Wearable Technology and Stroke

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Cork University Hospital,
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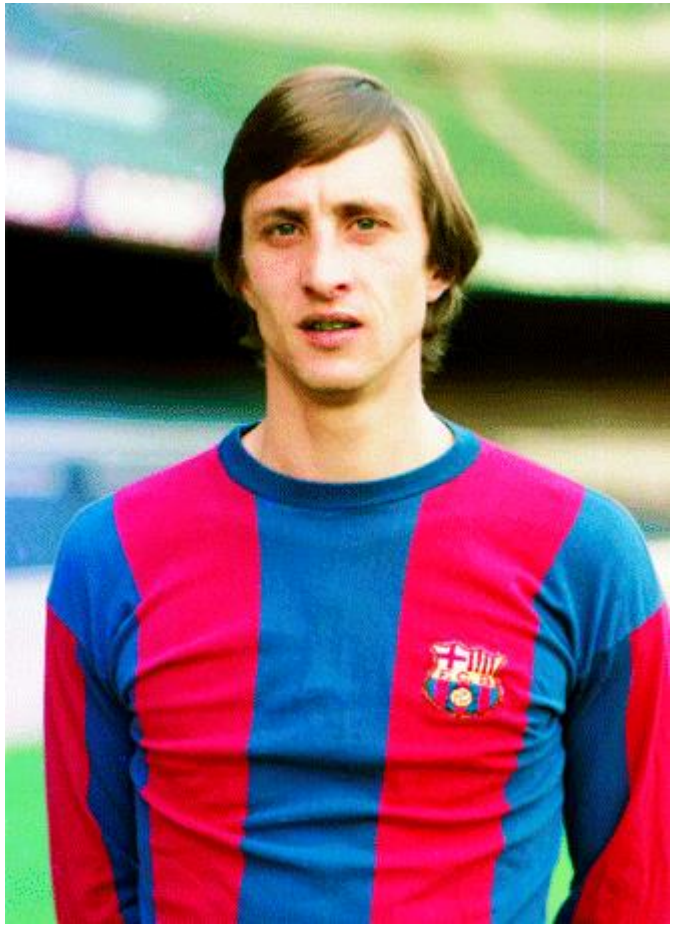
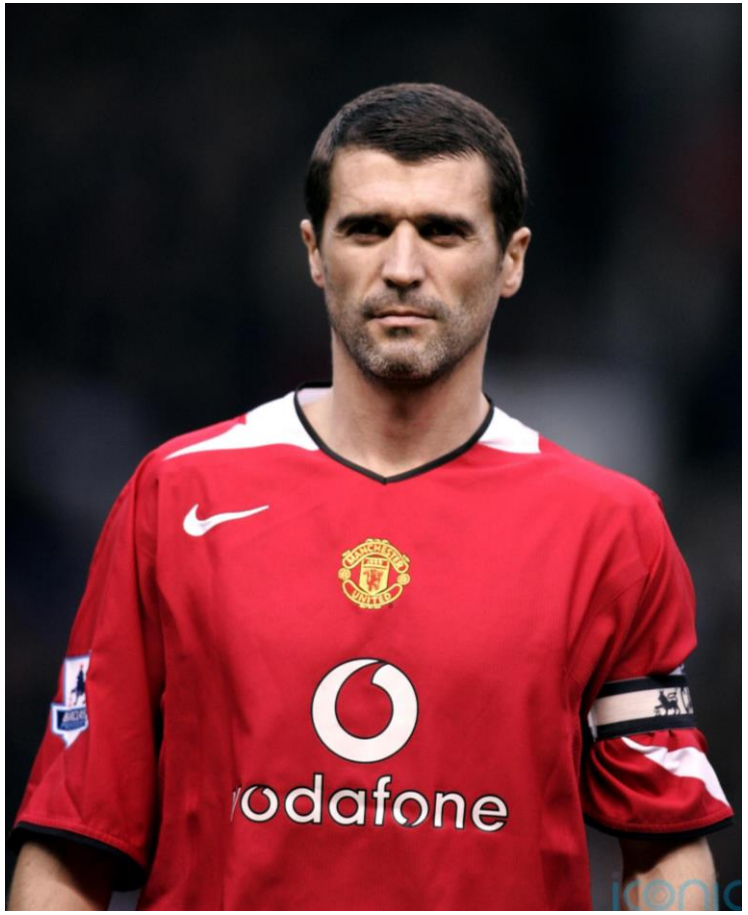
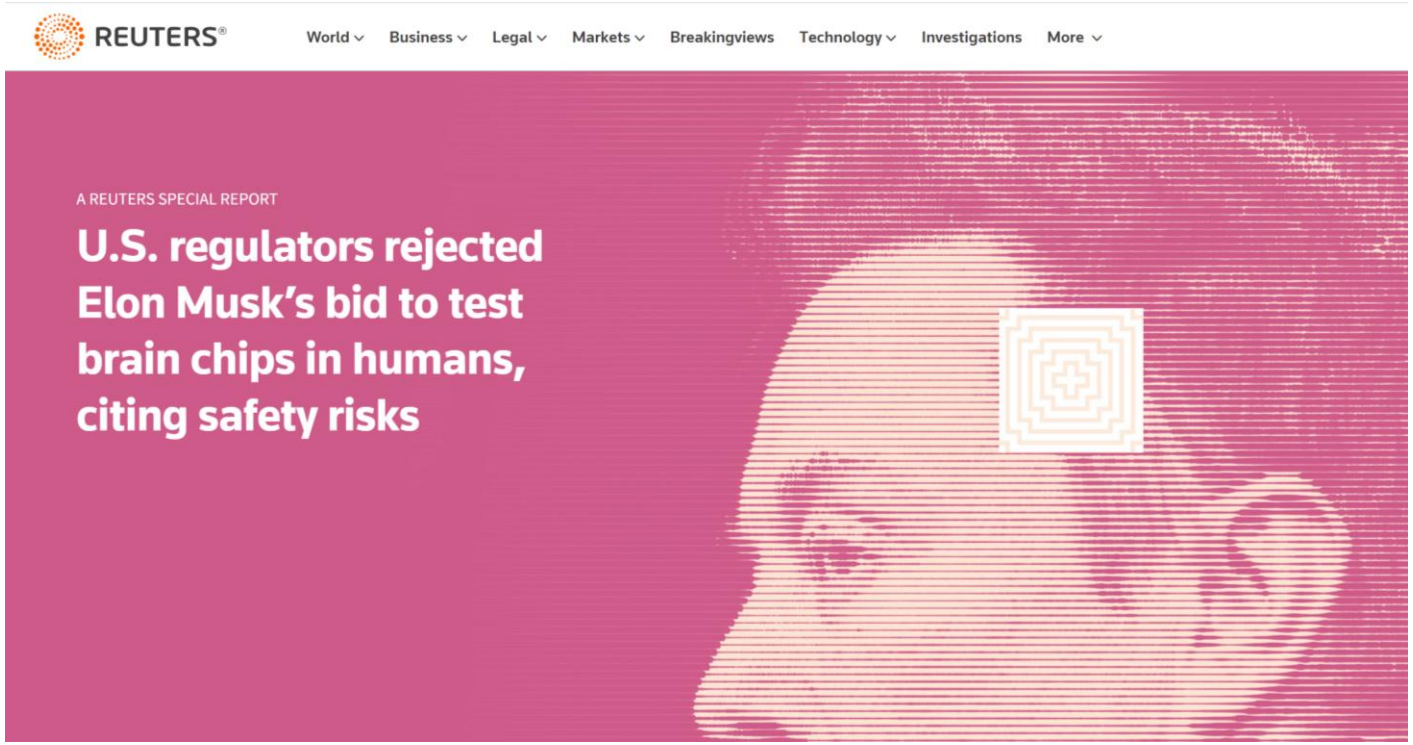



vodafone

Outline

- What does wearable technology measure?
- Is there evidence it improves health
    - in general?
    - post stroke?
- Are there any downsides?

What wearable technology is available?



What wearable technology is available?

What do they measure?

- Steps
- Sleep
- Heart rhythm
- Stand minutes
- Falls
- Heart rate variability
- Blood oxygen
- Exercise minutes
- Walking step length
- Walking asymmetry
- VO_2 max

What do they measure?

- **Steps**
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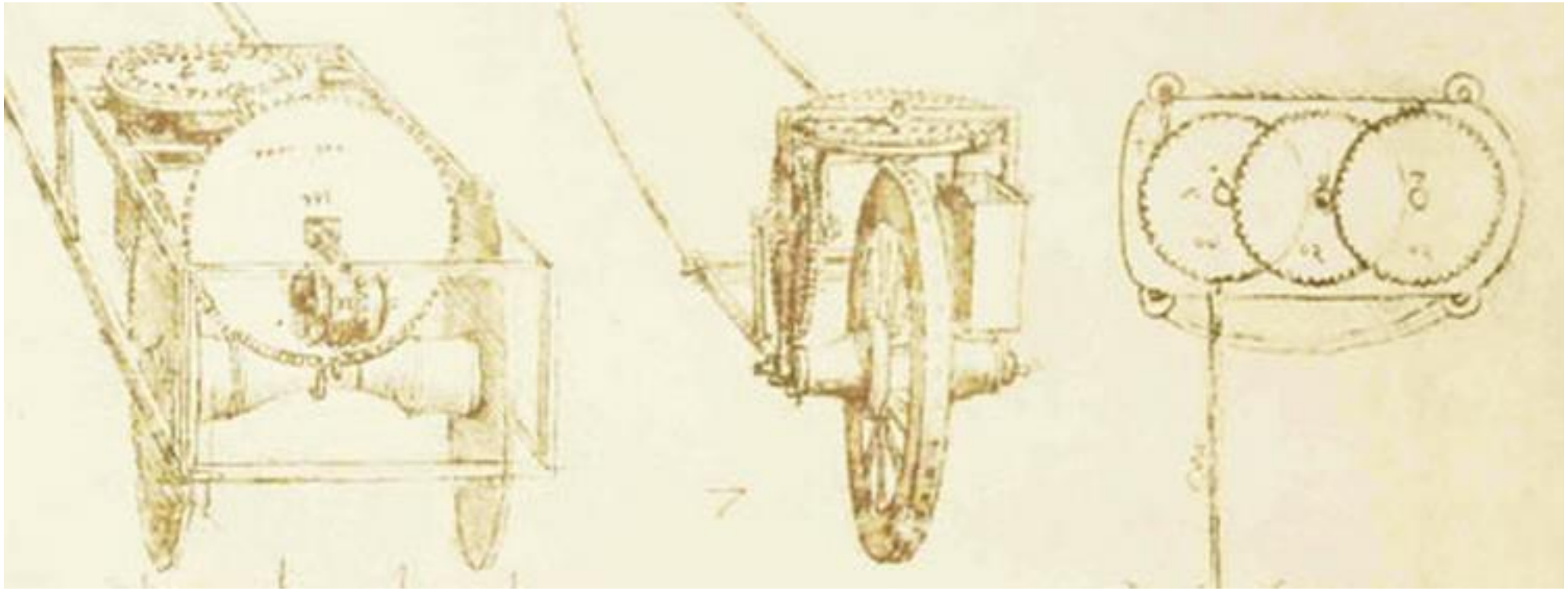
Steps



Steps


一日一万歩あるきましょう
万歩メーター
MANPO-METER
日本万歩クラブ推薦
東京オリンピック以来高まった国民の体力づくり、そのあらわれが"一日一万歩運動"です。
きょう何歩あるいたかしら？小さく軽く美しいデザインの「万歩メーター」は、日本万歩クラブ推薦の歩数計です。
白・黒・ベージュ・赤の4色がありますから、お好きな色をお選び下さい。（全国有名デパートで販売中）
¥2,200
製造元
ヤマサ時計計器株式会社

Steps

- Steps are intuitive, and readily understandable to the layperson
- Steps can be measured easily and accurately
- Steps are objective
- Steps are motivational, and they facilitate behaviour change
- Steps have the potential to be useful in translating scientific results into public health message

- Activity Measurement in Psychology and Medicine, WW Tryon, Springer Science & Business Media, 2013

Are step counters accurate?

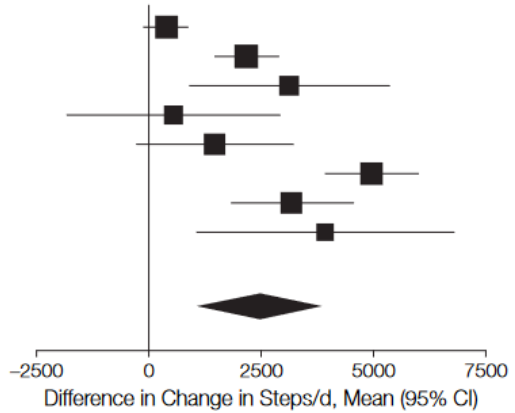
- By and large, yes
- Depends where on the body they are worn and by whom
- Must adhere to set industrial standards

Bassett, DR et al, Sports Med (2017) 47: 1303-1315

Do step counters promote activity?

Figure 2. Increase in Physical Activity Among Participants Randomly Assigned to Pedometer Interventions vs Control Participants

Source	Sample Size: Intervention	Sample Size: Control	Difference in Change in Steps/d, Mean (95% CI)	*P* Value
Butler and Dwyer,[17] 2004	17	16	395 (–118 to 908)	.13
Hultquist et al,[19] 2005	31	27	2226 (1488 to 2964)	<.001
Araiza et al,[16] 2006	15	15	3189 (905 to 5473)	.006
de Blok et al,[18] 2006	8	8	567 (–1872 to 3006)	.65
Talbot et al,[23] 2003	17	17	1498 (–300 to 3296)	.10
Moreau et al,[20] 2001	15	9	5066 (4003 to 6129)	<.001
Izawa et al,[14] 2005	24	21	3254 (1851 to 4657)	<.001
Ransdell et al,[21] 2004 and Ormes et al,[22] 2005	28	9	3994 (1050 to 6938)	.008
Summary difference	155	122	2491 (1098 to 3885)	<.001



Presents the difference in the change in steps per day before and after the intervention between the participants in the experimental and control arms of the randomized controlled trials. The size of the data markers are proportional to the sample size, which represents the number of individuals who completed the trials.

Do step counters promote activity?

Table 2. Baseline Participant Characteristics[a]

Characteristic	No. of Studies Reporting This Characteristic (No. of Participants)	Preintervention, Mean (SD)	Change Postintervention	
			Mean Change (95% Confidence Interval)[b]	P Value
BMI	18 (562)	30 (3.4)	–0.38 (–0.05 to –0.72)	.03
Blood pressure, mm Hg				
Systolic	12 (468)	129 (7.5)	–3.8 (–1.7 to –5.9)	<.001
Diastolic	12 (468)	79 (4.5)	–0.3 (0.02 to –0.46)	.001
Cholesterol, mmol/L				
Total	7 (192)	5.14 (0.3)	–0.09 (–0.32 to 0.15)	.50
HDL	7 (192)	1.34 (0.20)	0.06 (–0.012 to 0.14)	.10
LDL	7 (192)	2.93 (0.01)	–0.06 (–0.25 to 0.13)	.50
Triglycerides, mmol/L	7 (192)	2.19 (0.85)	–0.26 (–0.56 to 0.04)	.09
Fasting glucose, mmol/L	7 (211)	7.09 (2.09)	–0.03 (–0.11 to 0.11)	.70

Abbreviations: BMI, body mass index, which is calculated as weight in kilograms divided by height in meters squared; HDL, high density lipoprotein; LDL, low-density lipoprotein.

SI conversion factors: To convert total, high-density lipoprotein, and high-density lipoprotein cholesterol from mmol/L to mg/dL divide by 0.0259; triglycerides to mg/dL, divide by 0.0112; and fasting glucose to mg/dL, divide by 0.0555.

[a] For this analysis, data from all participants who wore pedometers (ie, participants in the intervention groups of the randomized controlled groups and all participants in the observational studies) were included and the changes in physical activity and health outcomes were calculated as the change from baseline.

[b] A negative value indicates that the parameter fell after the invention, whereas a positive value indicates that the parameter rose after the intervention.

Does Counting Steps Improve Health?

THE LANCET
Public Health

Articles

Daily steps and all-cause mortality: a meta-analysis of 15 international cohorts

Amanda E Paluch, Shivangi Bajpai, David R Bassett, Mercedes R Carnethon, Ulf Ekelund, Kelly R Evenson, Deborah A Galuska, Barbara J Jefferis, William E Kraus, I-Min Lee, Charles E Matthews, John D Omura, Alpa V Patel, Carl F Pieper, Erika Rees-Punia, Dhayana Dallmeier, Jochen Klenk, Peter H Whincup, Erin E Dooley, Kelley Pettee Gabriel, Priya Palta, Lisa A Pompeii, Ariel Chernofsky, Martin G Larson, Ramachandran S Vasan, Nicole Spartano, Marcel Ballin, Peter Nordström, Anna Nordström, Sigmund A Anderssen, Bjørge H Hansen, Jennifer A Cochrane, Terence Dwyer, Jing Wang, Luigi Ferrucci, Fangyu Liu, Jennifer Schrack, Jacek Urbanek, Pedro F Saint-Maurice, Naofumi Yamamoto, Yutaka Yoshitake, Robert L Newton Jr, Shengping Yang, Eric J Shiroma, Janet E Fulton, on behalf of The Steps for Health Collaborative

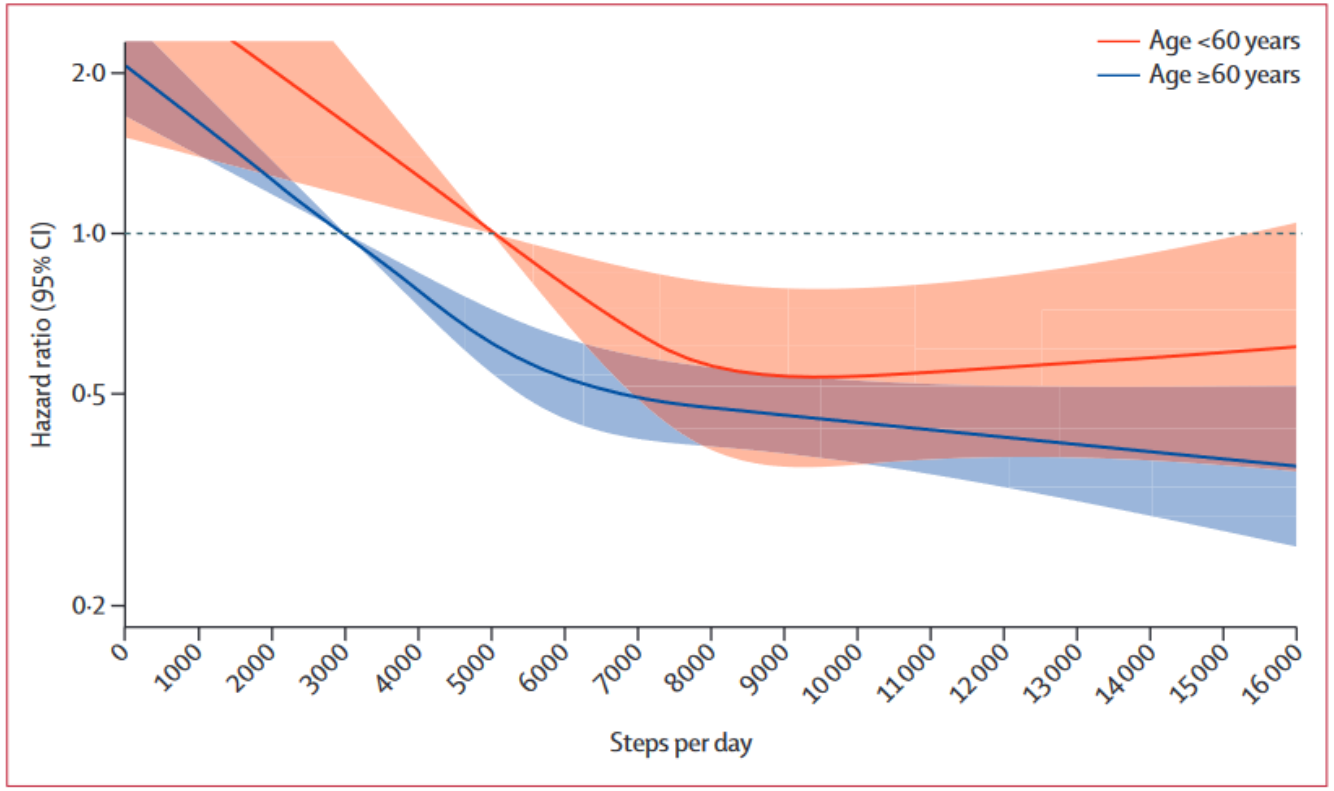


***Figure 3*: Dose-response association between steps per day and all-cause mortality, by age group**
Thick lines indicate hazard ratio estimates, with shaded areas showing 95% CIs. Reference set at the median of the medians in the lowest quartile group (age ≥60 years = 3000 steps per day and <60 years = 5000 steps per day). Model is adjusted for age, accelerometer wear time, race and ethnicity (if applicable), sex (if applicable), education or income, body-mass index, and study-specific variables for lifestyle, chronic conditions or risk factors, and general health status. $p_{interaction}$=0·012 by age group. 14 studies included in spline analysis, excluded Baltimore Longitudinal Study of Aging.[19] The y-axis is on a log scale.

VIEWPOINT

Wearable Devices as Facilitators, Not Drivers, of Health Behavior Change

Mitesh S. Patel,

"Using wearable devices to effectively promote health behavior change is a complex, multistep process. First, a person must be motivated enough to want a device and be able to afford it; this is a challenge, because some devices can cost hundreds of dollars. Perhaps for these reasons, wearable devices seem to appeal to groups that might need them least.

Author Reading at jama.com

Several large technology companies including Apple,

may justify that promise, but less because of their technology and more because of the behavioral change strategies that can be designed around them.

Most health-related behaviors such as eating well

Identifying and Addressing the Gaps

Second, once a device is acquired, a person needs to remember to wear it and occasionally recharge it—additional behaviors required from individuals who may have a difficult time already. Many wearable devices re-

Sleep & Stroke

Sleep & Stroke

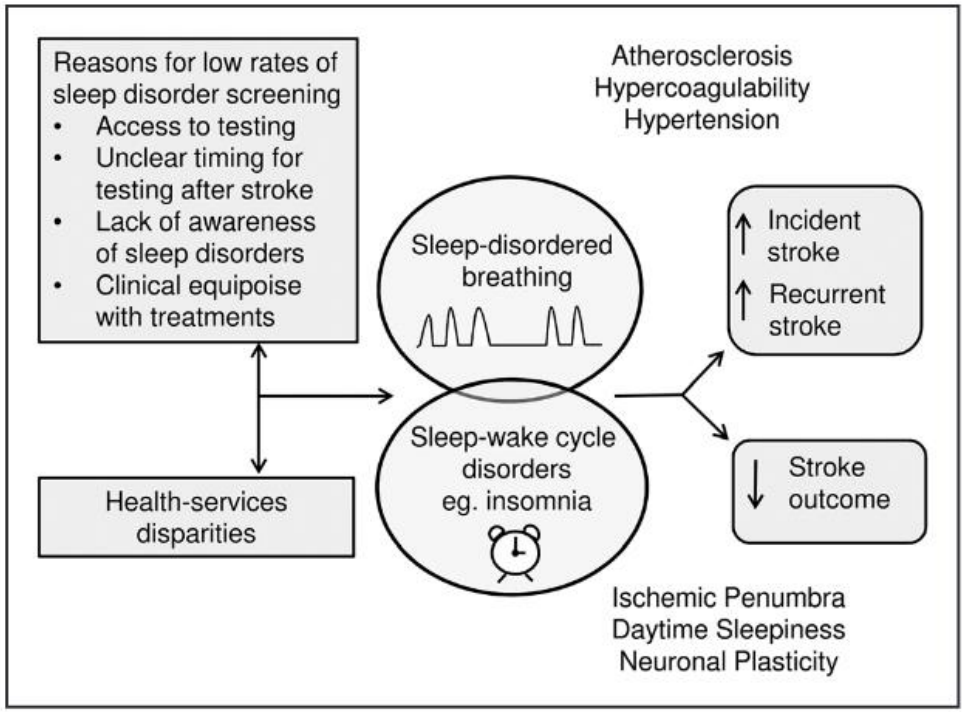


Figure. Potential causes and consequences of untreated sleep disorders after stroke with proposed mechanisms leading to increased risk of stroke and poor stroke outcome.

SP Khot, LB Morgenstern, Stroke, 2019; 50:1612-1617

What do Sleep Trackers Measure?

- **Sleep duration:** By tracking the time you're inactive, the devices can record when you fall asleep at night and when you stir in the morning.

- **Sleep quality:** Trackers can detect interrupted sleep, letting you know when you're tossing and turning or waking during the night.

- **Sleep phases:** Some tracking systems track the phases of your sleep and time your alarm to go off during a period when you're sleeping less deeply. In theory, that makes it easier for you to rouse.

- **Environmental factors:** Some devices record environmental factors like the amount of light or temperature in your bedroom.

Are Sleep Trackers Accurate?

SLEEPJ, 2021, 1–16

doi: 10.1093/sleep/zsaa291
Advance Access Publication Date: 30 December 2020
Original Article

ORIGINAL ARTICLE

Performance of seven consumer sleep-tracking devices compared with polysomnography

Evan D. Chinoy[1,2], Joseph A. Cuellar[1,2], Kirbie E. Huwa[1,2], Jason T. Jameson[1,2], Catherine H. Watson[1,3], Sara C. Bessman[1,4], Dale A. Hirsch[1], Adam D. Cooper[1,3], Sean P.A. Drummond[5] and Rachel R. Markwald[1,*]

[1]Sleep, Tactical Efficiency, and Endurance Laboratory, Warfighter Performance Department, Naval Health Research Center, San Diego, CA [2]Leidos, Inc., San Diego, CA [3]Innovative Employee Solutions, San Diego, CA [4]Eagle Applied Sciences, San Diego, CA [5]Turner Institute for Brain and Mental Health, Monash University, Melbourne, Victoria, Australia

*Corresponding authors. Rachel R. Markwald and Evan D. Chinoy, Sleep, Tactical Efficiency, and Endurance Laboratory, Warfighter Performance Department, Naval Health Research Center, 140 Sylvester Road, San Diego, CA 92106. Email: rachel.r.markwald.civ@mail.mil and evan.d.chinoy.ctr@mail.mil.

Sleep

"Consumer sleep-tracking devices exhibited high performance in detecting sleep, and most performed equivalent to (or better than) actigraphy in detecting wake.

Device sleep stage assessments were inconsistent. Findings indicate that many newer sleep-tracking devices demonstrate promising performance for tracking sleep and wake.

Devices should be tested in different populations and settings to further examine their wider validity and utility."

Table

Devic	PABAK
Fitbit	0.77
Garm	0.53
Garm	0.48
Early	0.67
ResM	0.69
Sleep	0.68

Propor … on all nights,
compa … e 8 caption for
additi

Atrial Fibrillation and Stroke

- AF is the commonest cardiac arrhythmia
- Associated with 25% of strokes
- Good treatment options with DOACs

Clinical Review & Education

JAMA | US Preventive Services Task Force | RECOMMENDATION STATEMENT

Screening for Atrial Fibrillation
US Preventive Services Task Force Recommendation Statement

US Preventive Services Task Force

RECOMMENDATION The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for AF. (I statement)

JAMA. 2022;327(4):360-367. doi:10.1001/jama.2021.23732

Guideline

EUROPEAN STROKE JOURNAL

European Stroke Journal
2022, Vol. 7(3) VI

DOI: 10.1177/23969873221099478
journals.sagepub.com/home/eso
SAGE

European Stroke Organisation (ESO) guideline on screening for subclinical atrial fibrillation after stroke or transient ischaemic attack of undetermined origin

Marta Rubiera[1], Ana Aires[2], Kateryna Antonenko[3], Sabrina Lémeret[4], Christian H Nolte[5,6], Jukka Putaala[7], Renate B Schnabel[8,9], Anil M Tuladhar[10], David J Werring[11], Dena Zeraatkar[12,13] and Maurizio Paciaroni[14]

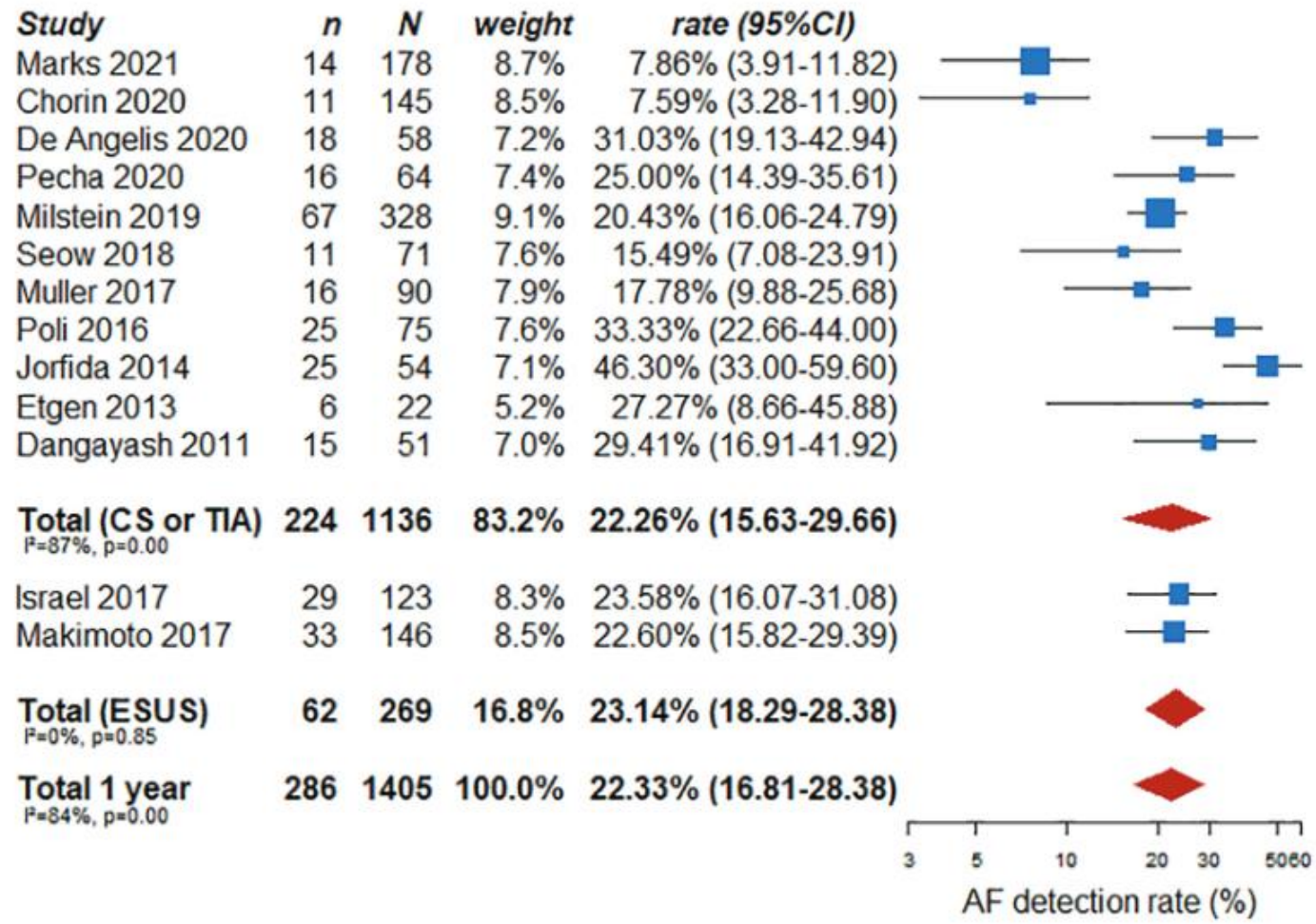


Figure 5. AF detection rate in single arm studies (1-year follow-up).

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Large-Scale Assessment of a Smartwatch to Identify Atrial Fibrillation

Marco V. Perez, M.D., Kenneth W. Mahaffey, M.D., Haley Hedlin, Ph.D., John S. Rumsfeld, M.D., Ph.D., Ariadna Garcia, M.S., Todd Ferris, M.D., Vidhya Balasubramanian, M.S., Andrea M. Russo, M.D., Amol Rajmane, M.D., Lauren Cheung, M.D., Grace Hung, M.S., Justin Lee, M.P.H., Peter Kowey, M.D., Nisha Talati, M.B.A., Divya Nag, Santosh E. Gummidipundi, M.S., Alexis Beatty, M.D., M.A.S., Mellanie True Hills, B.S., Sumbul Desai, M.D., Christopher B. Granger, M.D., Manisha Desai, Ph.D., and Mintu P. Turakhia, M.D., M.A.S., for the Apple Heart Study Investigators*

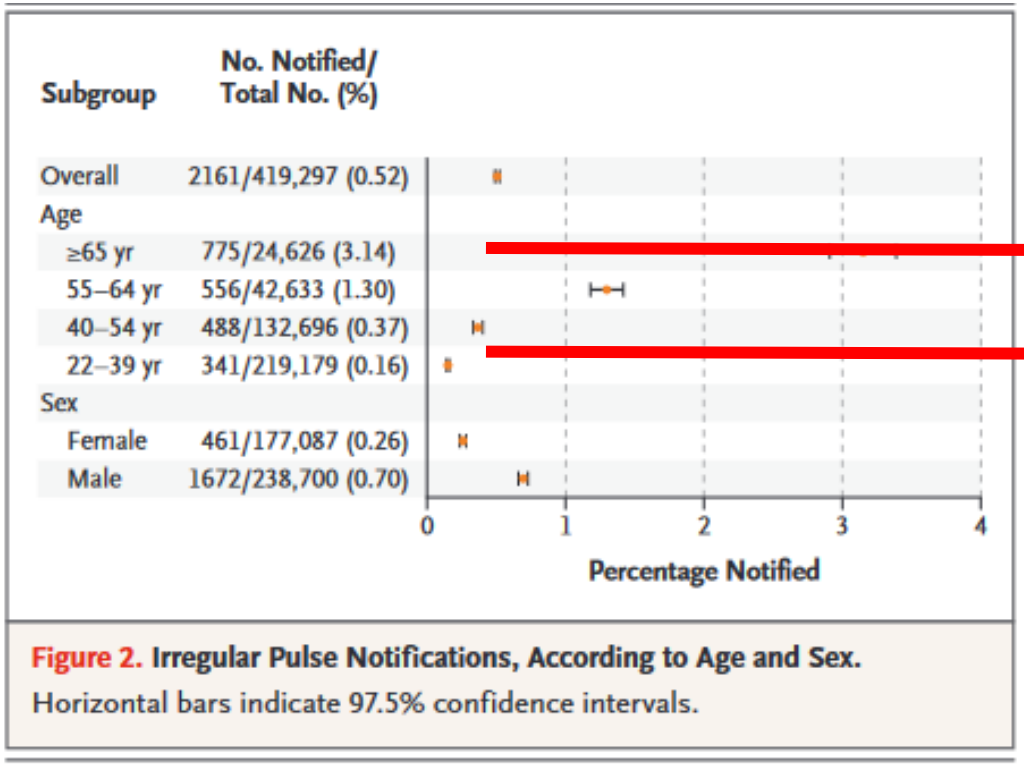


Figure 2. Irregular Pulse Notifications, According to Age and Sex.
Horizontal bars indicate 97.5% confidence intervals.

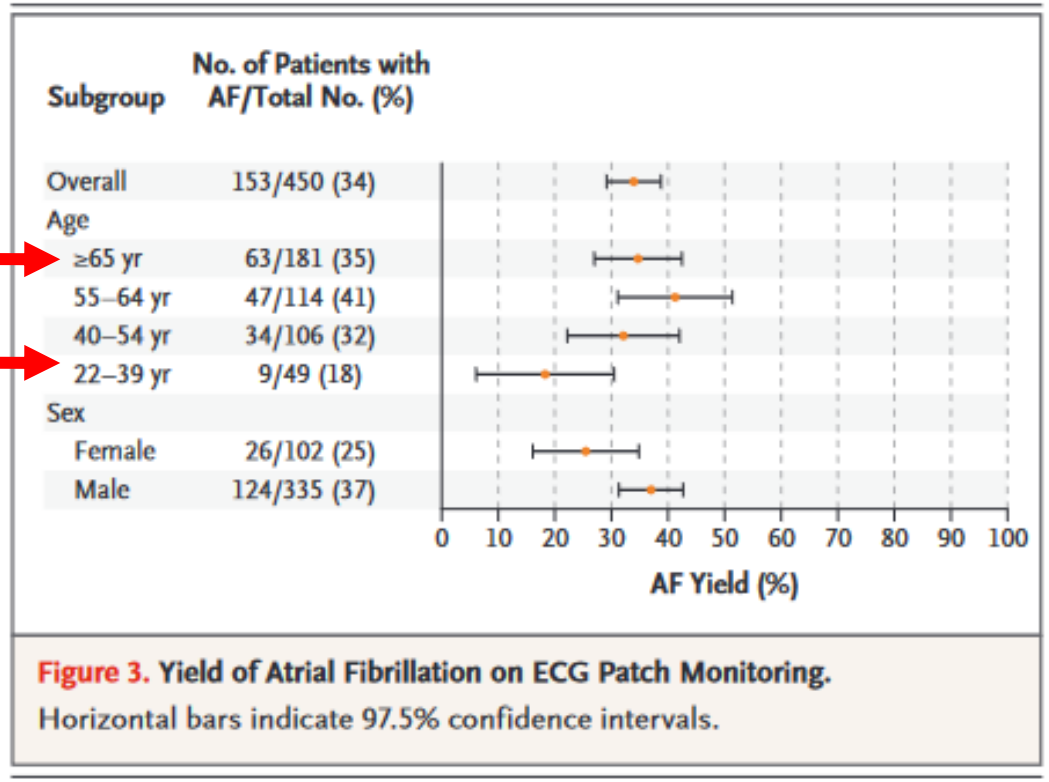
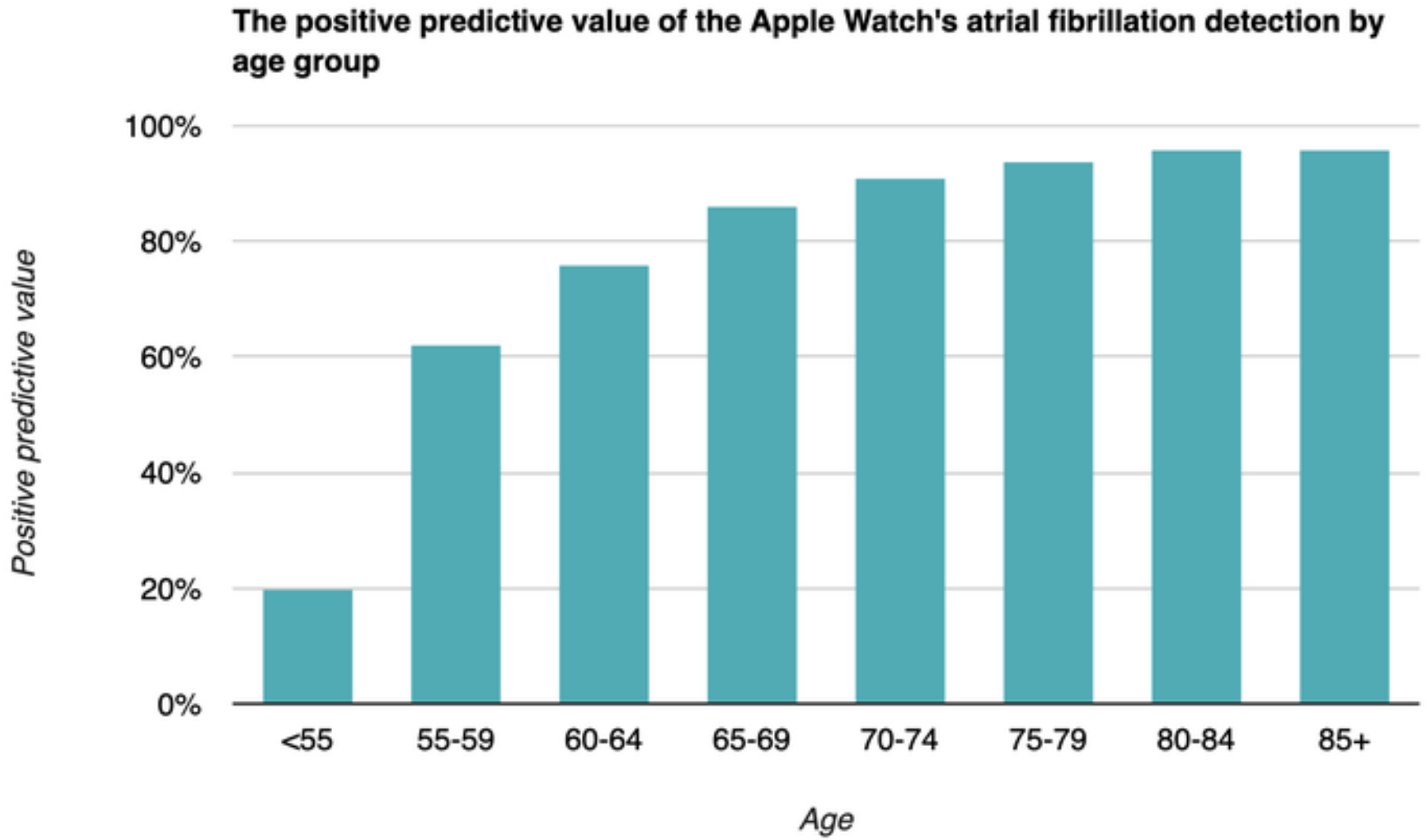


Figure 3. Yield of Atrial Fibrillation on ECG Patch Monitoring.
Horizontal bars indicate 97.5% confidence intervals.

- Sensitivity of about 50%
- Specificity of about 95%
- Positive predictive value is based on pre-test prevalence



- Ref. D. Yadzi, MD

Journal of the American Medical Informatics Association, 27(9), 2020, 1359–1363
doi: 10.1093/jamia/ocaa137
Research and Applications

Research a

Clinical e
evaluatio

Kirk D. Wyatt,
Heather A. He

[1]Division of Pediatri
sota, USA, [2]Departm
Informatics, Mayo C
icine, Mayo Clinic, R

Corresponding Aut
Heaton.Heather@mayo.edu

- 264 patients over a 4 month period
- 49% already had pre-existing cardiovascular diagnosis
- Median patient age 55
- New atrial fibrillation found in just 4.9% (n=13) patients

Fitter, Happier, More Productive? The Normative Ontology of Fitness Trackers

"Fitness trackers are supposedly benign technologies that will playfully help us get in shape, understand our bodies, and treat them better so we can live healthy lives. But these healthy lives are …detached from any meaningful interpretation of the complexity of an individual's well-being.

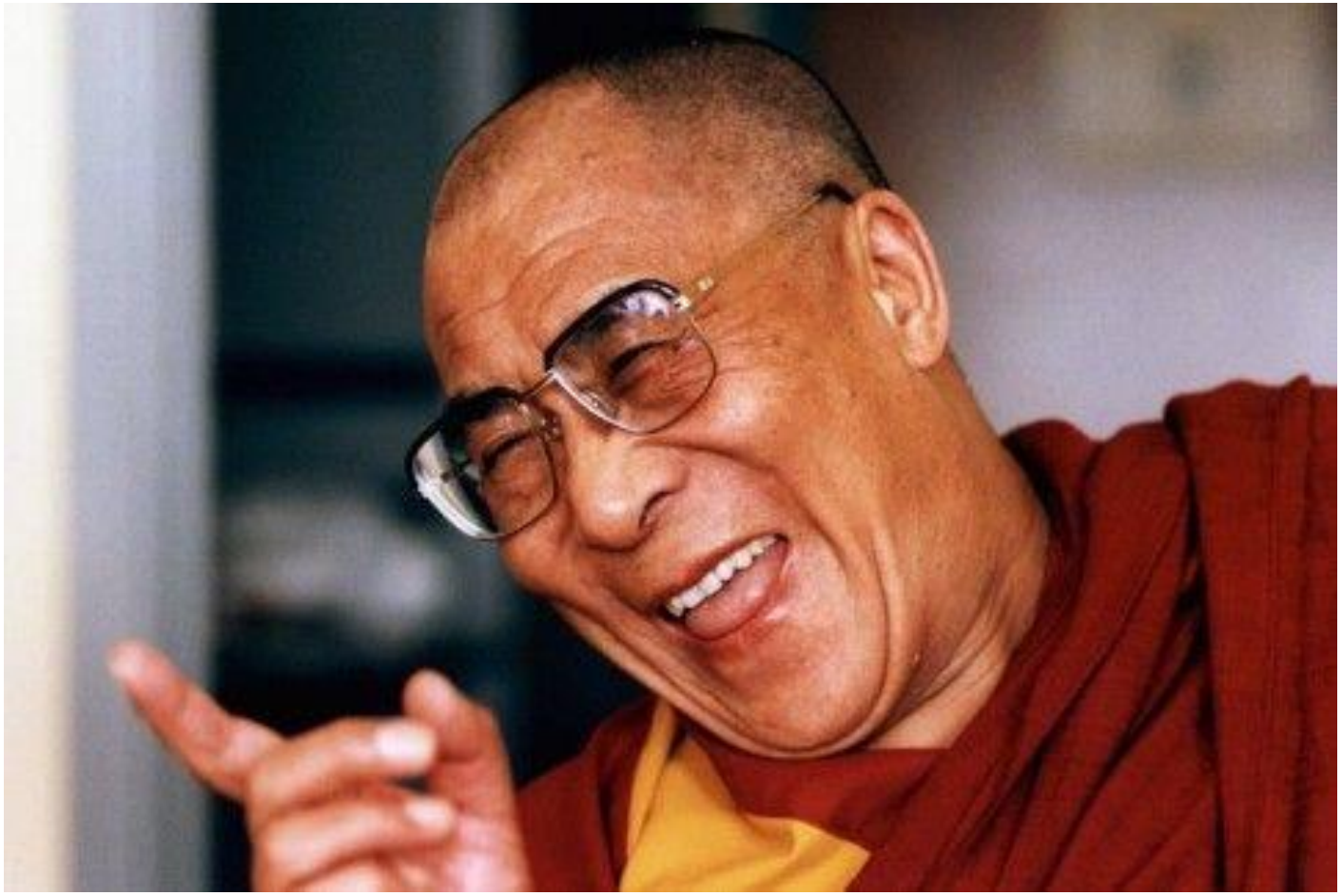
In this new world a joyful step and a miserable step have the same value"

ACM ISBN 978-1-4503-5621-3/18/04 ...$15.00.
http://dx.doi.org/10.1145/3170427.3188401

other step, and measure it too. Proceed until scientific needs are met. Then average the results: that will be a step. Then take a map. Using instruments as precise as desired, measure the distance between distinct places. Cal-

Summary

- Wearable technology showing promise in some areas
- More research needed in other areas
- Dependent on your personality



“Happiness is the highest form of health” – Dalai Lama

Thank You