

WIH 3001 DATA SCIENCE PROJECT

Employing HRV Analysis for Stress Level Detection

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Introduction

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GLOBAL IMPACT:

WHO has recognized stress as "***the health epidemic of the 21st century***" for several years.
(Fink, 2016)

CONSEQUENCES:

Poor stress management can cause ***health problems*** like heart disease, high blood pressure, and ***mental health disorders*** like depression and anxiety.



Stress

Mental or emotional strain
caused by challenging or demanding situations.

SYMPTOMS:

- ***Psychological***: feeling overwhelmed, difficulty in handling mental, emotional pressures.
- ***Physical***: fatigue, changes in sleeping patterns and eating habits.

(Stress, 2021)



SELF-AWARENESS:

Recognizing the signs of stress helps in ***taking proactive measures*** such as adopting stress-reduction techniques or seeking professional help.

Stress in Malaysia

In May 2022, Rakuten Insight had conducted a mental health survey in Malaysia.

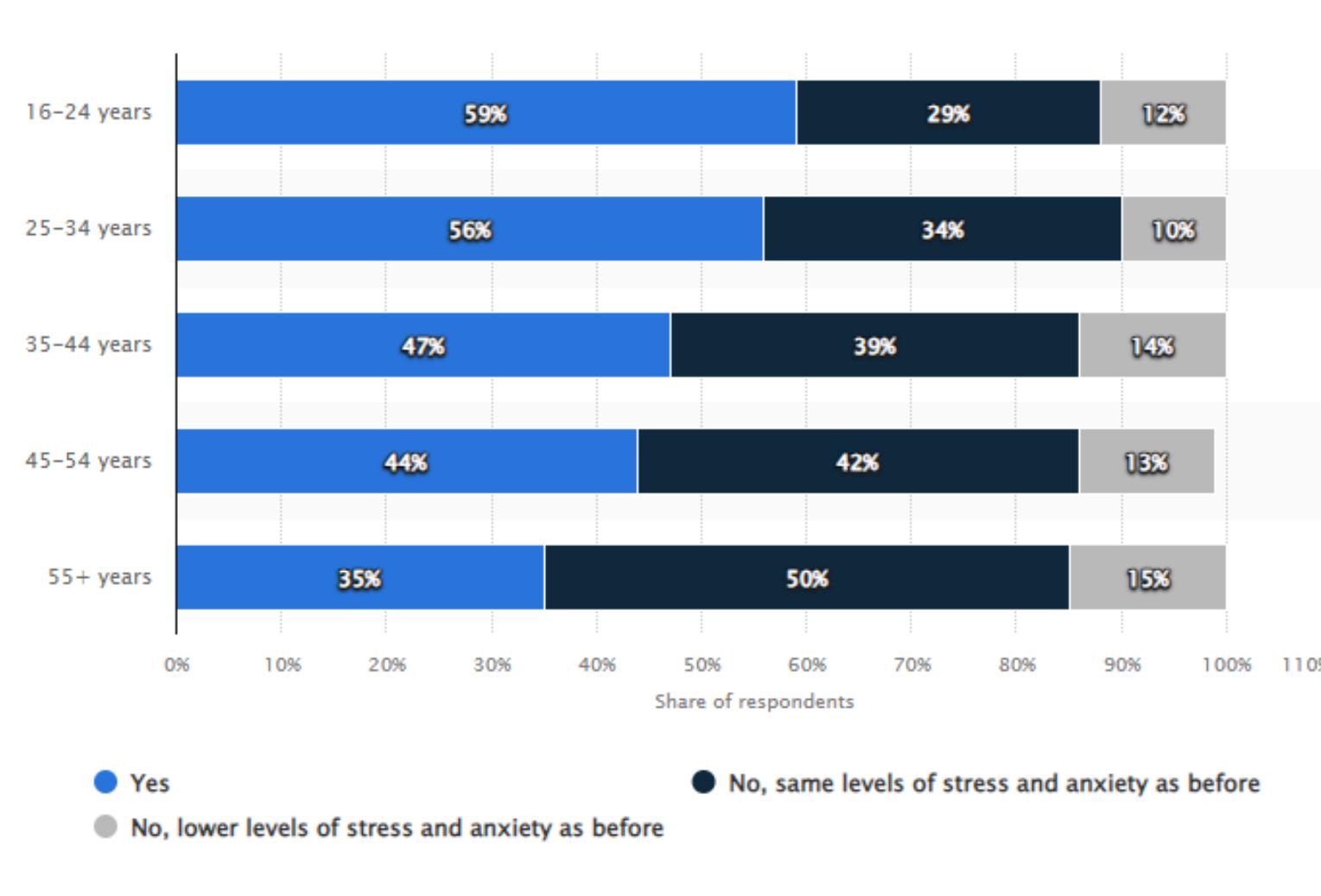


Image 1: Share of people suffering from higher level of stress or anxiety during the past year in Malaysia as of May 2022, by age group.

(Malaysia: Stress and Anxiety Level by Age 2022 | Statista, 2022)

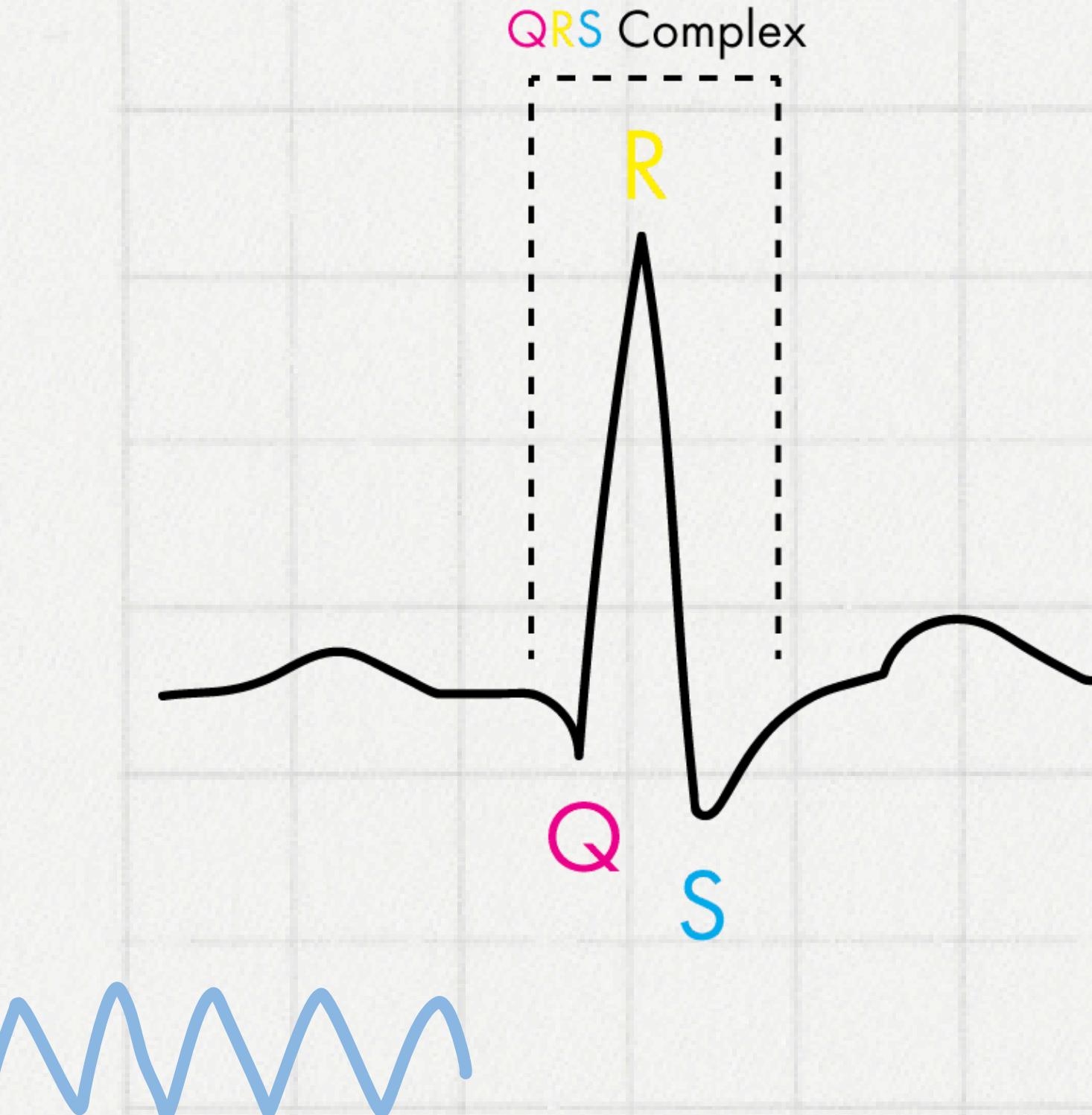
59%

Individuals **aged 16-24** experienced **increased** in stress or anxiety in 2022.

WHAT CAN WE SEE FROM THE GRAPH?

- 1.Rising stress levels among young adults
- 2.Stable stress levels in slightly older adults
- 3.Urban lifestyle as a contributing factor
- 4.Require targeted mental health interventions

Heart Rate Variability (HRV)



- HRV is an index of the functional status of the autonomic nervous system (ANS).
- HRV measures ***the time variance between consecutive heartbeats***, offering valuable insights into the body's response to stress. (Clinic, 2021)

HOW IS HRV LINKED TO STRESS?

- HRV is a non-invasive metric *reflecting the autonomic nervous system's (ANS) influence* on heart rhythms.
- *Lower HRV is associated with higher stress levels*, making it a reliable indicator of physiological stress.
- *Reduced HRV* has been observed commonly in individuals indicating a *poor stress response*.
(Cleveland Clinic, n.d.)



WHAT IS THE ROLE OF HRV IN STRESS DETECTION?

- Analyzing HRV data* with a data-driven approach can:
- Identify stress levels
 - Enhancing self-awareness
 - Transform stress management to proactive process



WHY IS HRV CHOSEN AS INDICATOR?

- **Effectiveness** in detecting stress levels.
 - HRV metrics undergo significant changes during stress episodes. (Kim et al., 2018)
 - Effective in distinguishing between the 'fight-or-flight' stress response and a relaxed state. (WebMD Editorial Contributors, 2021)
- **Real-time monitoring** without being over intrusive
- **Practical and user-friendly** for daily used.
 - HRV measurement through wearable technology like smartwatches.

02

Problem Statement



Rising Global Stress Issue

Stress levels are rising worldwide and are particularly severe in Malaysia.

Health Risks

WHO labels stress as a major health challenge linked to heart disease, anxiety, and depression. Poor management of stress might increase the risks of having physically and psychological issues.

Inadequacies in Existing Methods

Existing methods for stress detection and management are often not real-time and may be invasive or impractical.



Specific Target on Youth

There's a significant focus on addressing stress issues among the younger demographic in Malaysia.



03 Objectives

1. To ***identify the best machine learning algorithm*** to detect stress levels using HRV analysis.
2. To ***develop a machine learning model*** capable of analyzing HRV data to detect stress levels.
3. To ***test the developed model*** of the HRV-based stress detection system.

04

Data Science

Methodology



01 Problem Understanding

- Define the problem statement, objectives, and the scope of the project.
- Understanding HRV's role in indicating stress and devising strategies to analyze these patterns are central to this phase.

02 Data Acquisition

- Data collection will involve sourcing HRV data pertinent to stress detection.
- A Kaggle dataset with HRV metrics under various stress levels has been provided as a potential source of HRV data.

03 Data Exploration & Pre-processing

- Perform EDA to understand the structure, features, and patterns within the acquired dataset.
- Pre-process data by handling missing values, addressing outliers, and rectifying any inconsistencies in the data.

04 Exploratory Data Analysis

- Extract meaningful insights from HRV data related to stress indicators.
- Statistical and machine learning techniques is used to identify patterns and correlations between HRV and stress levels.

05 Model Development

- Split dataset into training and testing sets to validate the performance of the machine learning models.
- Develop predictive models using machine learning algorithms.

06 Model Evaluation & Tuning

- Evaluate model with cross-validation techniques.
- Fine-tune model performance by optimizing hyperparameters to enhance accuracy and effectiveness.

07 Model Deployment

- Develop a user-friendly platform or interactive dashboard that can allow user analyze stress levels through HRV data.

08 Monitoring & Maintenance

- Continuous monitoring the model's performance.
- Regular updates and gather user feedback for improvement.

09 Documenting & Reporting

- Document the entire process, from data preprocessing to model deployment, for transparency and future reference.

05

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**Thank you
very much!**