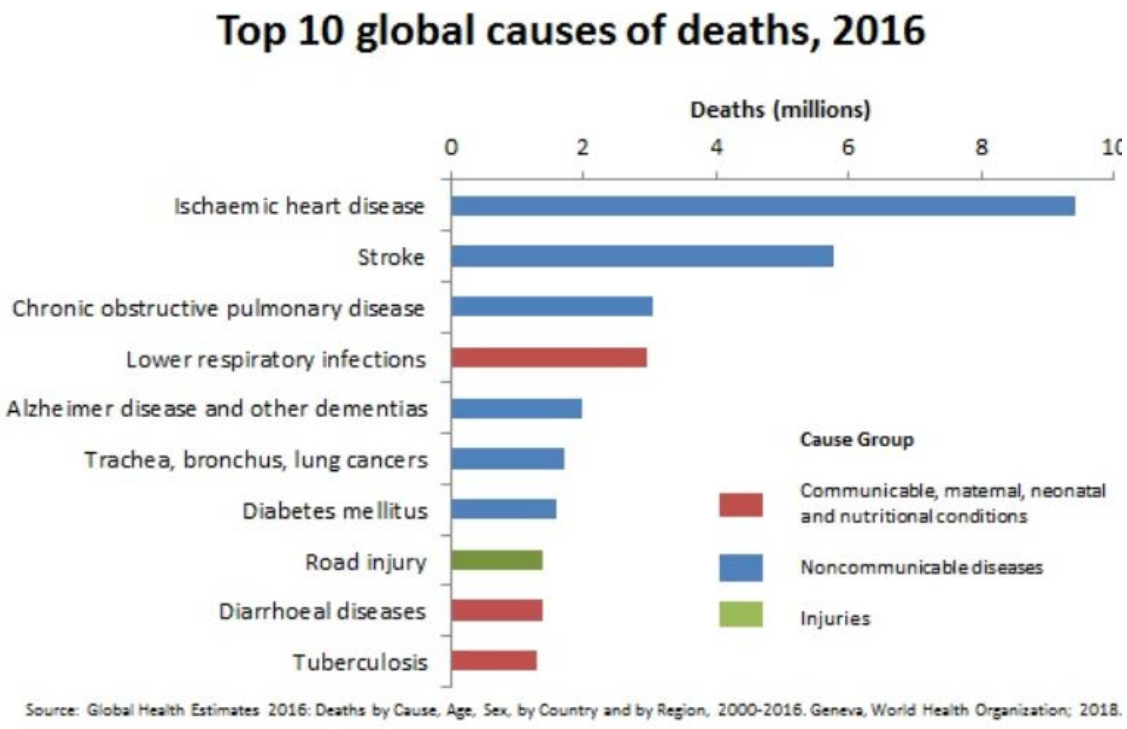
Personalized Lifestyle Interventions – opportunities and challenges

Falk Müller-Riemenschneider
Saw Swee Hock School of Public Health, National University of Singapore
Email: ephmf@nus.edu.sg

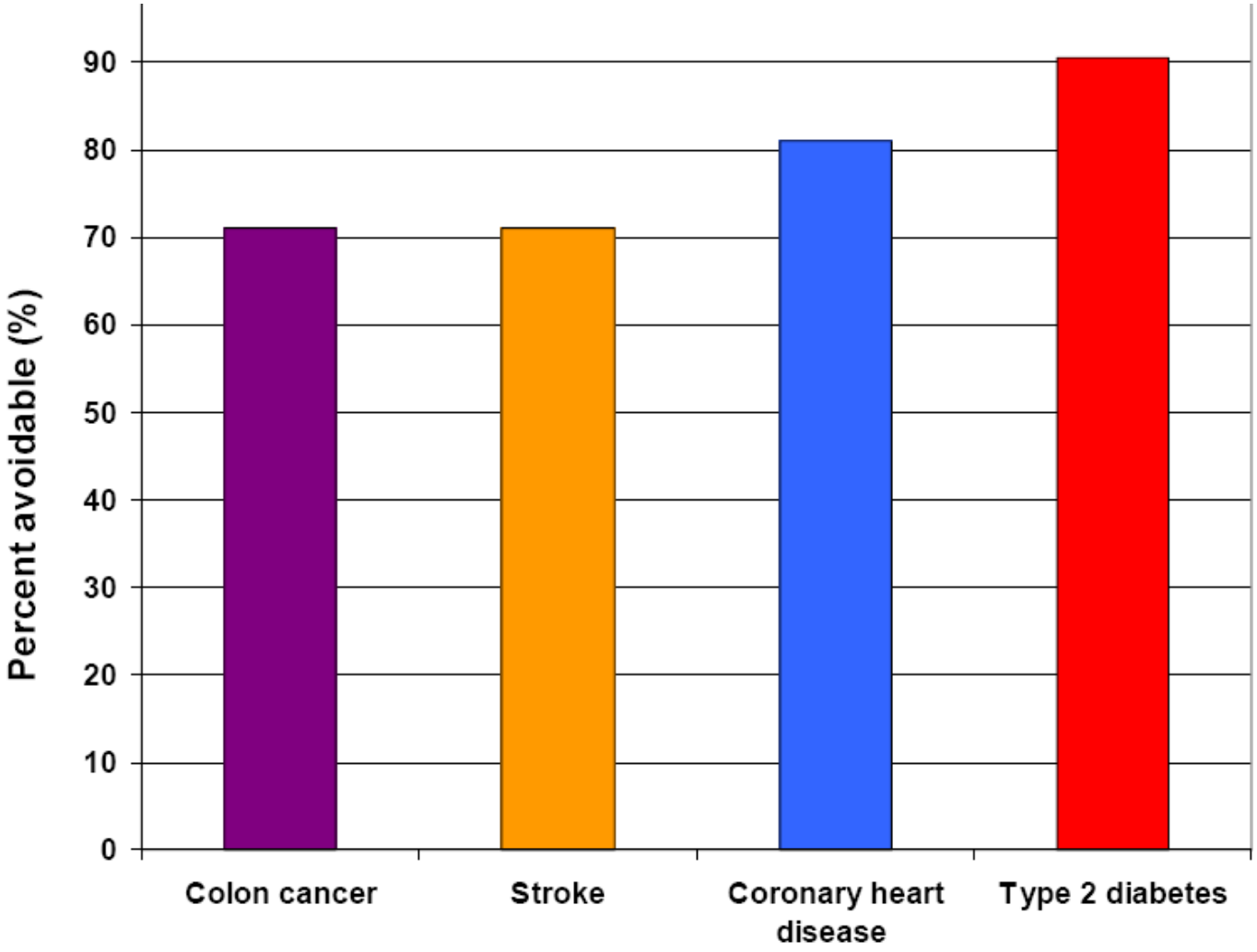
Content

- Lifestyle and population health
- Promoting healthy lifestyles
- Ecological momentary assessment/ Personalized lifestyle interventions
- Practice examples

Public Health



Lifestyle factors cause chronic diseases



Willett et al. Science 2002

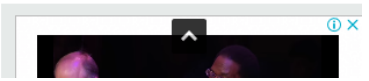
A healthy lifestyle

…commonly relates to these behaviors…

A healthy lifestyle

…Is becoming increasingly important…

Parliament: Health Minister Gan Kim Yong declares 'war on diabetes'; new task force set up



Promoting lifestyle behaviours

Promoting healthy lifestyles

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Knowledge → Attitudes → Intention/ Motivation → Volition → Behaviour

New Study Finds 73% Of People Who Set Fitness Goals As New Year's Resolutions Give Them Up

Whether aiming to lose weight, get fit, or train for an athletic event, simply setting a resolution doesn't guarantee success. On average, people who have set fitness resolutions say they have given up on them four times in the past, and cited a number of stumbling blocks when it comes to achieving their fitness goals:

- 42 percent say it's too difficult to follow a diet or workout regimen
- 38 percent say it's too hard to get back on track once they fall off
- 36 percent say it's hard to find time

Nearly half of those who gave up before reaching their fitness resolution goal did so within six weeks or less.

Increasing personal relevance of lifestyle interventions

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<u>Interventions based on these approaches</u>

1. Targeting

- Based on group characteristics
- Same for all participants

2. Tailoring

- Reach one specific person
- Based on individual characteristics (age, attitudes etc.)
- Related to outcome of interest

(Belton (2014). Youth-Physical Activity Towards Health: evidence and background to the development of the Y-PATH physical activity intervention for adolescents.)

Problems with traditional approaches

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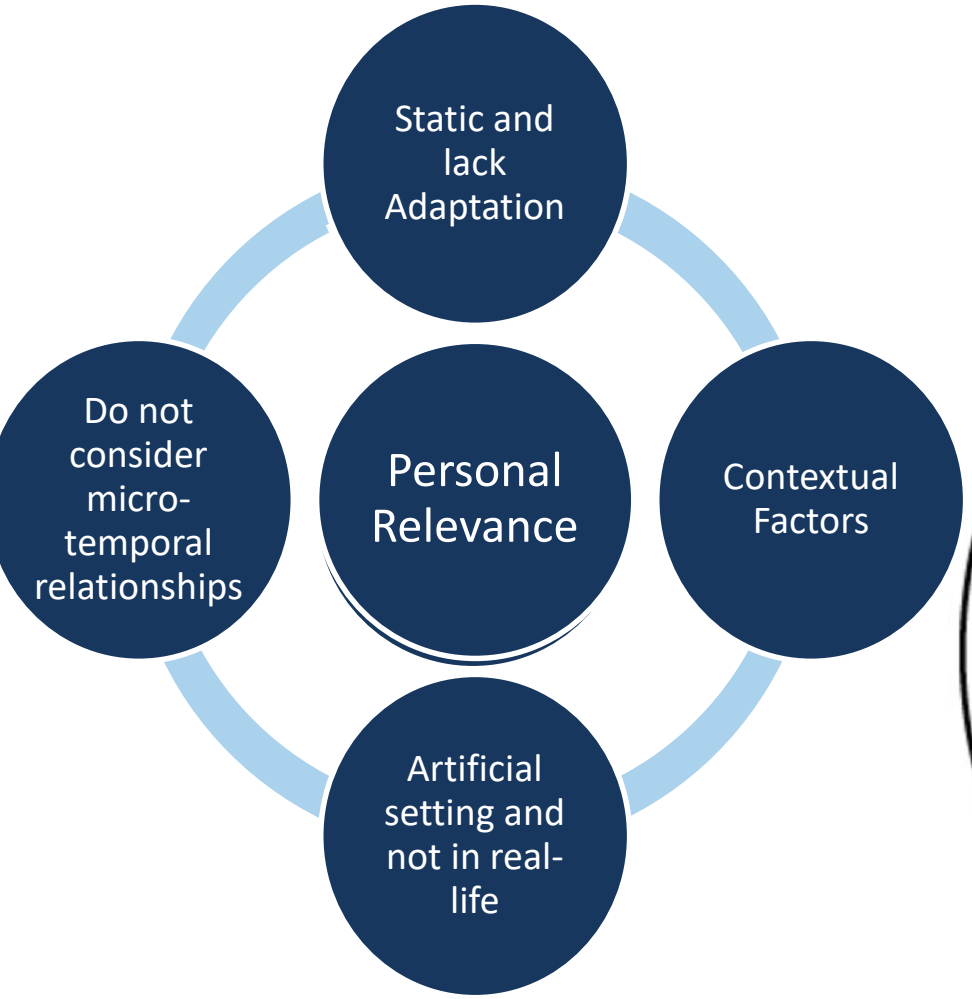
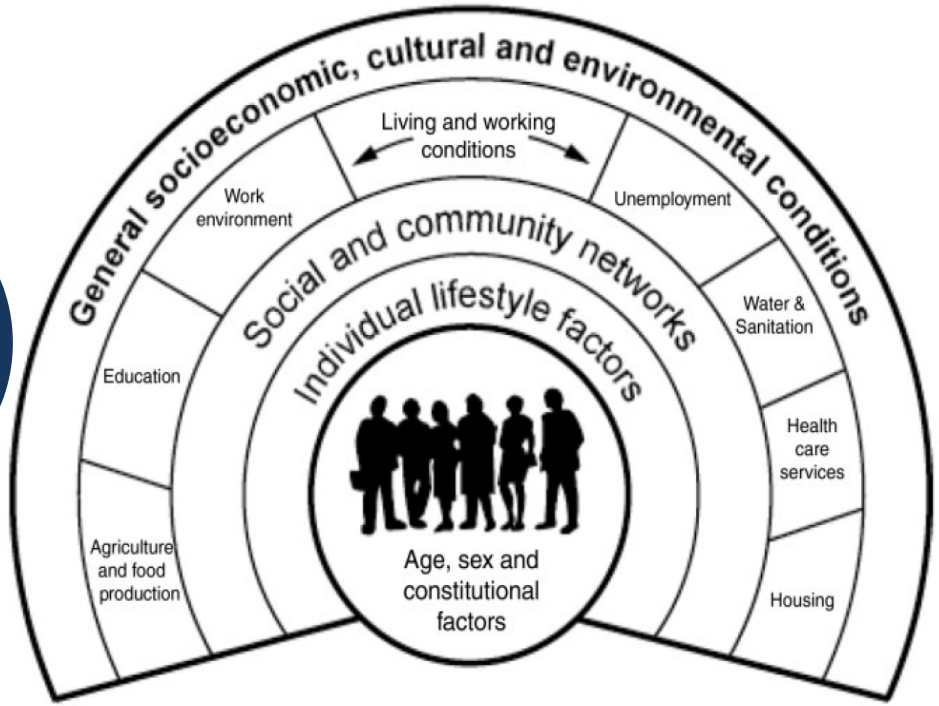
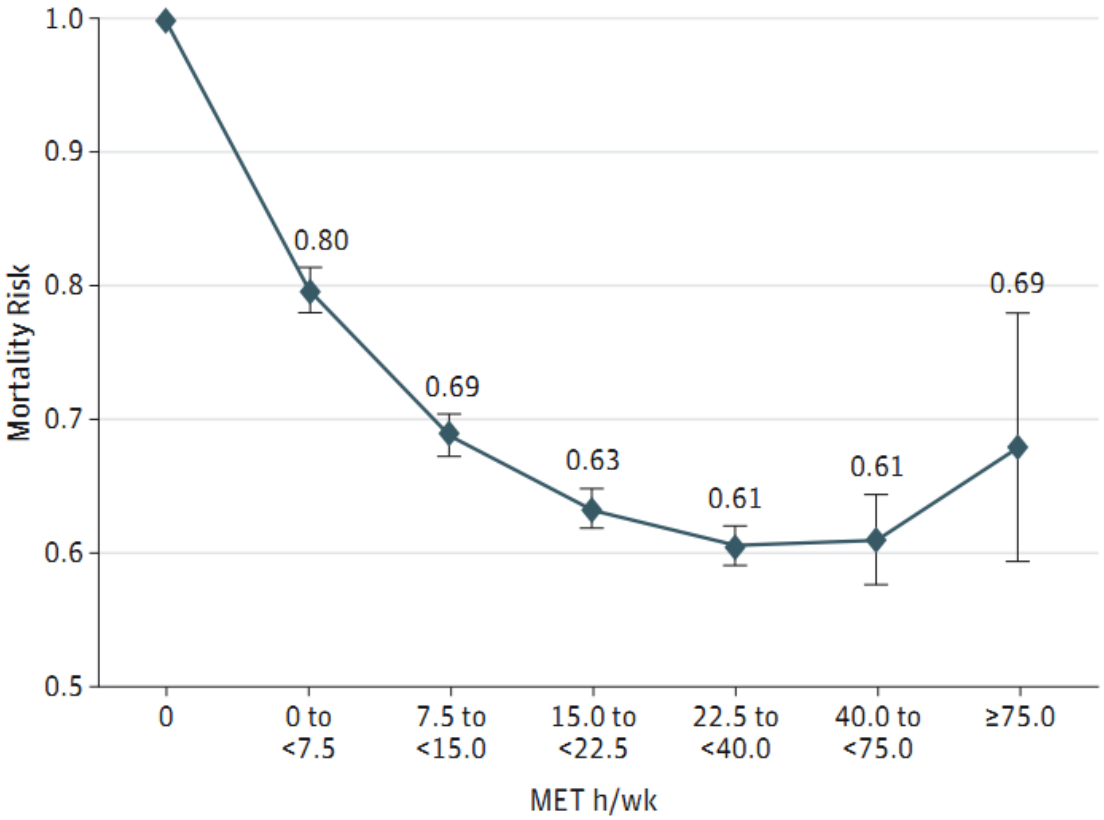




A Social Model of Health (Dahlgren & Whitehead, 1991)

Physical activity and mHealth

Physical activity and health

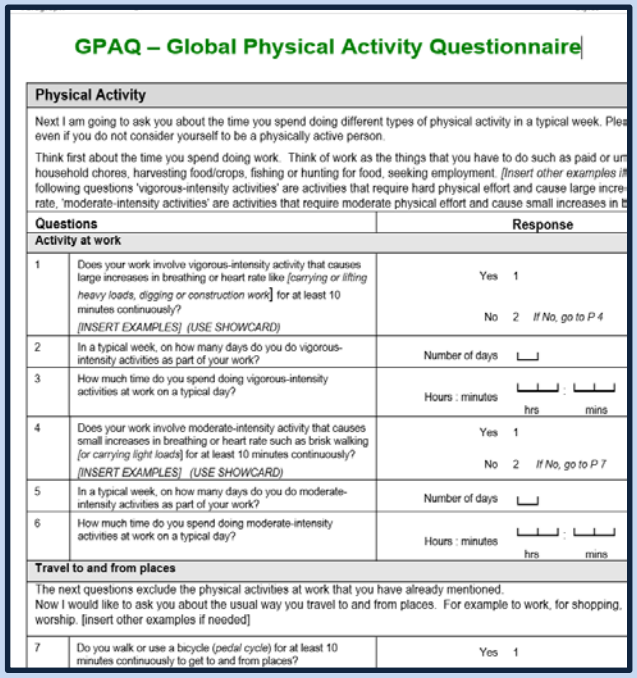


Physical Activity

1. Some is good!
2. More is better!
3. It cannot be too much!

Arem et al. Leisure Time Physical Activity and Mortality A Detailed Pooled Analysis of the Dose-Response Relationship. JAMA Int Med 2015

Measuring physical activity



GPAQ – Global Physical Activity Questionnaire

Physical Activity

Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Ples
even if you do not consider yourself to be a physically active person.

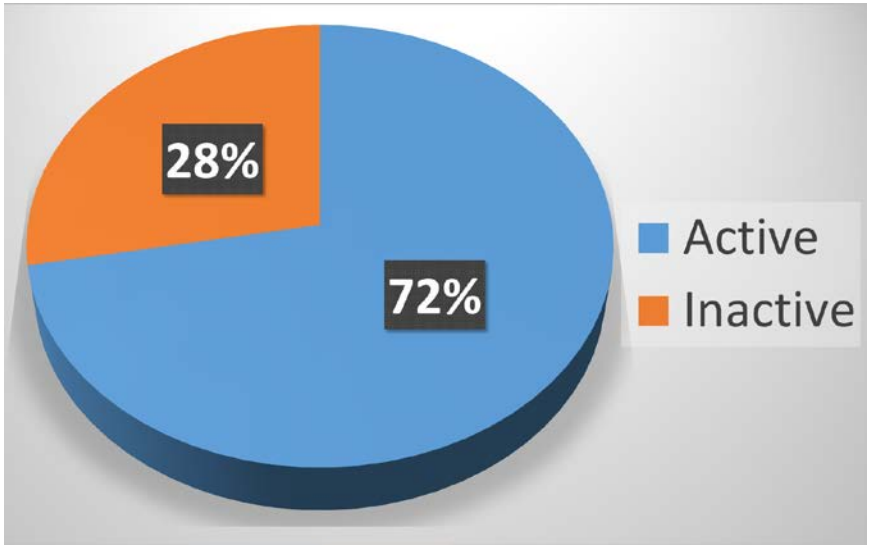
Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or un
household chores, harvesting food/crops, fishing or hunting for food, seeking employment. *[Insert other examples li*
following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large incre
rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in b

Questions		Response
Activity at work		
1	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like *[carrying or lifting heavy loads, digging or construction work]* for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 *If No, go to P 4*
2	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days ⌊_⌋
3	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hours : minutes ⌊_⌋⌊_⌋ : ⌊_⌋⌊_⌋ hrs mins
4	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking *[or carrying light loads]* for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 *If No, go to P 7*
5	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days ⌊_⌋
6	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours : minutes ⌊_⌋⌊_⌋ : ⌊_⌋⌊_⌋ hrs mins
Travel to and from places		
The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, worship. [insert other examples if needed]		
7	Do you walk or use a bicycle (*pedal cycle*) for at least 10 minutes continuously to get to and from places?	Yes 1

What proportion of Singaporeans is active?

Meeting Physical Activity Recommendations
Singapore Health study

Self-report



Technology for physical activity measurement

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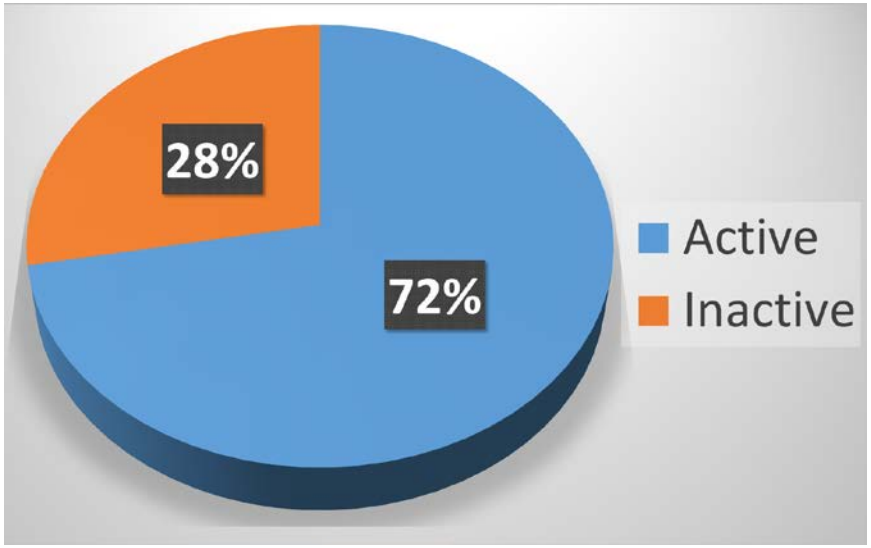
What proportion of Singaporeans is REALLY active?

Key advantages of using technology

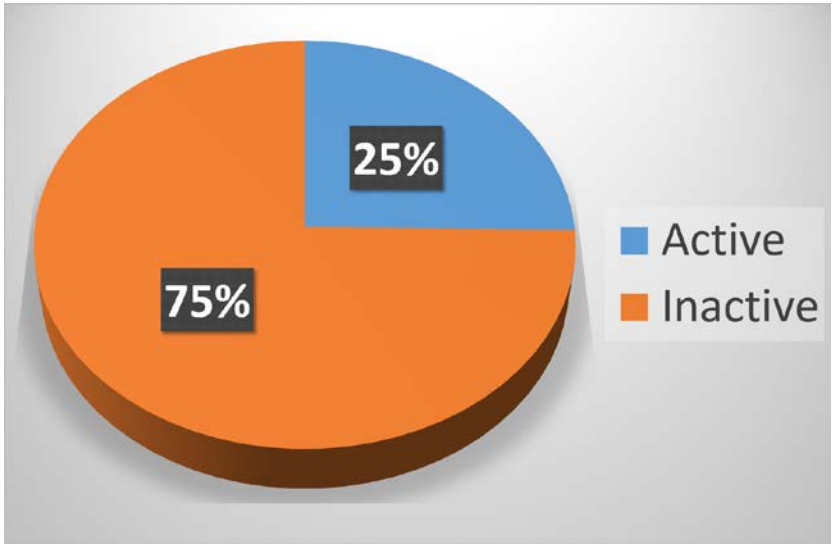
- Objective: less social desirability and recall bias

Meeting Physical Activity Recommendations
Singapore Health study

Self-report



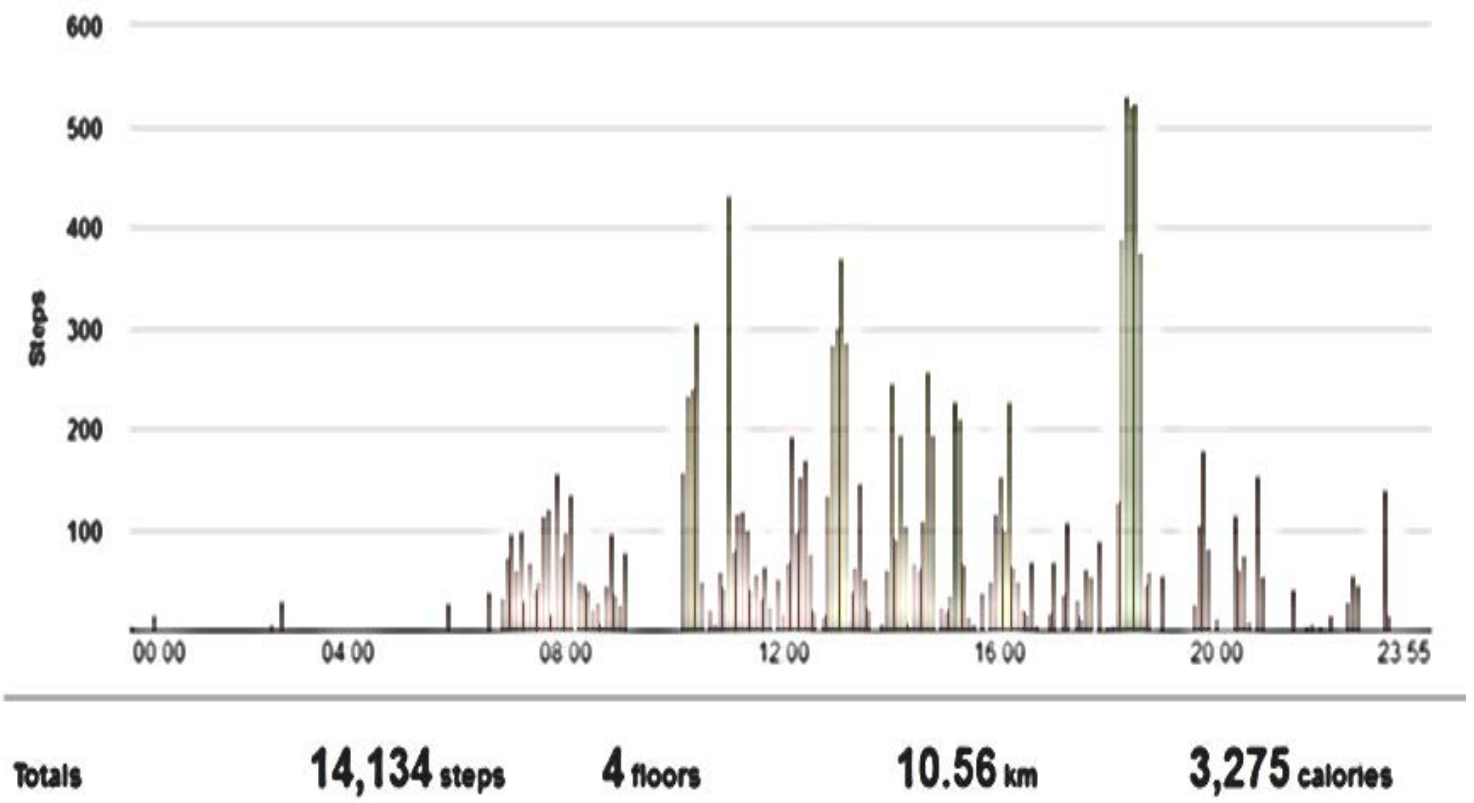
Accelerometer



Technology for physical activity measurement

Key advantages of using technology

- Detailed: provide real-time high resolution data



The rise in wearables for objective monitoring

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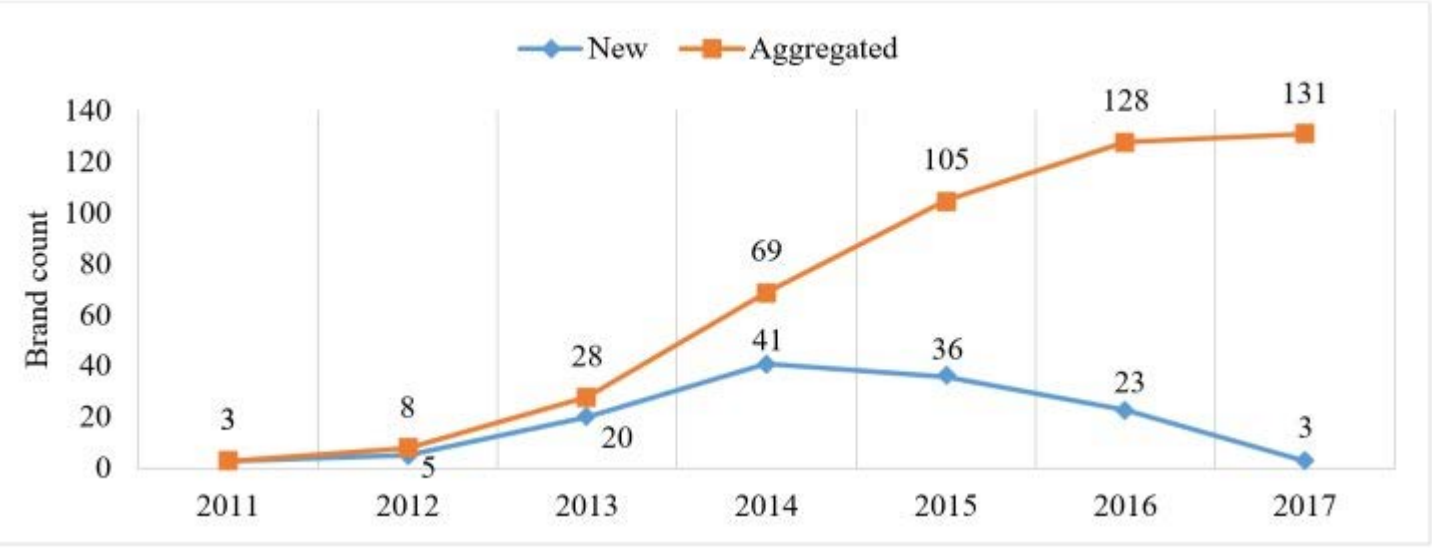
Number of physical activity tracker brands



(Henriksen (2018). Using Fitness Trackers and Smartwatches to Measure Physical Activity in Research: Analysis of Consumer Wrist-Worn Wearables. *Journal of medical Internet research*, *20*(3)

Developing lifestyle Interventions

The PANDA Research Program

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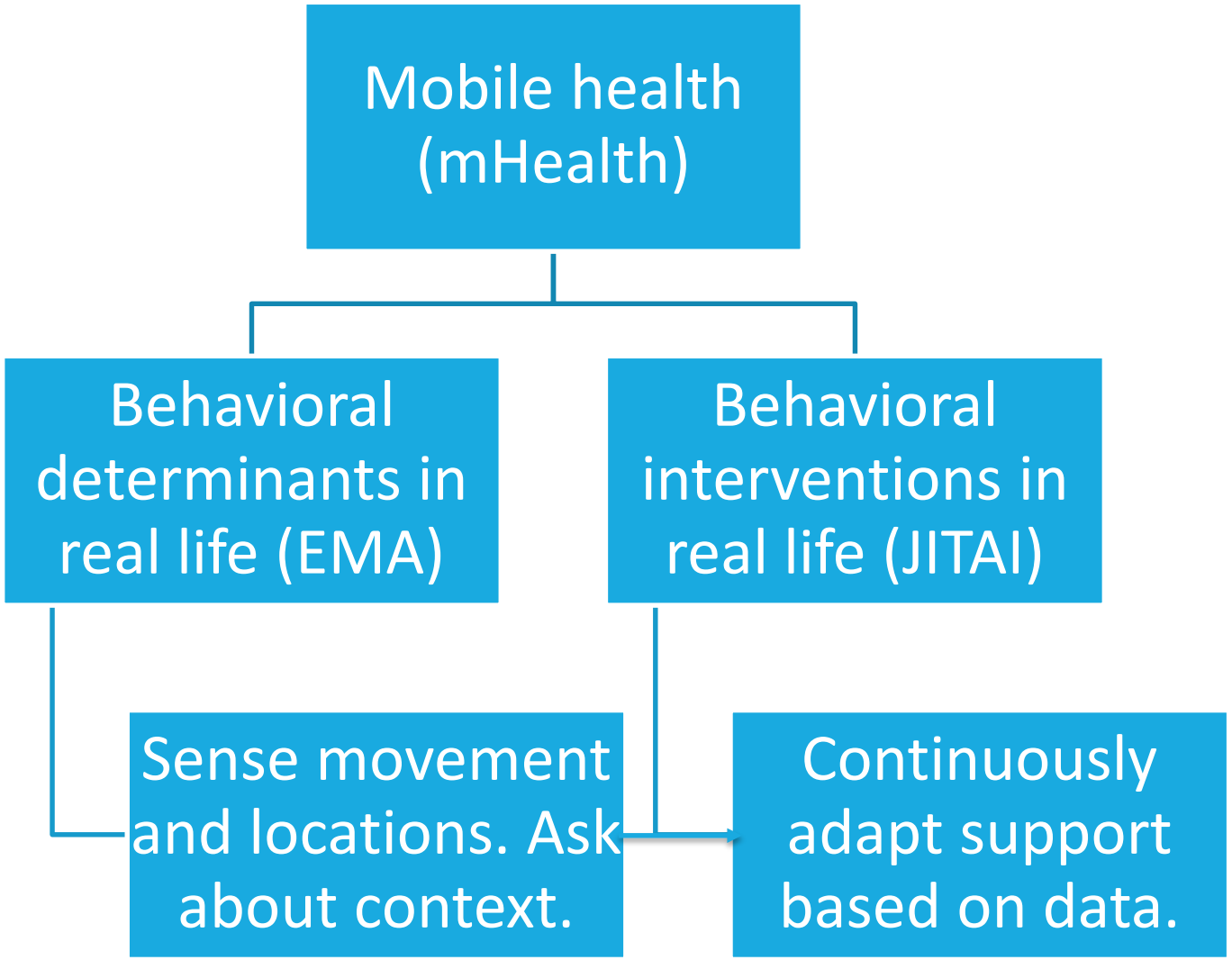
1. Mapping environmental factors
2. Interaction of individuals with their environment
3. Dynamically tailored *real-time* interventions

PHYSICAL ACTIVITY AND NUTRITION DETERMINANTS IN ASIA

Developing (personalized) lifestyle interventions



What's EMA?

Ecological

- Data collection in real world

Momentary

- Data collection in real time

Assessment

- Multiple assessments

(Stone (1994). Ecological momentary assessment (EMA) in behavioural medicine. Annals of Behavioral Medicine.)

What's EMA?

<u>It's about..</u>

Examining health behaviours and contexts in real time (using smartphone apps and sensors)

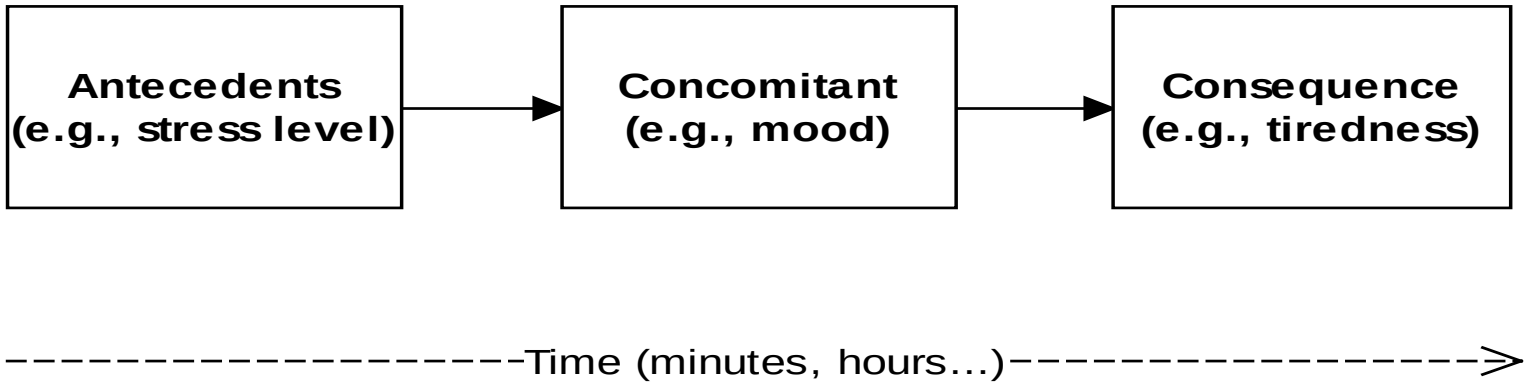
<u>How does it work?</u>

Asking questions and sensing behaviour to infer causality

When, where, and with whom are you active?

EMA enables us to understand in REAL-LIFE…

- Behaviors and changes in behaviors across time
- Micro-temporal relationships between e.g. behaviors and health states
- Contextual factors (e.g. social networks, environment, policy) related to behaviors



(Dunton, 2018; ISBNPA conference Hong Kong)

JITAI: Personalizing lifestyle interventions through mHealth

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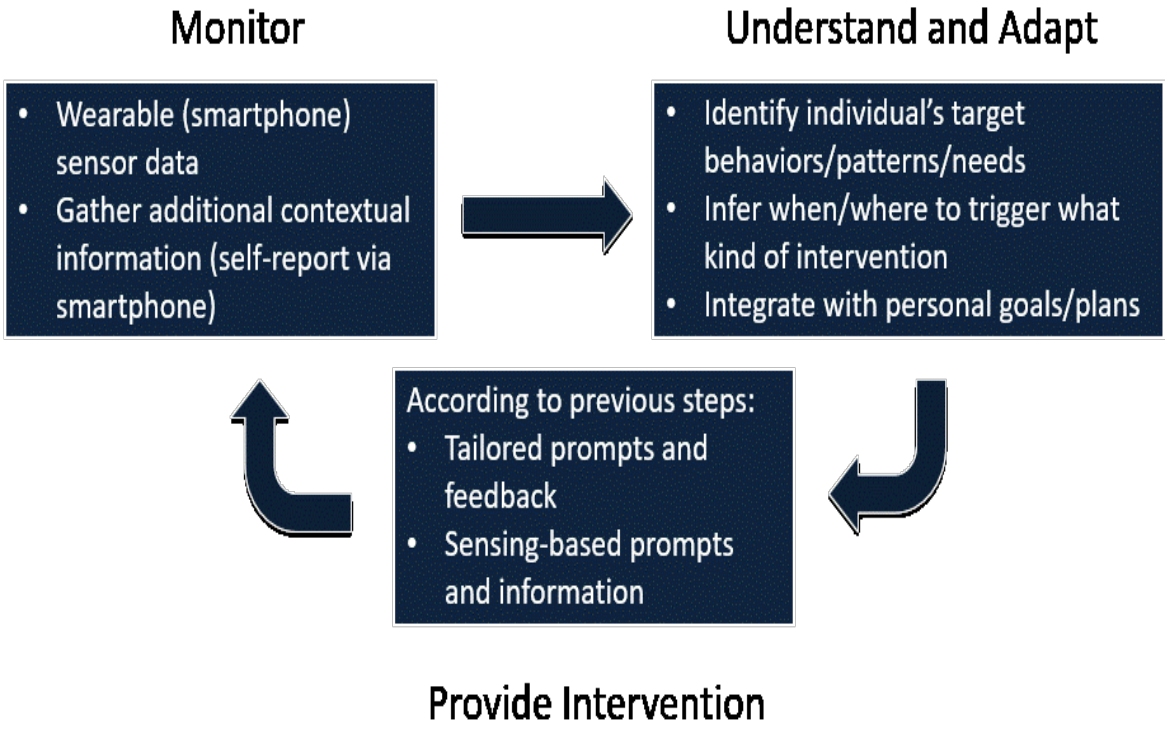
Use temporally dense data on behaviours, contexts and internal states to

- Identify state of vulnerability/opportunity for support
- Deliver right type of support when and where needed
- Adapt rules and support continuously
- Avoid support that is interruptive or counter-productive



(Nahum-Shani (2017). Just-in-time adaptive interventions (JITAIs) in mobile health: key components and design principles for ongoing health behaviour support. *Annals of Behavioral Medicine*, *52*(6), 446-462.)

The PANDA Research Program

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P.A.N.D.A
PHYSICAL ACTIVITY AND NUTRITION DETERMINANTS IN ASIA

1. Mapping environmental factors
2. Interaction of individuals with their environment
3. Dynamically tailored *real-time* interventions

Food-EPI
Apps for life
NUH HEAL Study
FEAST Tool
Sedentary behavior review

EMA using mobile technologies
Continuous Glucose Monitoring
Bicycle share scheme natural experiment
Health Insights Singapore - NUS Student Cohort

Cutting areas 1 and 2:
Parks and Health
GUSTO SRP (Baby PANDA)
Digital marketing

Cutting areas 2 and 3:
National Steps Challenge: Validation and Insights

Parks and Health

NATIONAL PARKS | LET'S MAKE SINGAPORE OUR GARDEN

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Parks and Health

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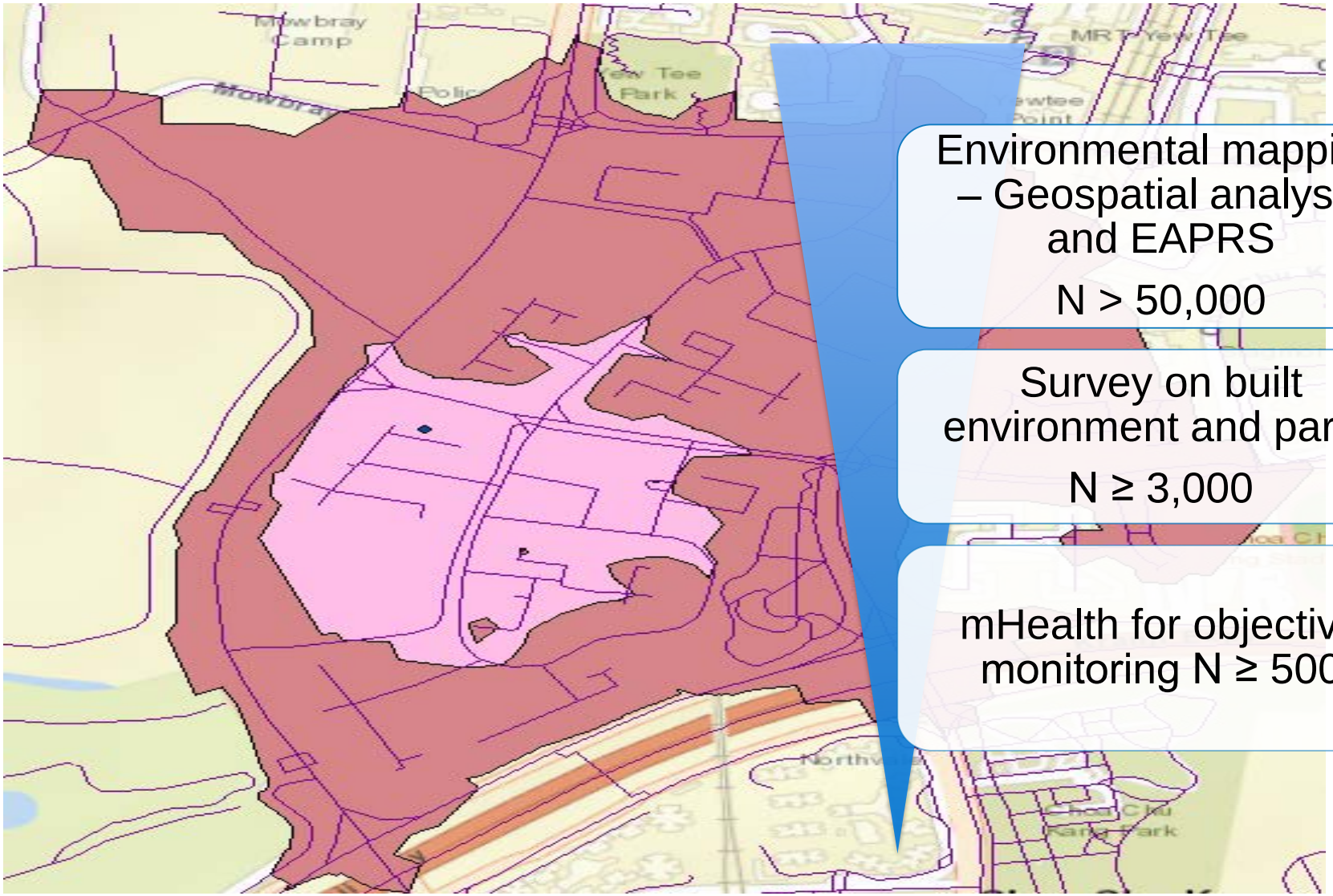
Geospatial Analyses	• Investigate relationship between parks/green spaces, park attributes as well as the neighbourhood environment with health and well-being.
Participant Survey	• Investigation into use and reasons for parks/green space use, facilitators and barriers of use, perceptions of neighbourhood environments and how these influence relationships between parks/green space, health and well-being.
Objective Movement and Location Monitoring	• Investigate participants engagement with parks/green spaces and their environment through objective movement and activity monitoring

Participants



Environmental mapping – Geospatial analysis and EAPRS

N > 50,000

Survey on built environment and parks

N ≥ 3,000

mHealth for objective monitoring N ≥ 500

Objective monitoring over multiple consecutive days

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Ecological Momentary Assessment (EMA)

Location tracking on mobile phone

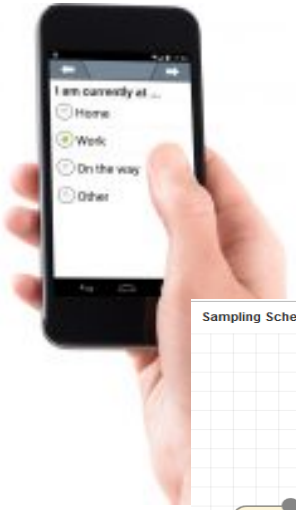
Accelerometer

Collects multiple "in the moment" surveys each day

24 hours tracking of participant's location via GPS, cell-towers and WIFI

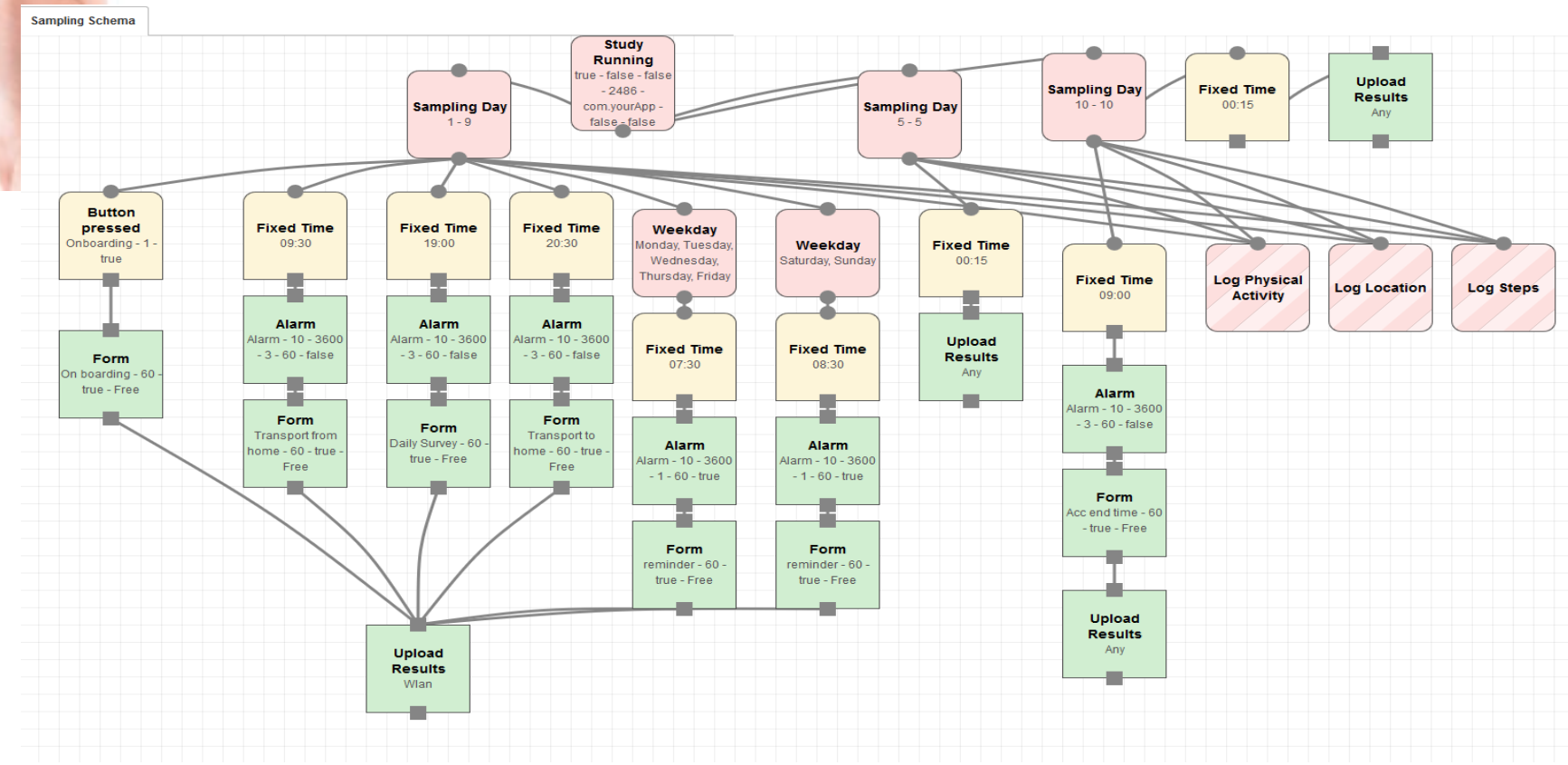
Physical activity monitoring through accelerometers

Setting up EMA

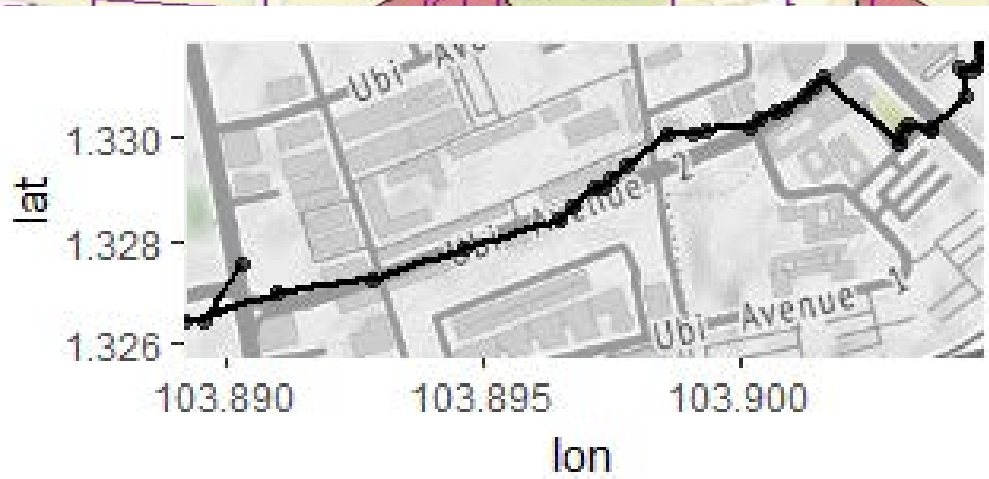


movisensXS

- The android app enables EMA and additionally allows to log measurements from a variety of internal sensors such as accelerometer, ambient light sensor, battery status, connectivity status, or location



Location tracking

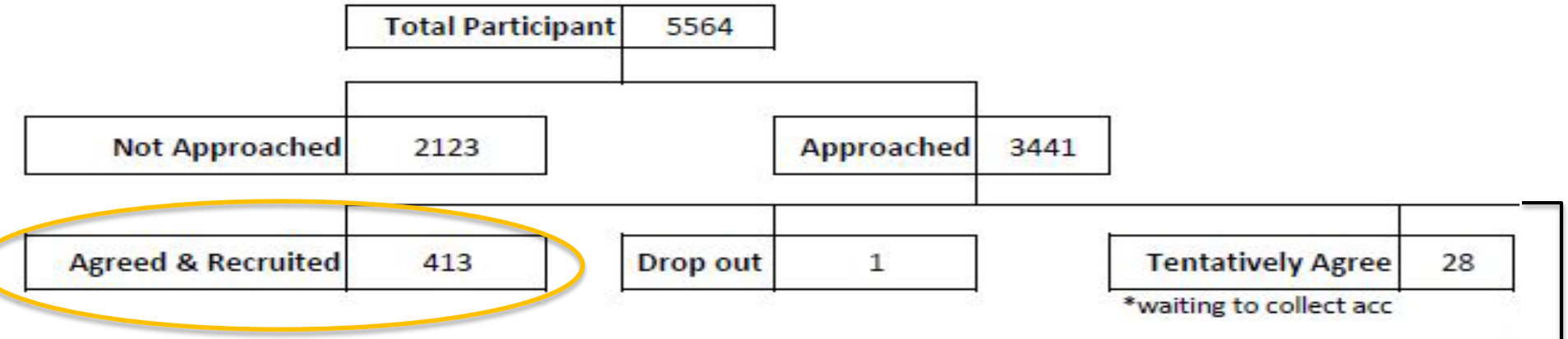


In combination with EMA and accelerometer

- Time spend in parks or transport
- Active vs passive transport
- intensity of activity in parks, transport etc.
- Relationship between e.g. park exposure and stress level

…

Participant recruitment



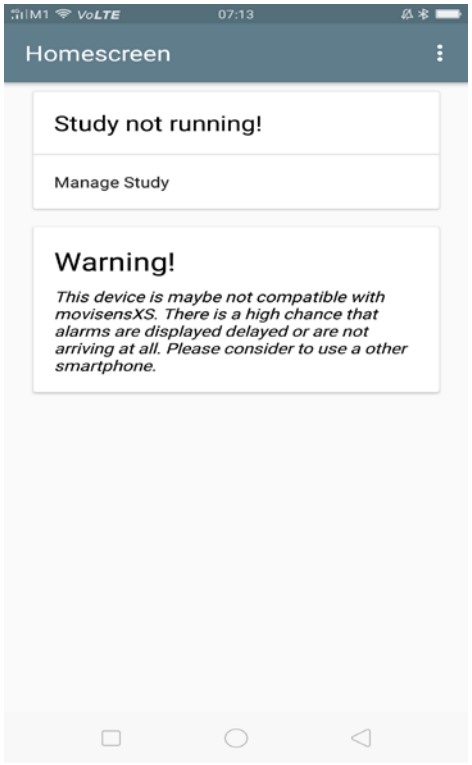
Refused	850
Refused - Not interested / not keen / no time / not free / inconvenient / troublesome	429
Refused - Not willing to carry smart phone over 9 days / Not in the habit of carrying phone	19
Refused - Not willing to on location tracker / intrusive	30
Refused - Not willing to return accelerometer to HS after 10-14 days / location to return too far	117
Refused - Not willing to use app (e.g. phone no space)	9
Refused - Not willing to use data each day	9
Refused - Not willing to wear accelerometer for 9 days	133
Refused - Others	76
Refused - Reimbursement not enough / not attractive	26
Refused - Travelling / travels a lot	2

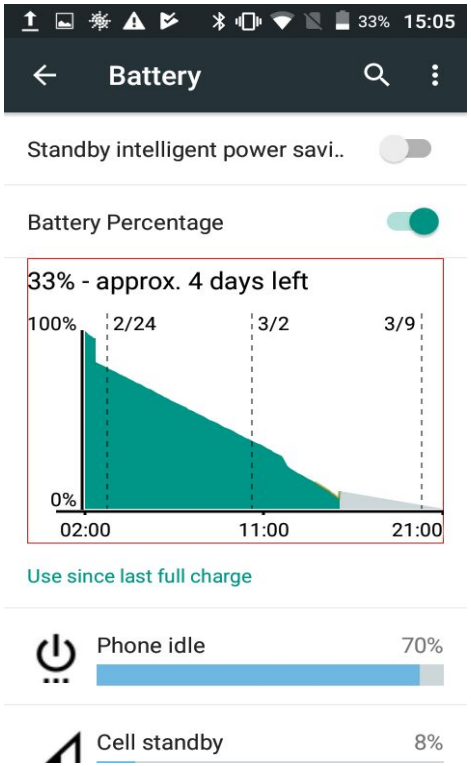
Ineligible	2149
Ineligible - Can't read English	737
Ineligible - Irregular sleeping hours / Work irregular hours	12
Ineligible - Limited physical mobility	8
Ineligible - Night shift	61
Ineligible - No data plan	90
Ineligible - No smart phone	36
Ineligible - Not app savvy	229
Ineligible - Oppo user	141
Ineligible - Others	15
Ineligible - Phone battery faulty / smart phone will shut down by itself intermittently / intermittent data access	6
Ineligible - Refused HS	40
Ineligible - Travelling / travels a lot	84
Ineligible - Using non-android phone (e.g. iPhone)	690

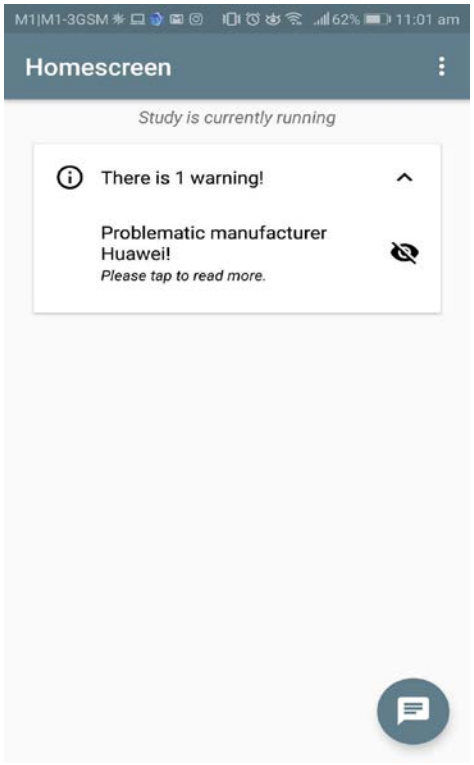
Refused/ineligible: 2999

Of 413 who agreed and participated:
75% have complete data

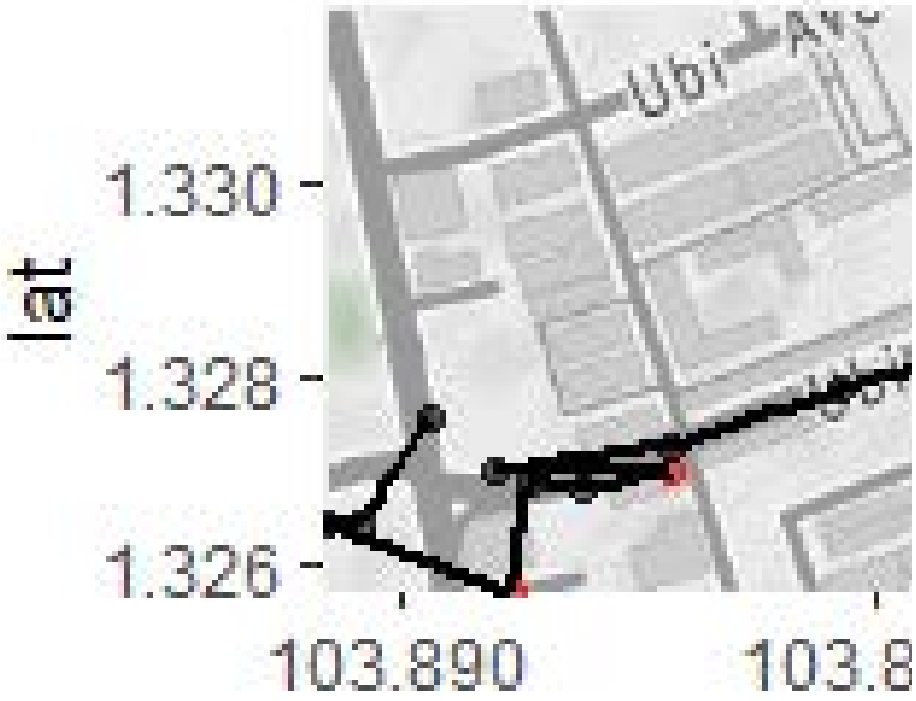
Smartphone incompatibility







Device accuracy – issues with location tracking



- drift during journeys
- missing data between locations
- understanding transportation type
- Inaccuracies in static reporting of location
- signaling strength

Accuracy of wearable devices

How accurate are wearables that measure heart rate or step counts?

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Test trackers

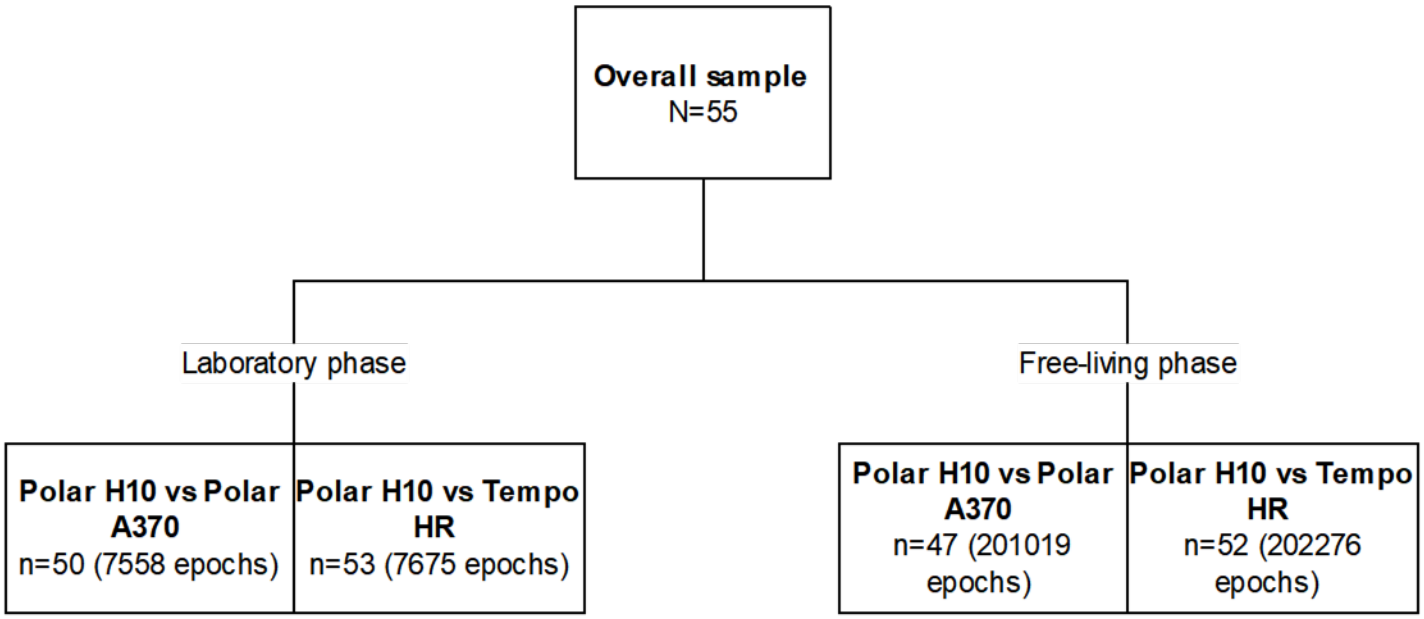
- National Steps Challenge heart rate tracker
- Polar A370

Criterion

- Polar H10 chest strap (heart rate)

Health Promotion Board

Study methodology



Laboratory phase: Wear trackers during cycling exercise
Free-living phase: Wear trackers during normal day

Accuracy of wrist-worn heart rate monitors

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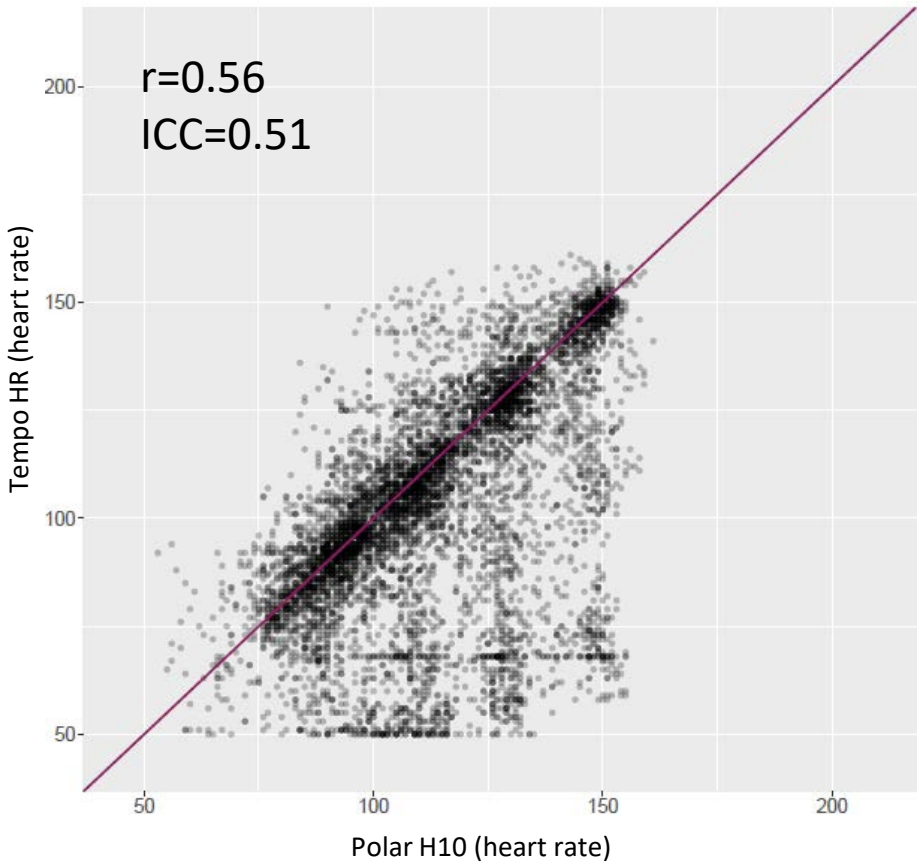
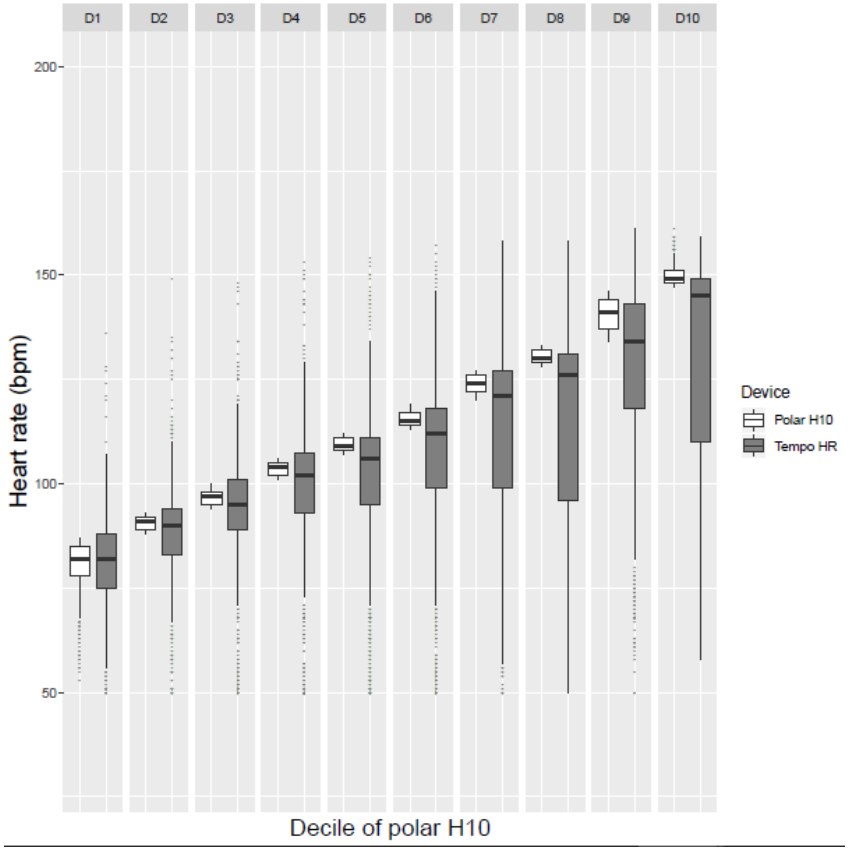
Overall

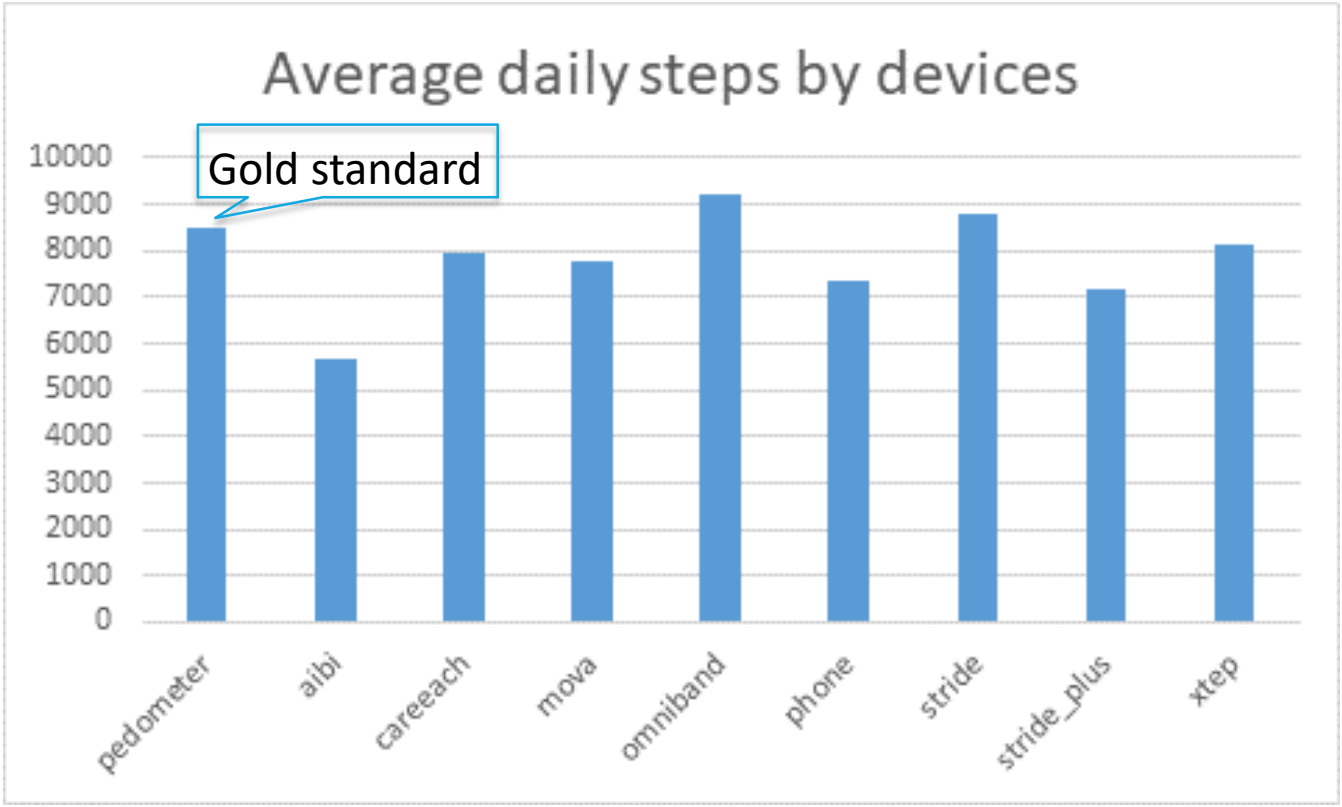


According to activity intensity



Device accuracy – step counts

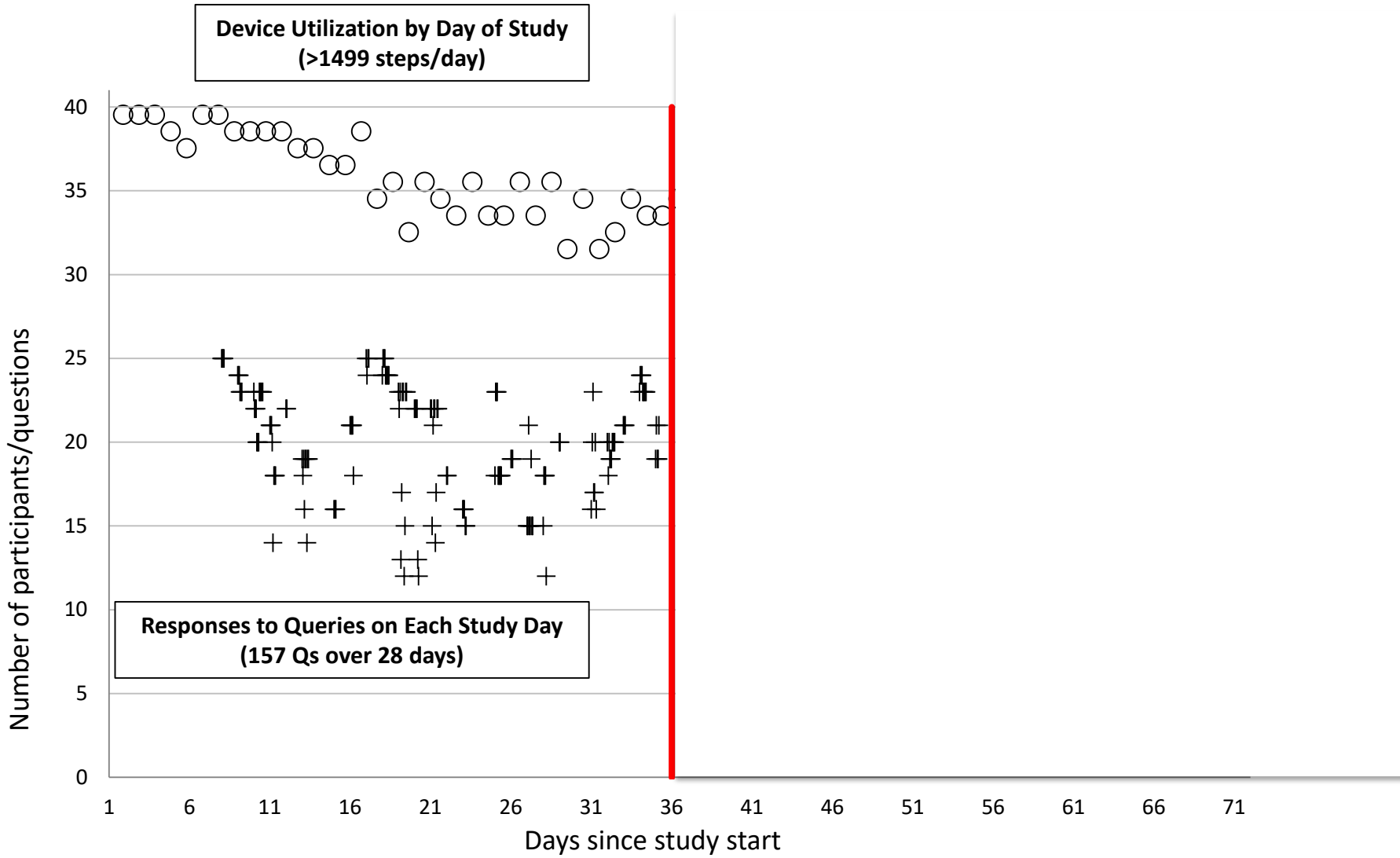
	Actigraph	Fitbit
Steps per day	8,812	10,193



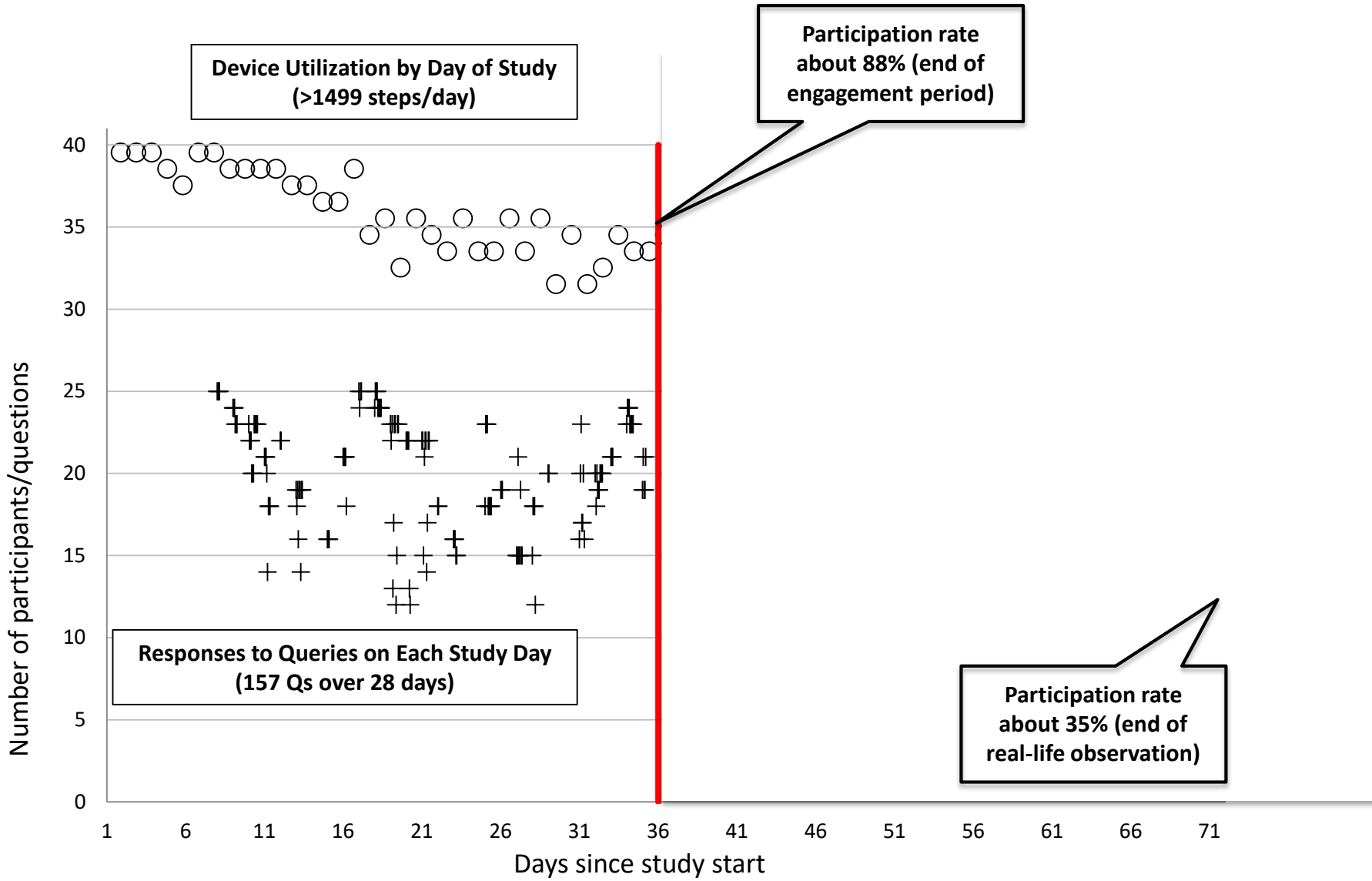
Chu et al. Comparison of wrist-worn Fitbit Flex and waist-worn ActiGraph for measuring steps in free-living adults. Plosone 2017

Participant engagement

Long-term Ecological Momentary Assessment



Long-term participant engagement



Summary

- Lifestyle behaviours are key to population health
- mHealth holds promise for lifestyle interventions
  - Understanding behaviours using EMA
  - Providing personalized interventions (JITAI)
- Challenges include
  - Participant selection and generalizability
  - Device incompatibilities and data quality
  - Device accuracy and technological failures
  - Continuous participant engagement
- Realistic expectations about effectiveness of personalized lifestyle interventions

Thank you!

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http://blog.nus.edu.sg/sphpanda/ ; Twitter: @PANDA_SGSPH