

IPPPPT INJURY PREDICTION, PREVENTION & PERFORMANCE TOOL

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INTRODUCTION

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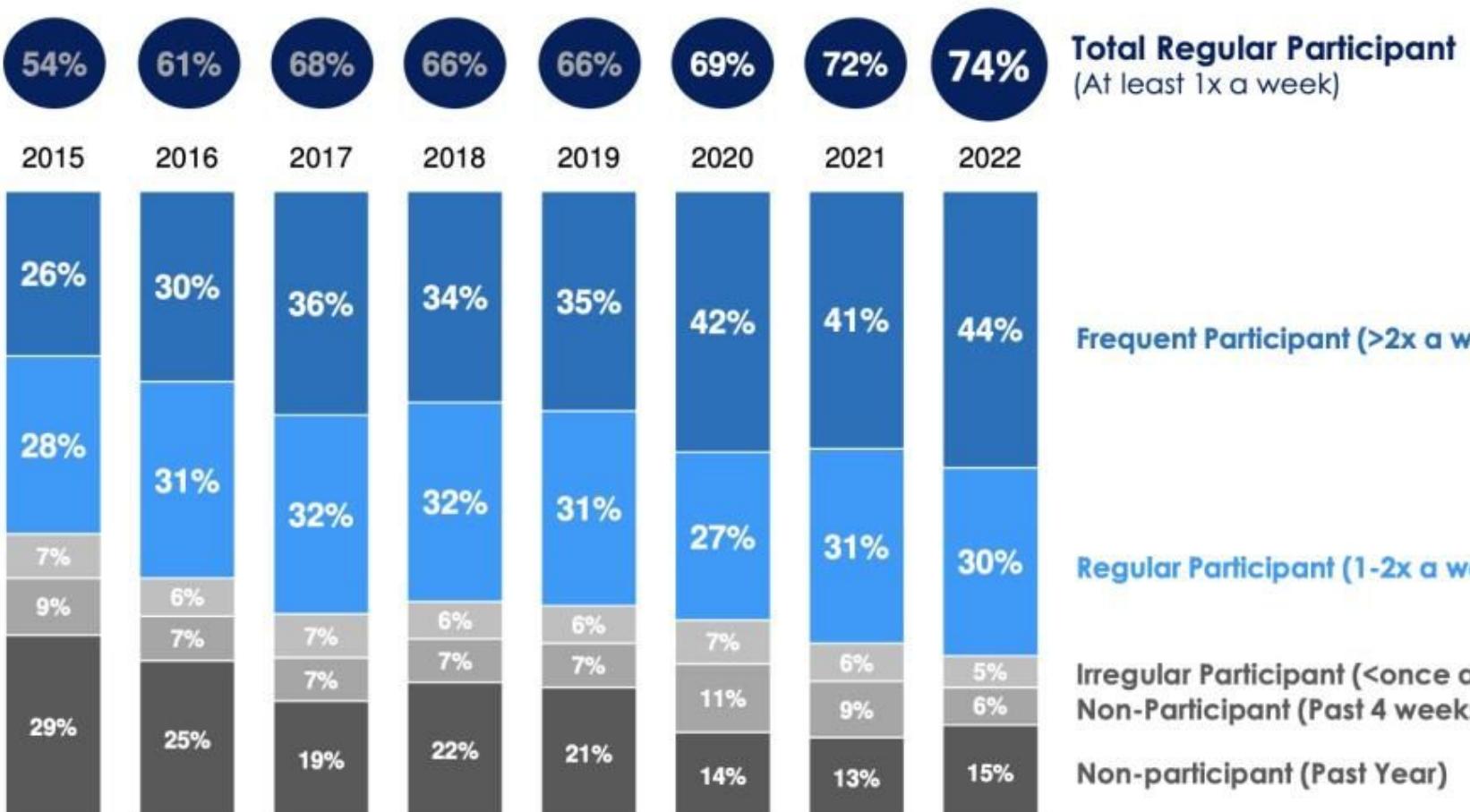


01

INTRODUCTION

Background
Problem Statement

Participation Level Through the Years



FITNESS TESTS

- ✖ 6 stations **National Physical Fitness Award (NAPFA)** for students in Singapore.
- ✖ 3 stations **Individual Physical Proficiency Test (IPPT)** for national servicemen.
- ✖ Common station is **2.4km run**.
- ✖ Focus on servicemen as it is mandatory.

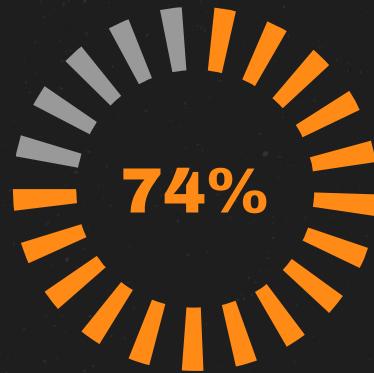


402,500

NSF and NSmen subjected to IPPT*

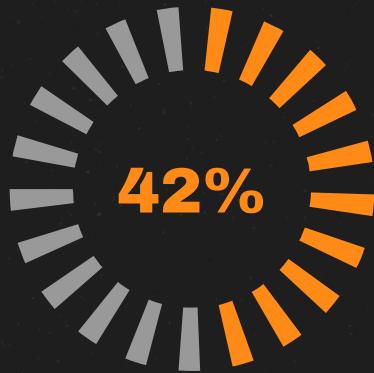
*NS Matters: <https://www.ns.sg/web/portal/nsmen/home>

NATIONAL SPORTS PARTICIPATION SURVEY



Sporting Activities

Participation \geq once a week by SG residents



Running

Young adults (aged 20-39)



Injury

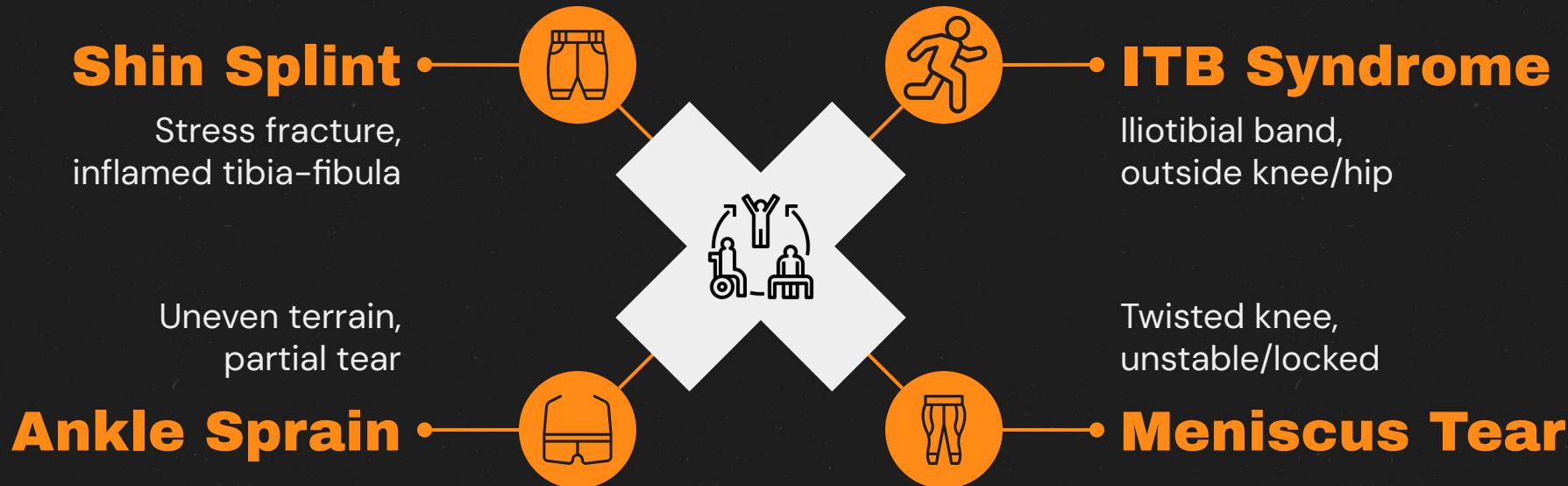
Regular runners*



* <https://www.yalemedicine.org/conditions/running-injury>



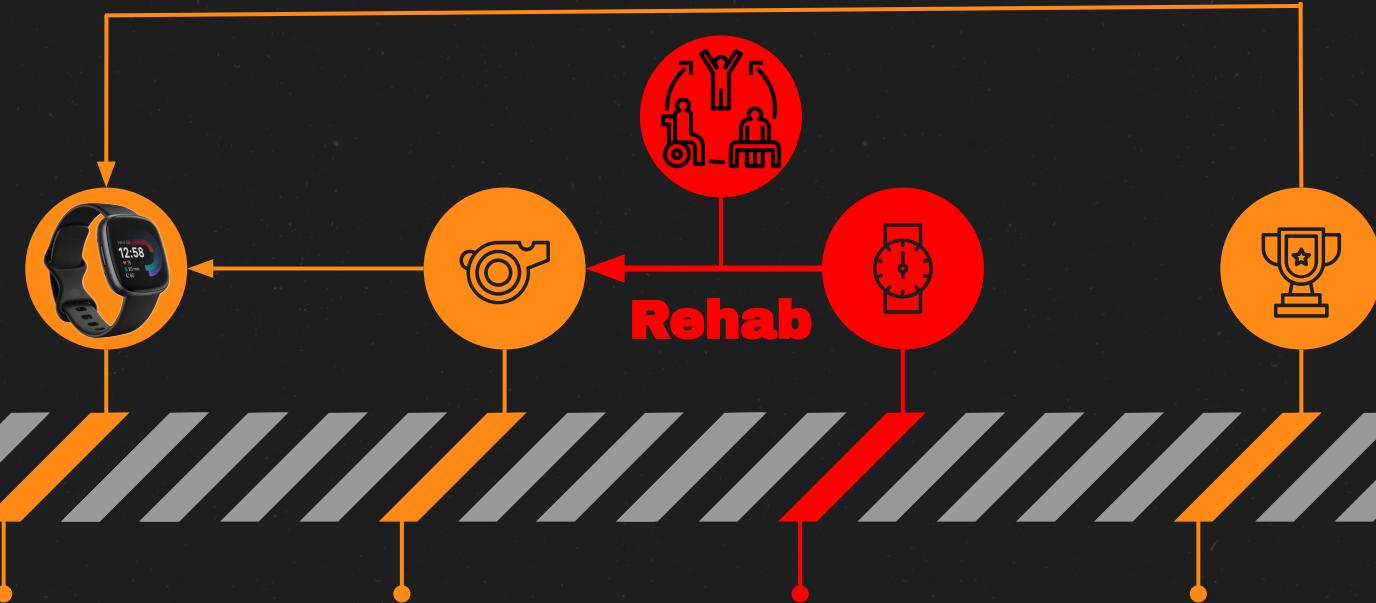
COMMON RUNNING INJURIES



*<https://www.mountelizabeth.com.sg/health-plus/article/common-injuries-runners-run-into>



TRAINING PEDAGOGY



HRZ

Training

Using Fitbit Versa 4

Review

Adherence to
training plan

Injury

Overtraining /
undiagnosed injury

IPPT

Assessment

PAIN POINTS



Quality Feedback

HRZ adherence ≠ performance improvement

Rehab Downtime

6 – 12 weeks | Physiotherapist

IPPT Resources

Time | Manpower | Money



* <https://www.mountelizabeth.com.sg/health-plus/article/common-injuries-healing-times>

O(n)
ONE TIME
GOOD ONE



PROBLEM STATEMENT



How can **trainers** and **individuals** use **machine learning** to analyse heart rate data from wearables in order to **review training performance** and **highlight those at risk of injury** in order achieve IPPT Gold standards before attempting IPPT?



02

METHODOLOGY

Challenges

METHODOLOGY

Selection of test subjects

Syncing data between wearables and apps

Collecting data using API

PHASE 1



PHASE 4

EDA, modelling

PHASE 2



PHASE 5

App development and deployment

PHASE 3



PHASE 6

Beta testing

1. SELECTING TEST SUBJECTS X



Size



~1,000 pax, 5 coys

Training Program



Staggered schedule, run types
*Assumption: Endurance run

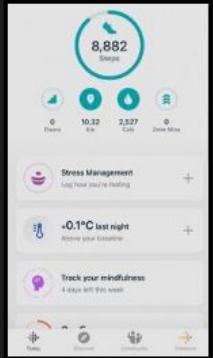
Enforcement



Adherence to trial



2. SYNCING DATA



Cross Platform

Fitbit vs other wearables



Sharing Data

Automatic syncing



HR Data

Post privacy, visibility



3. COLLECTING DATA



Terms of use

Legal restrictions, scraping data



API App

Athlete permission



Data Quality

Wearables data vs Strava API





03

EDA

Exploratory Data
Analysis



BOUNDARIES

Age	Heart Rate Percentages				
	60%	70%	80%	90%	100%
18	121	141	162	182	202
19	121	141	161	181	201
20	120	140	160	180	200
21	119	139	159	179	199
22	119	139	158	178	198
23	118	138	158	177	197

New 3-Station IPPT Format

2.4KM FOR MEN

Age Cat	<22	22-24	25-27	28-30	31-33	34-36	37-39	40-42	43-45	46-48	49-51	52-54	55-57	58-60
Age Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Total Score														
8:30	50													
8:40	49	50												
8:50	48	49	50											
9:00	47	48	49											
9:10	46	47	48	50										
9:20	45	46	47	49	50									
9:30	44	45	46	48	49	50								
9:40	43	44	45	47	48	49	50							
9:50	42	43	44	46	47	48	49	50						
10:00	41	42	43	45	46	47	48	49	50					
10:10	40	41	42	44	45	46	47	48	49	50				
10:20	39	40	41	43	44	45	46	47	48	49	50			
10:30	38	39	40	42	43	44	45	46	47	48	49	50		
10:40		38	39	41	42	43	45	44	45	46	47	48	49	50
10:50		37	38	38	40	41	42	43	44	45	46	47	48	49
11:00		37	37	38	39	40	41	42	43	44	45	46	47	48



Max HR

Zone 5 (90-100%)



Injury

Prolonged Zone 5



2.4km Gold

Speed: 3.8095 m/sec



04

MODELLING

Selection
Hyperparameter Tuning



MODEL COMPARISON

Model	MAE	MSE	RMSE	R2	RMSLE	MAPE
0 CatBoost Regressor	629.397	2.07934e+06	1376.31	0.9803	0.0676	0.0497
1 Extra Trees Regressor	762.012	2.764e+06	1612.24	0.9729	0.0817	0.0607
2 Random Forest	760.63	2.92968e+06	1663.01	0.9714	0.0818	0.0597
3 Light Gradient Boosting Machine	752.236	3.05557e+06	1687.78	0.9711	0.0773	0.0567
4 Extreme Gradient Boosting	932.797	3.53405e+06	1855.33	0.9652	0.1061	0.0801
5 Gradient Boosting Regressor	920.291	3.7643e+06	1901.18	0.9633	0.1024	0.077



05

DEMO

Streamlit App



1. COMD DASHBOARD

{ IPPPT }

Insights Analyse User Training Guide

Insights Dashboard

The dashboard displays a map with a red running route overlaid, followed by an elevation profile graph showing altitude changes over distance. Below the graph are three performance metrics: Pace, GAP, and Heart Rate.

Pace: Avg 4:35 /km, on

GAP: 4:30 /km

Heart Rate: 146 bpm, on



2. ANALYSE INDIVIDUAL

{ IPPPT }

Insights Analyse User Training Guide

Strava User Analyser

Enter Strava user ID:

Select number of activities:

1 100 200

Submit





3. TRAINING GUIDE

{ IPPPT }

The screenshot shows a mobile application interface. At the top, there is a navigation bar with three tabs: 'Insights' (orange), 'Analyse User' (light gray), and 'Training Guide' (light gray). Below the navigation bar is a header section with the text '5XX Wearables Guide' and a search bar with a magnifying glass icon and the text 'Search'. There is also a 'Duplicate' button. The main content area features a banner with a blue background showing a smartwatch and a smartphone. Below the banner, the title '5XX Wearables Guide' is displayed in a large, bold, white font. A sub-instruction 'Tap on the triangle icon ▶ to view the contents inside.' is shown in small white text. The 'Fitbit Onboarding' section contains four steps:

- ▶ Step 1. Install Fitbit app on phone
- ▶ Step 2. Install Strava app on your phone, pair to Fitbit and share heart rate data.
- ▶ Step 3. Join your assigned Strava group
- ▶ Step 4. Adjust the 'Always on Display' settings on your Fitbit

The 'References' section includes a table titled 'Heart Rate Percentages' showing heart rate values for different ages and percentages.

Age	Heart Rate				
	60%	70%	80%	90%	100%
18	121	141	162	182	202
19	121	141	161	181	201
20	120	140	160	180	200
21	119	139	159	179	199
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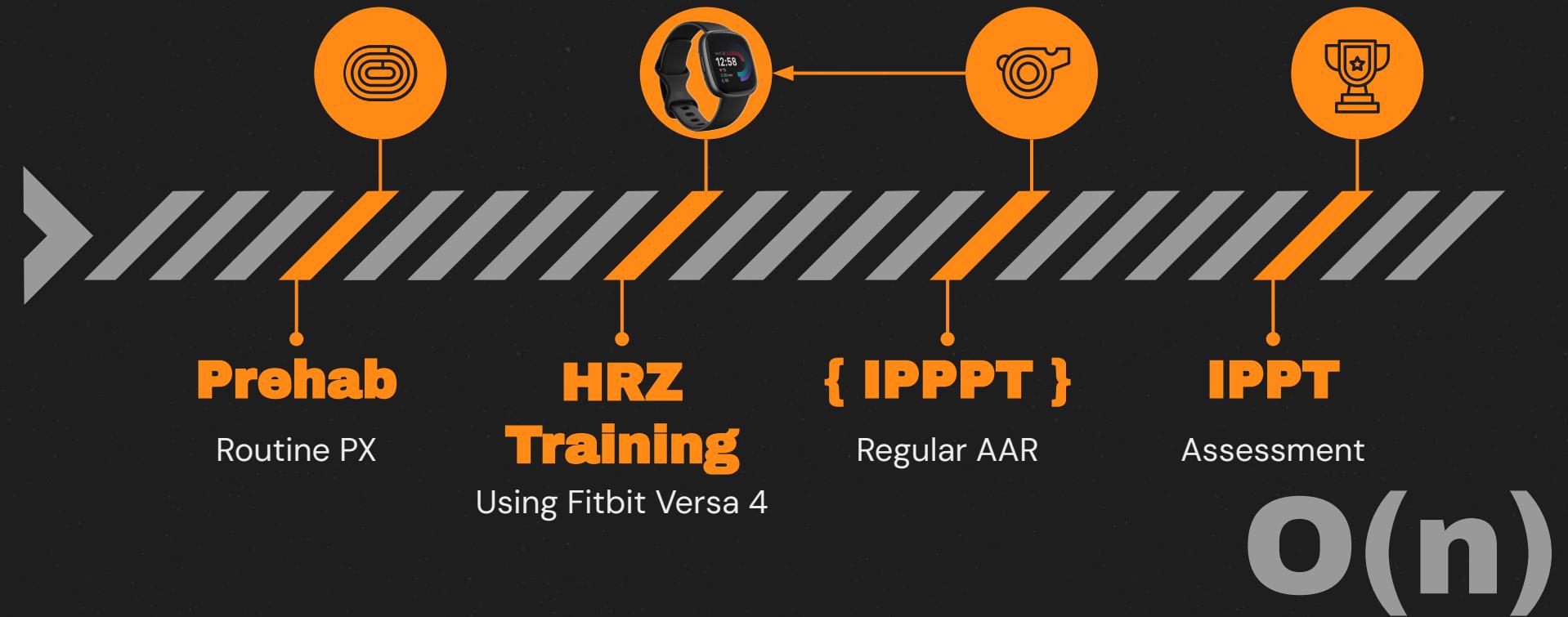
06

CONCLUSION

Comparison
Way Ahead



NEW TRAINING PEDAGOGY



COMPARISON

	Current	New
	Quality Feedback HRZ adherence ≠ performance improvement	 Aggregated performance indicators
	Rehab Downtime 6 - 12 weeks, physiotherapist	 Possible injuries are highlighted and prevented
	IPPT Resources Time, manpower, money	↓ no. of conducts

WAY AHEAD



Detailed HR Data

Analyse other types of run conducts



Physiotherapy

Route to physiotherapist for prehab



Other Metrics

Data from wearables



Beta Testing

Trial on selected coy





THANKS!



Do you have any questions?

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