

TC 124 Workshop

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TC 124 PL PNW 124-9 and PNW
124-11: Stress measurements and
sleep measurements in wearables

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June 5, 2024

History

PWI 124-9, Future IEC 63203-402-X: Wearable electronic devices and technologies - Part 402-X: Performance of stress measurements in wearables

- Originally accepted in May 2022 as PNW.
- Original PL Edwin Begemann, NL, and Kerri Haresign, US
- Changes in the NL and US resulted in both PLs stepping away from the project. Veronica Lancaster stepped in as PL in September 2023

PWI 124-11, Future IEC 63203-402-X: Wearable electronic devices and technologies - Part 402-X: Performance Measurement of Fitness Wearables - Sleep Measurements

- Originally accepted in July 2023 as PNW.
- Original PL Kerri Haresign, US
- Changes in the US resulted in Kerri Haresign stepping away from the project. Veronica Lancaster stepped in as PL in September 2023

PWI 124-9, Future IEC 63203-402-X: Wearable electronic devices and technologies - Part X: Performance of stress measurements in wearables

- For this specification, stress will be addressed within the limited context of **wearable consumer monitoring solutions**.
- **Only metrics related to stress responses** using consumer wearables are included
 - Various technologies; measuring all sources vs one (or a few) sources;
 - Heart Rate, Breathing Rate, Skin Conductance are inputs to measure stress levels
- **Currently:**
 - No common understanding of stress, every wearable solution has its own interpretation of stress but described as “stress” to user
 - No clear view on stress for consumer
 - Measuring differently by own algorithms validated against various ‘ground truths’
 - Results in stress measurements vary
- The purpose of defining stress in this context is to provide **parameters, and limits**, under which a product can be expected to measure stress and report **useful information to a user** of the solution.
- When will the stress measurement **used and believed** by the user?
 - When it is **accurate**
 - When the user **believes the result shown**
 - A **better definition** of stress and accuracy **helps the consumer** in working with the metric

Let's talk about stress...

- Researchers, scientists and experts have been trying, to come to an agreement on the definition of stress.
- Canadian physician and medical researcher Hans Selye defined stress as “The rate of wear and tear on the body”. Since that time, the scope of the sources of such stress has grown to include both physical and cognitive/emotional sources.
- There are many sources of stress:
 - Physical, Chemical, Nutrition, Cognitive, Emotional
- Stress: how the body reacts to any kind of demand, threat or change being experienced.
 - Stress is required to function properly
 - Stress does not need to have a negative connotation
 - Too much and continuous stress is unhealthy
- The body & brain do not distinguish between the different types of stress

Why a performance measurement standard?

- Consumer devices are already tracking stress to help consumers better manage it
 - Fitbit, WHOOP, Oura Ring, Samsung, Garmin, Apple, Pebble, Google, Jawbone, and Nike.
 - Trackers collect information on metrics such as heart rate, skin temperature, and sleep quality. They also assess heart rate variability, or HRV, which is the balance between the body's systems for ramping up to a challenge and slowing down to rest.
 - Some devices measure electrical changes in sweat glands that respond to stress or emotional reactions.
 - Measuring a combination of these factors can be an indication of chronic stress.
- However, these devices are measuring stress differently
 - Some use proprietary algorithms
 - Some analyze HRV, heart rate, breathing variability, and electrodermal activity

Performance of stress measurements in wearables

- The U.S. currently has several published American National Standards addressing stress, published by the Consumer Technology Association.
- These address physical and psychosocial stress, heart rate, respiration, skin conductance, and chronic stress.
- The original comments, draft working document and the U.S. American National Standards can be used as a starting point to create a performance measurement standard for an international standard.
 - The North American market is strong, with recent robust growth due to mental health awareness and the need for stress management.
 - Japan and India have seen a surge in demand due to rising stress levels and a focus on well-being.
 - Germany and the U.K. are seeing steady growth in stress tracking devices.
 - China is emerging as a key market with its large population and growing disposable income.

Proposed Document Outline

- Scope
- References
- Terms and Definitions
- Test Methods and Procedures
 - HRV
 - Respiratory
 - Skin
- Accuracy
- Test Report

PWI 124-11, Future IEC 63203-402-X: Wearable electronic devices and technologies - Part 402-X: Performance Measurement of Fitness Wearables - Sleep Measurements

- Sleep will be addressed within the limited context of **wearable consumer monitoring solutions**.
- Similar to stress management, the purpose of defining sleep measurement in this context is to provide **parameters, and limits**, under which a product can be expected to measure sleep, and factors related to sleep, to report **useful information to a user** of the solution.
- Sleep tracking is already a measurement **used and believed** by some users
 - However, it could be more **accurate**
 - Users need to **believe in the result shown**
 - More accurate sleep tracking can **help the consumer** to achieve better sleep

Let's talk about sleep...

- Sleep plays a vital role in supporting healthy brain function and physical health.
- The way you sleep impacts the way you feel when you are awake.
- What happens when we sleep?
 - During non-REM sleep, your blood pressure and heart rate fall.
 - During sleep, your parasympathetic system controls your body, and your heart does not work as hard as it does when you are awake.
 - During REM sleep and when waking, your sympathetic system is activated, increasing your heart rate and blood pressure to the usual levels when you are awake and relaxed.
- What happens when we don't sleep?
 - People who do not sleep enough can have a higher risk of coronary heart disease, high blood pressure, depression, obesity, or stroke.
 - Metabolism is not as effective.
 - Higher levels of the hormones that control hunger
 - Decreased ability to respond to insulin
 - Increased consumption of food, especially fatty, sweet, and salty foods
 - Decreased physical activity

Why a performance measurement standard?

- Consumer devices have been tracking sleep for some time
 - Fitbit, WHOOP, Oura Ring, Samsung galaxy watch, Garmin, Apple, Google Pixel watch, Nest hub, Eight sleep pod, and Withings sleep. Earbud manufacturers Anker has earbuds for side sleepers, and Bose is working on fixing its discontinued sleepbuds.
 - Some research estimates claim 1 in 3 Americans have used or are using a sleep-tracking device, with 78% indicating they are useful and 68% saying these devices have changed their sleeping behavior.
 - Trackers have been on the market long enough for consumers to select devices that fit their specific lifecycle, such as busy adults, specific to sleep tracking, athletes, or adults seeking non-invasive trackers not requiring a device to be worn.
- However, these devices are not medical devices. They are not diagnostic. They provide the consumer with insight into their sleep patterns. Therefore, accuracy in reporting is important.
 - Some use proprietary algorithms
 - Some analyze HRV, heart rate, respiratory rate, body temperature, quantity and quality of sleep, snoring detection, sleep depth, sleep interruptions, sleep schedule, wakefulness, and time to sleep.

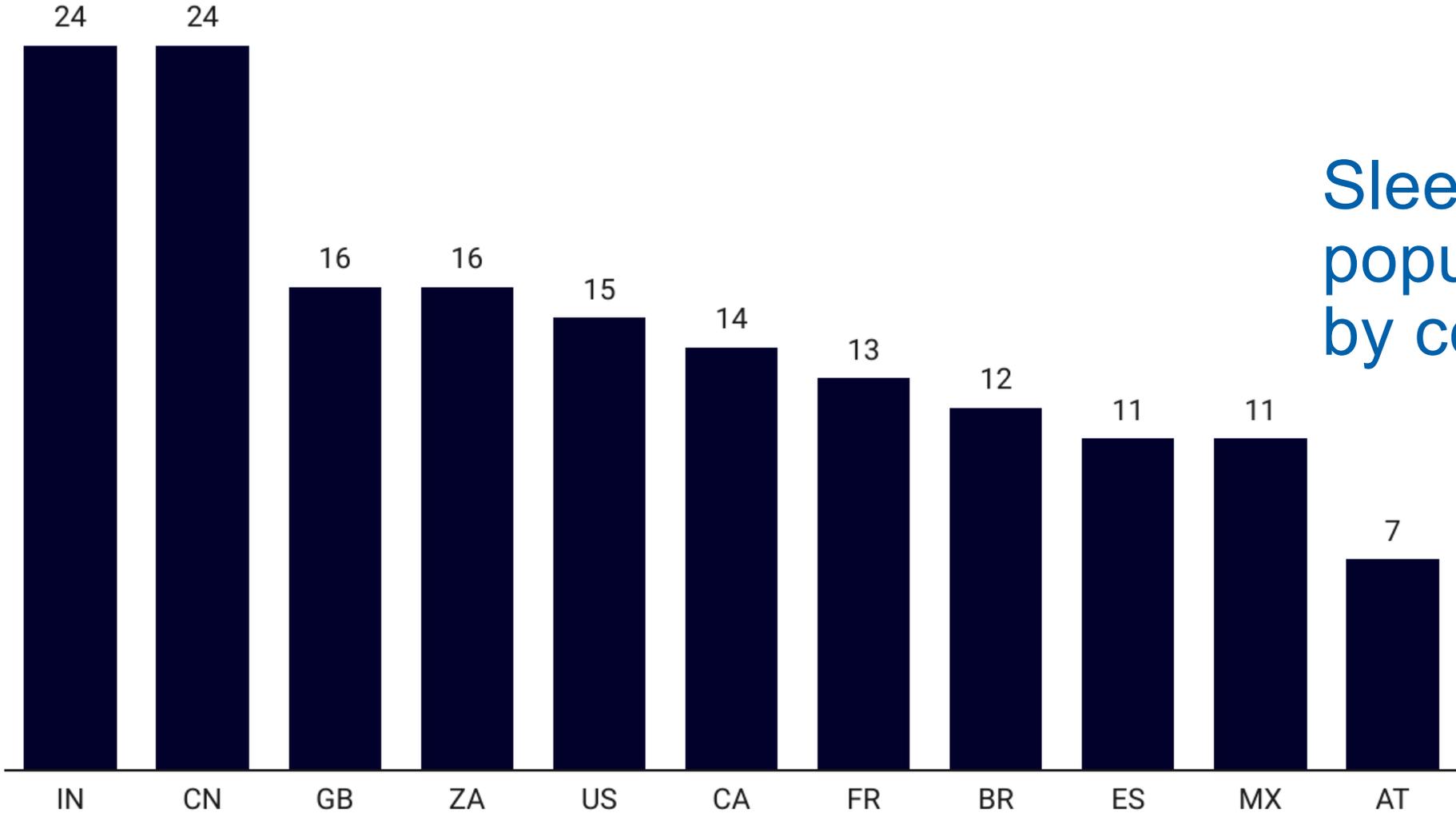
Performance of sleep measurements in wearables

- The U.S. currently has several published American National Standards addressing sleep, published by the Consumer Technology Association.
- These address wearable sleep monitors, devices and applications, environmental factors, detecting snoring, and sleep quality.
- The original comments and U.S. American National Standards can be used as a starting point to create a performance measurement standard for an international standard.
 - Sleep trackers have increased in popularity due to high consumer demand and technological advancements.
 - The market size of global wearable sleep trackers will be \$2.22 billion by 2024, but will cross \$3.26 billion by the end of 2029
 - The Non-Wearable Sleep Trackers market valuation recorded \$309 million in revenue in 2023, but is predicted to reach \$743 million by the end of 2030.
 - The market size of global wearable sleep trackers The U.S. market is strong, with 1 of 3 Americans using sleep tracking devices and 78% find them useful.
 - The top three sleep tracker exporters are China, the U.S., and Vietnam.
 - The top three sleep tracker importers were India, the Philippines, and Peru.

How Popular Are Sleep Monitoring Apps?



Share of respondents in selected countries who used sleep tracking apps in the past 12 months (in %)



Sleep tracking popularity statistics by country

Proposed Document Outline

- Scope
- References
- Terms and Definitions
 - Definitions and Characteristics
 - Temporal surround of a sleep episode
 - Features of wakefulness and sleep
 - Calculations based on initial sleep and final wakefulness
 - Describing sleep and sleep subdivisions
 - Sleep-wake cycle over one week
- Test Methods, Procedures, Performance Criteria
 - Methodology for measuring elemental parameters used in sleep devices (by feature)
 - Evaluation
 - Events, Processes, Patterns
 - Methods of evaluation
 - Compliance
 - TBD. American National Standard identifies criteria required to be compliant in identifying sleep/wak and sleep stage.
- Accuracy
- Test Report



Thank you

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