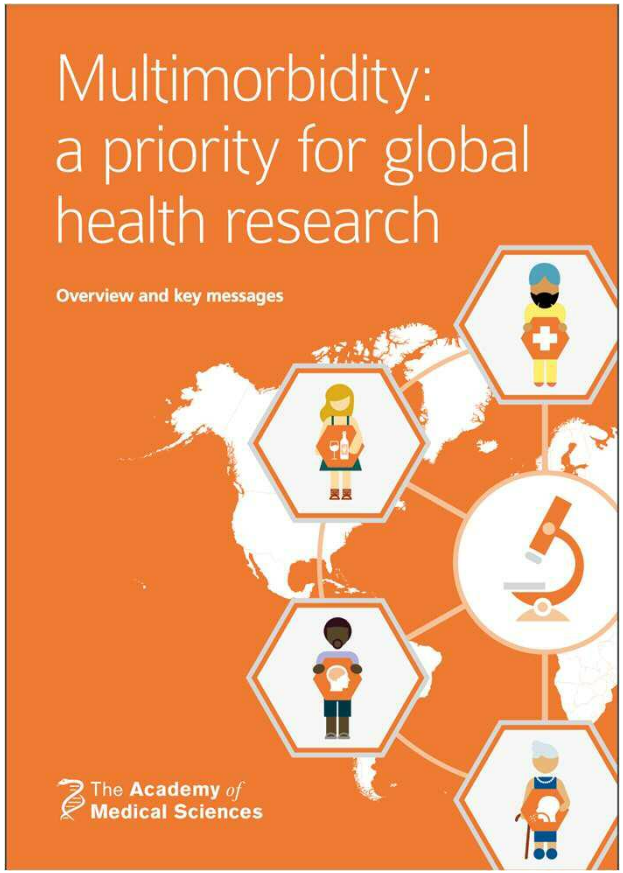
- 24% of UK population
- 54% of over 65s in 2015 (Kingston *et al.*, 2018)
- To increase to 68% by 2035 (Kingston *et al.*, 2018)
- 1 in 3 urgent hospital admissions have 5+ LTCs (Department of Health and Social Care, 2021)

Background

A research priority

- “Despite the huge problems multimorbidity brings, **there is surprisingly little research into its impact on patients, healthcare systems and society at large.**

- There is very little information about how many people - and which types of people - suffer from multimorbidity, which medical conditions occur together most commonly, and the **toll that multimorbidity has on everyone’s health**.”



Background

A research priority

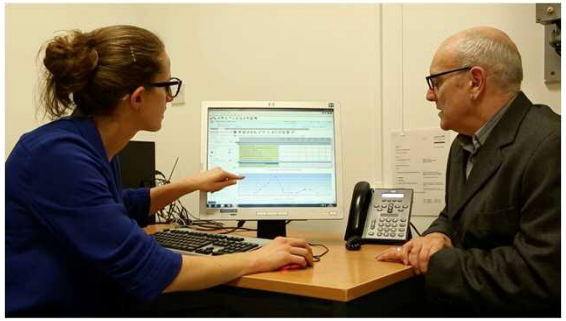
Aims to drive advances in understanding of multimorbidity:

- ‘Bringing together long-term remote monitoring, digital epidemiology and continuous disease monitoring’
- ‘Developing measures to collect, link, store and share appropriate data and outcomes for multimorbidity, particularly focusing on longitudinal aspects including continuous disease monitoring’

Background

Consumer devices for health

- Self-management
- Clinical care
- Population health research



REMORA

CLOUDY WITH A CHANCE OF PAIN

Background

Opportunities from smartwatches

- Self-reported data via touchscreen, in theory multiple times per day

and

- Near-continuous passive sensor data

and

- Feedback via watchface

Background

Watch Your Steps – Objectives

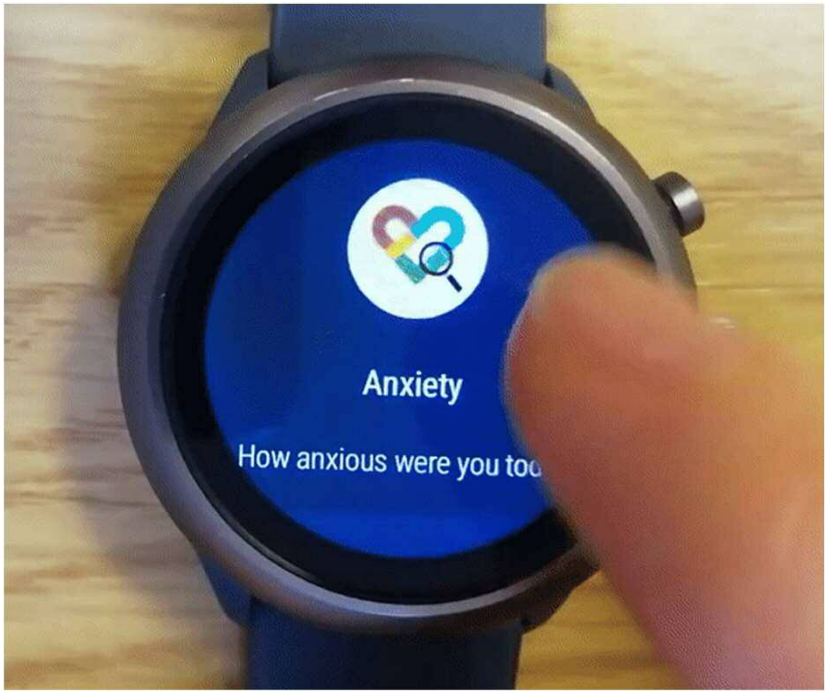
- Through our smartwatch feasibility study, we:
  - aimed to assess levels of engagement through time
  - and to illustrate what symptom patterns became apparent through tracking daily data.

Methods – design and settings

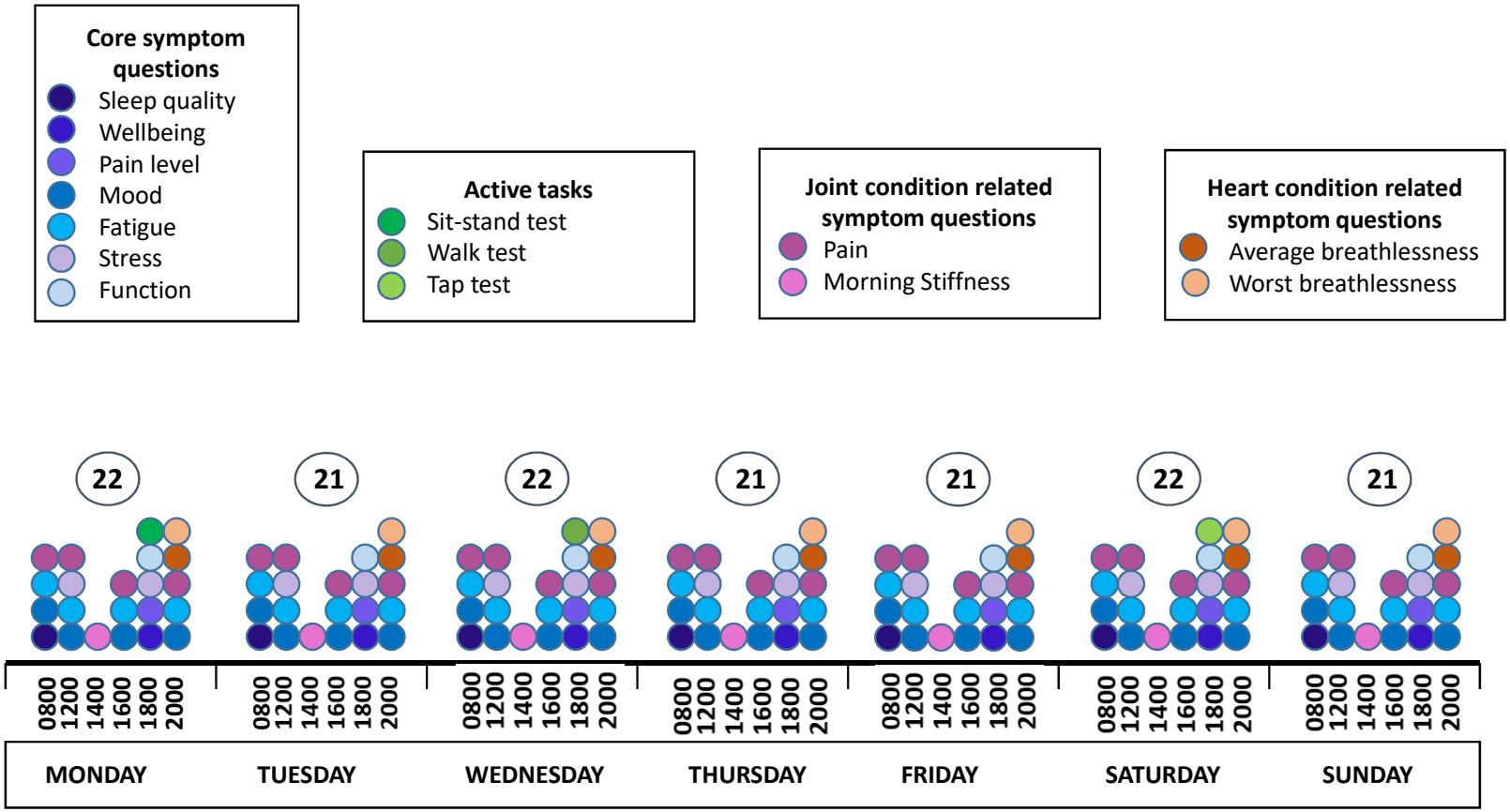
- A prospective observational smartwatch
- Daily data collection for multiple times in a day for 90 days.
- Adults with clinician-diagnosed multimorbidity were recruited from clinical settings (in Greater Manchester) and patient and public involvement groups.
- Eligible people were loaned a Fossil Sport smartwatch with a pre-loaded data collection app.

Methods

Watch Your Steps



Methods – collection and analysis (example participant)



Methods – collection and analysis

- We calculated completion rates to assess levels of engagement through time. Daily completion rate of these symptoms was calculated by proportions of scheduled daily questions answered by each participant on each day.

$$\textbf{Completion rate} = \frac{\#\ \text{completed tasks}}{\#\ \text{tasks scheduled}}$$

Scheduled: timely, prompted by app

Additional: untimely and/or unprompted

Methods – collection and analysis

- We calculated mean daily reported scores for pain, fatigue and mood over the course of the study and presented as smoothed patterns. These are illustrated through three representative example participants.

Pain level	How was your overall level of pain today?	NRS 0-10	0 = “No pain” 10 = “Worst possible pain”
Mood	How is your mood?	NRS 0-10	0 = “Very low” 10 = “Very happy”
Fatigue	How much fatigue do you feel?	NRS 0-10	0 = “No fatigue” 10 = “Extreme fatigue”

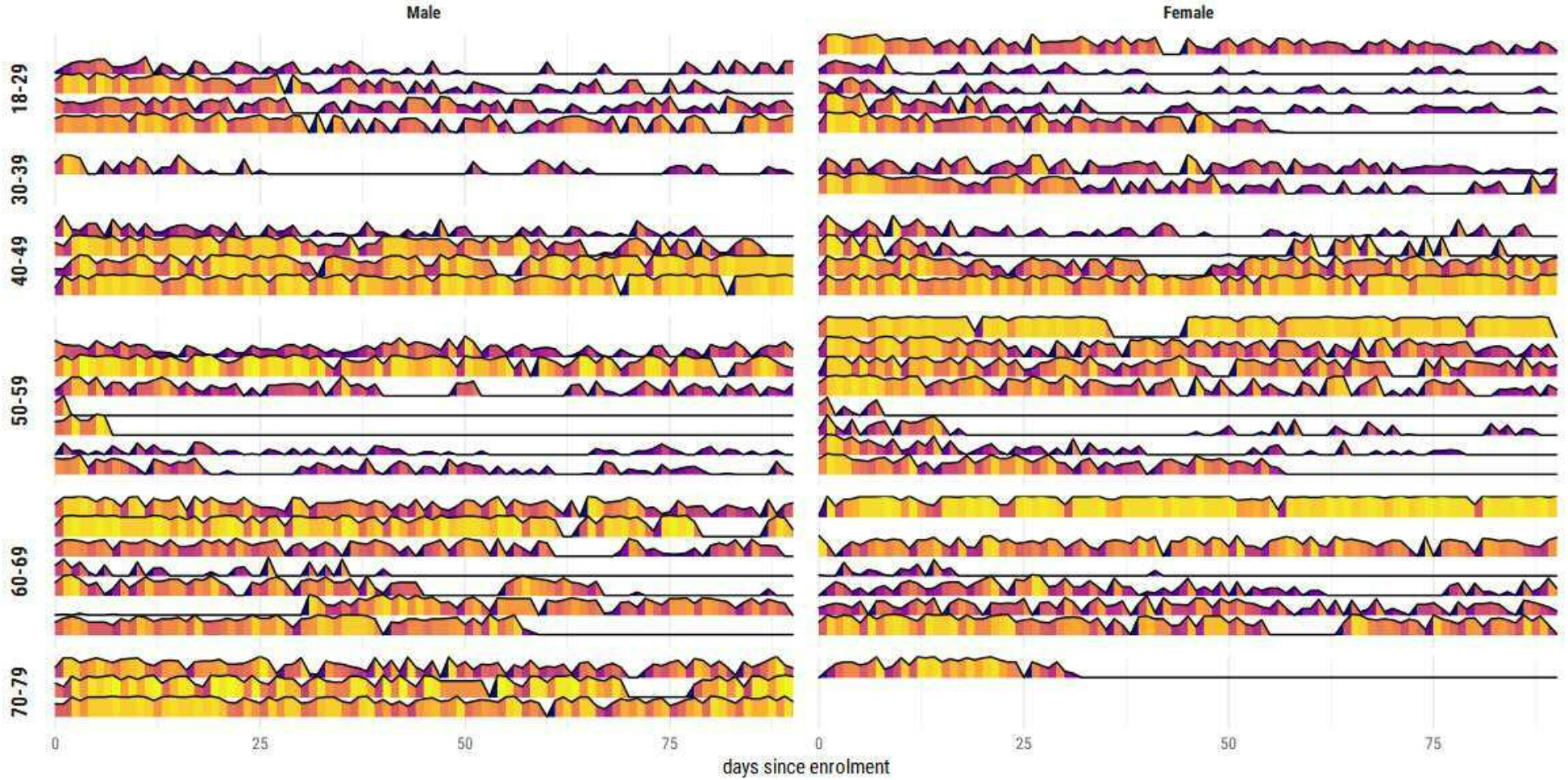
Results

Completion rates

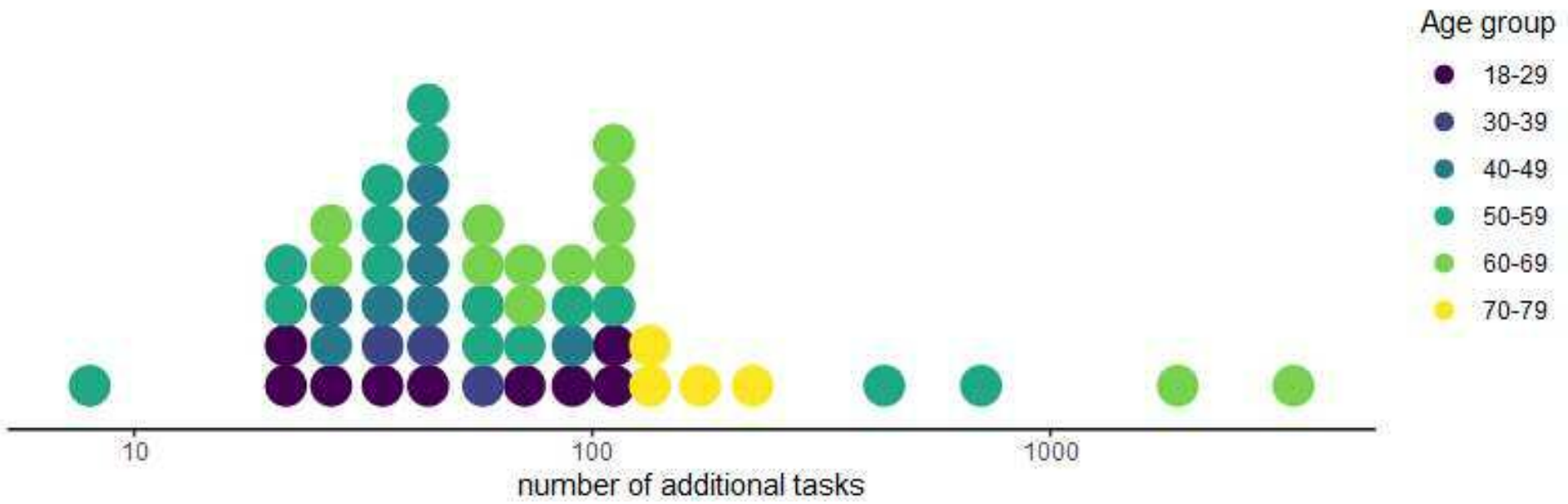
- Fifty three participants took part in the study:
  - Approx. half of them male (n=26; 49%);
  - and half aged between 50 and 69 years (n=28; 52%).
- The majority provided data throughout the study, although sometimes at low rates and at sporadic intervals

Results

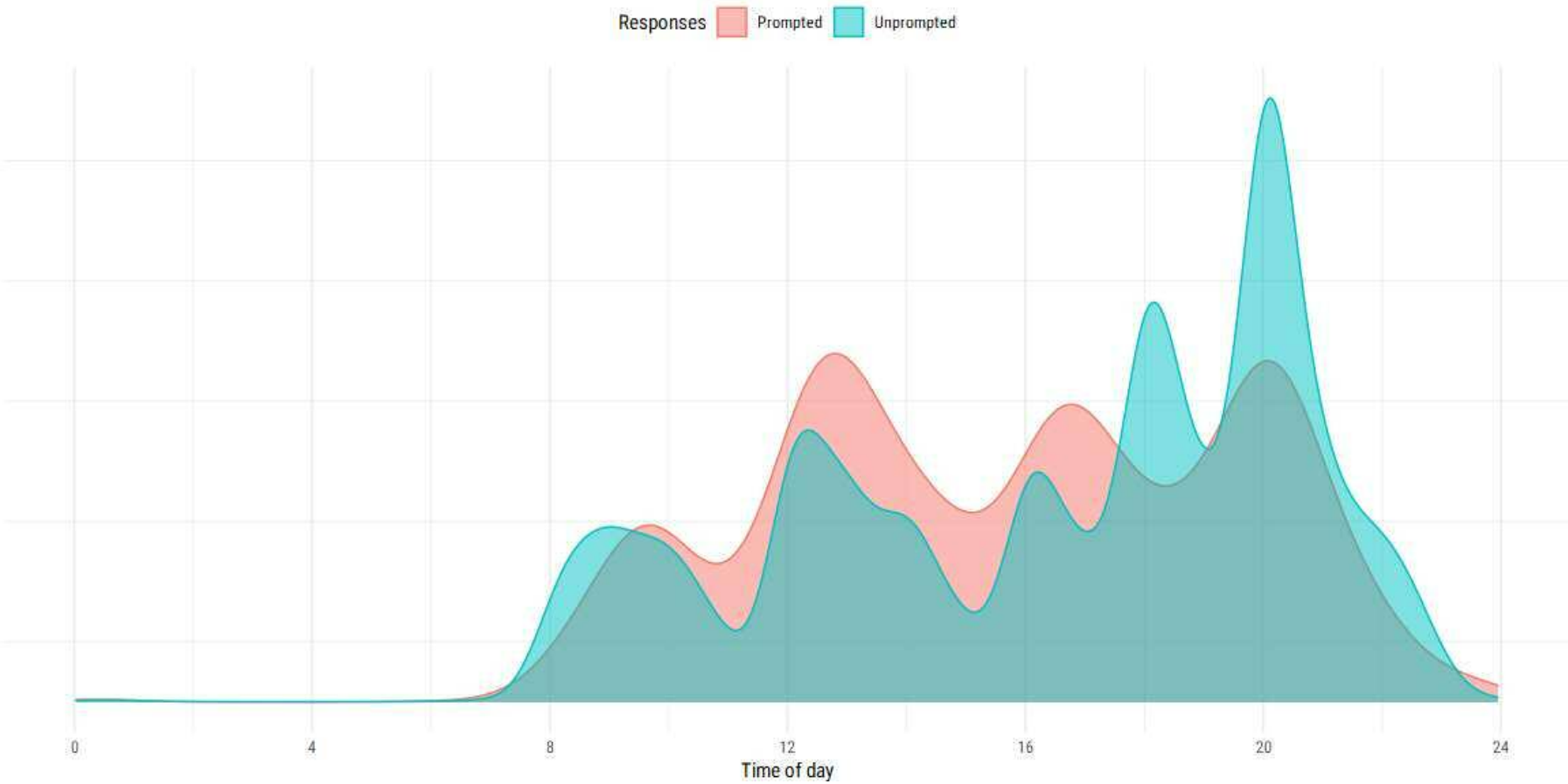
Completion rates



Additional tasks



Responses by time of day



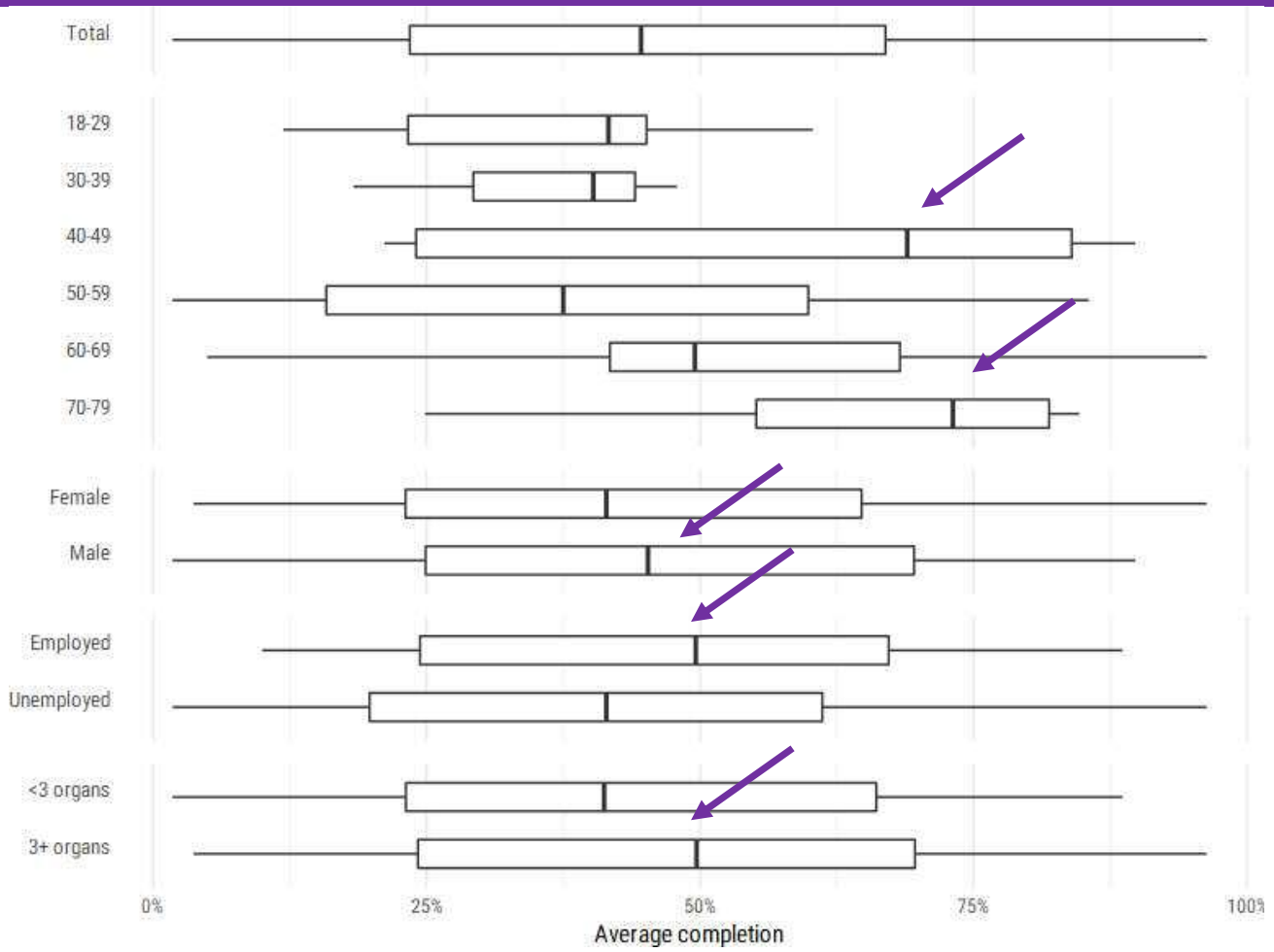
Results

Completion rates

- The median question completion rate was 45% (IQR 23-67%):
  - It was the highest among 70-79-year-olds with 73% completion (55-82%).

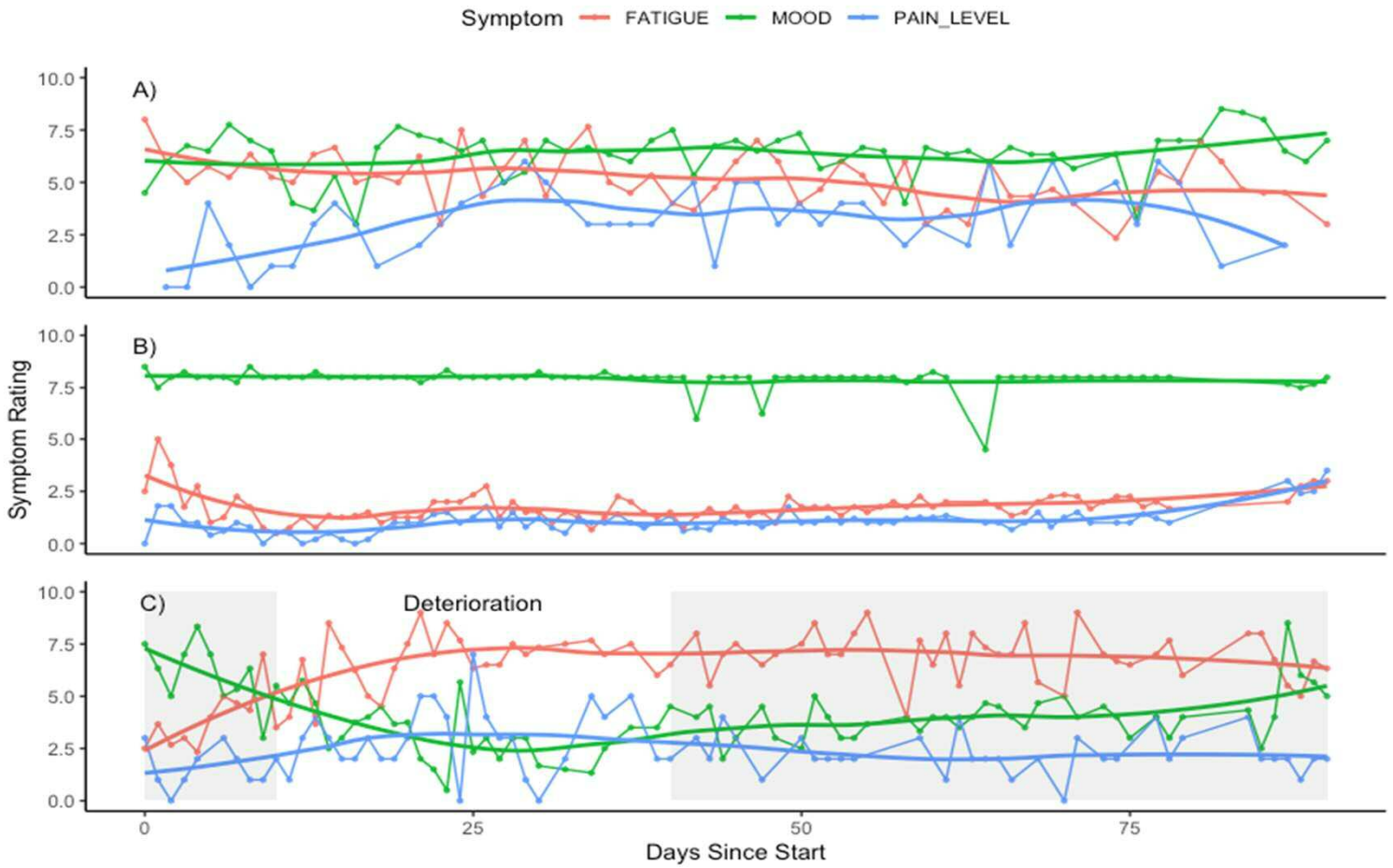
Results

Average completion



Results

Patterns in self-reported symptoms

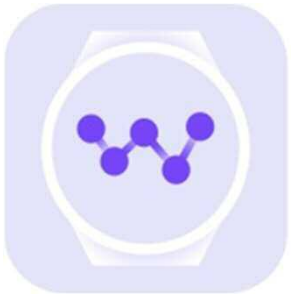


- FATIGUE
  - (0 is best)
- PAIN LEVEL
  - (0 is best)
- MOOD
  - (0 is worst)

- Volatility Vs Stability
- Long Vs Short term trends
- Relationships between symptoms

Conclusion

- This study demonstrates smartwatches are a feasible tool for collecting daily multiple symptoms from individuals living with multimorbidity.
- Also, smartwatch data collection captures symptoms' variability in real-time, which is otherwise dependent on recall at intermittent visits in clinical care and in research studies.



watch
your steps

Thanks for your attention!

Syed Mustafa Ali
syedmustafa.ali@manchester.ac.uk