

Project Title

Sub-Clustering General Population with High Body Mass Index to Inform Future Risk Of Diabetes

Project Lead and Members

Project Lead: Zheng Huili

Project Members: Chalani Udhyami Ubeynarayana, Serena Low Kiat Mun, Angela Moh Mei Chung, Jonathon Khoo Kay Chin, Bhuvaneshwari Pandian, Wong Sweet Fun, Bastari Irwan, Soh Yee Boon, Lim Su Chi

Organisation(s) Involved

Khoo Teck Puat Hospital, Nanyang Technological University, National University of Singapore

Healthcare Family Group(s) Involved in this Project

Allied Health, Healthcare Administration, Medical

Applicable Specialty or Discipline

Endocrinology, Population Health

Project Period

Start date: September 2013

Completed date: December 2017

Aims

To identify individuals with high BMI and differential risk for diabetes mellitus (DM) incidence using readily available proxy measurements of adiposopathy that drive DM through excess fat, unhealthy fat distribution and metabolic distress.

Background

See poster appended/ below

Methods

See poster appended/ below

Results

See poster appended/ below

Conclusion

See poster appended/ below

Lessons Learnt

- Compared to body mass index, metabolic health is more informative of the future risk of diabetes
- Adiposopathy could be modified by age-driven sarcopenia
- High body mass index itself may not be harmful initially
- Clustering can guide right siting of primary care

Additional Information

Singapore Health & Biomedical Congress (SHBC) 2023: Singapore Young Investigator Award (Health Services Research) – (Bronze Award)

Project Category

Applied/ Translational Research

Quantitative Research

Keywords

Body Mass Index, Diabetes, Clustering

Name and Email of Project Contact Person(s)

Name: Ms Zheng Huili

Email: zheng.huili@ktph.com.sg

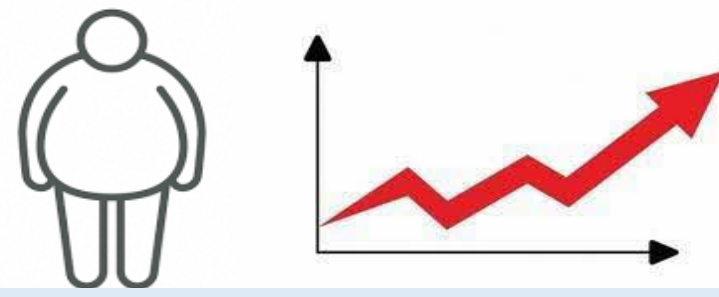
Sub-clustering general population with high body mass index to inform future risk of diabetes

Zheng Huili¹, Chalani Udhyami Ubeynarayana¹, Serena Low Kiat Mun^{1,3,4}, Angela Moh Mei Chung¹, Jonathon Khoo Kay Chin¹, Bhuvaneshwari Pandian¹, Wong Sweet Fun², Bastari Irwan², Soh Yee Boon², Lim Su Chi^{1,3,4,5*}

¹ Clinical Research Unit, Khoo Teck Puat Hospital, ² Community Transformation Office, Khoo Teck Puat Hospital, ³ Diabetes Centre, Admiralty Medical Centre, ⁴ Lee Kong Chian School of Medicine, Nanyang Technological University, ⁵ Saw Swee Hock School of Public Health, National University of Singapore

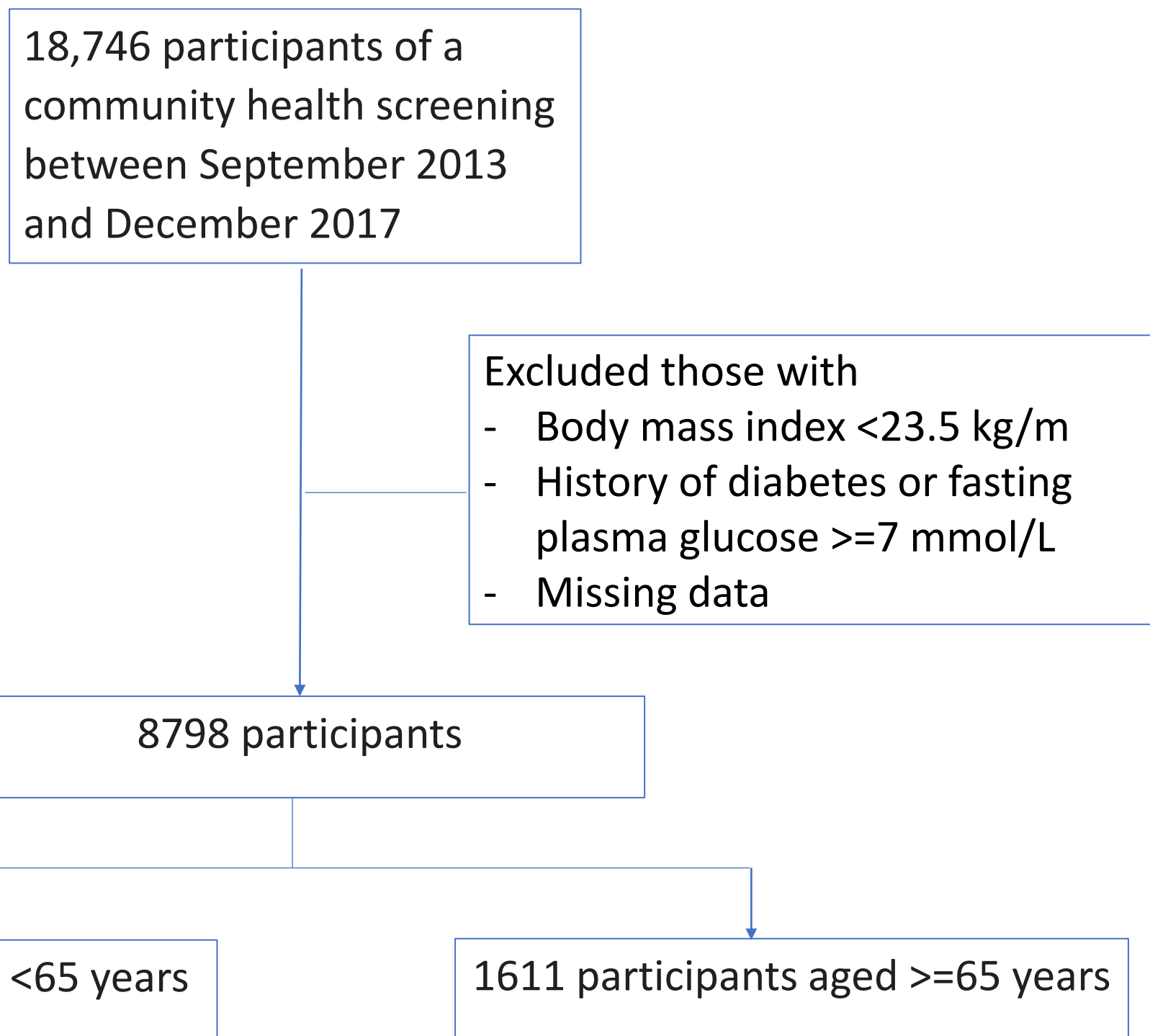
Background

- As the prevalence of obesity in Singapore is high and rising, risk stratification is essential for efficient resource allocation in primary care
- Hypotheses: (i) Phenotype and prognosis of adiposopathy (“disease fat tissue”) are heterogenous, (ii) body composition changes with age
- Aim: To identify individuals with high BMI and differential risk for diabetes mellitus (DM) incidence using readily available proxy measurements of adiposopathy that drive DM through **excess fat, unhealthy fat distribution and metabolic distress**

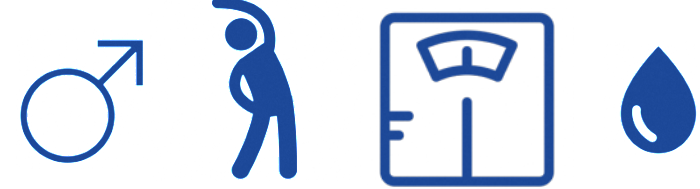


Methods

Study population: 8798 participants with high BMI and no DM at baseline



Data collected: Demographics, lifestyle behaviour, anthropometric, blood sample



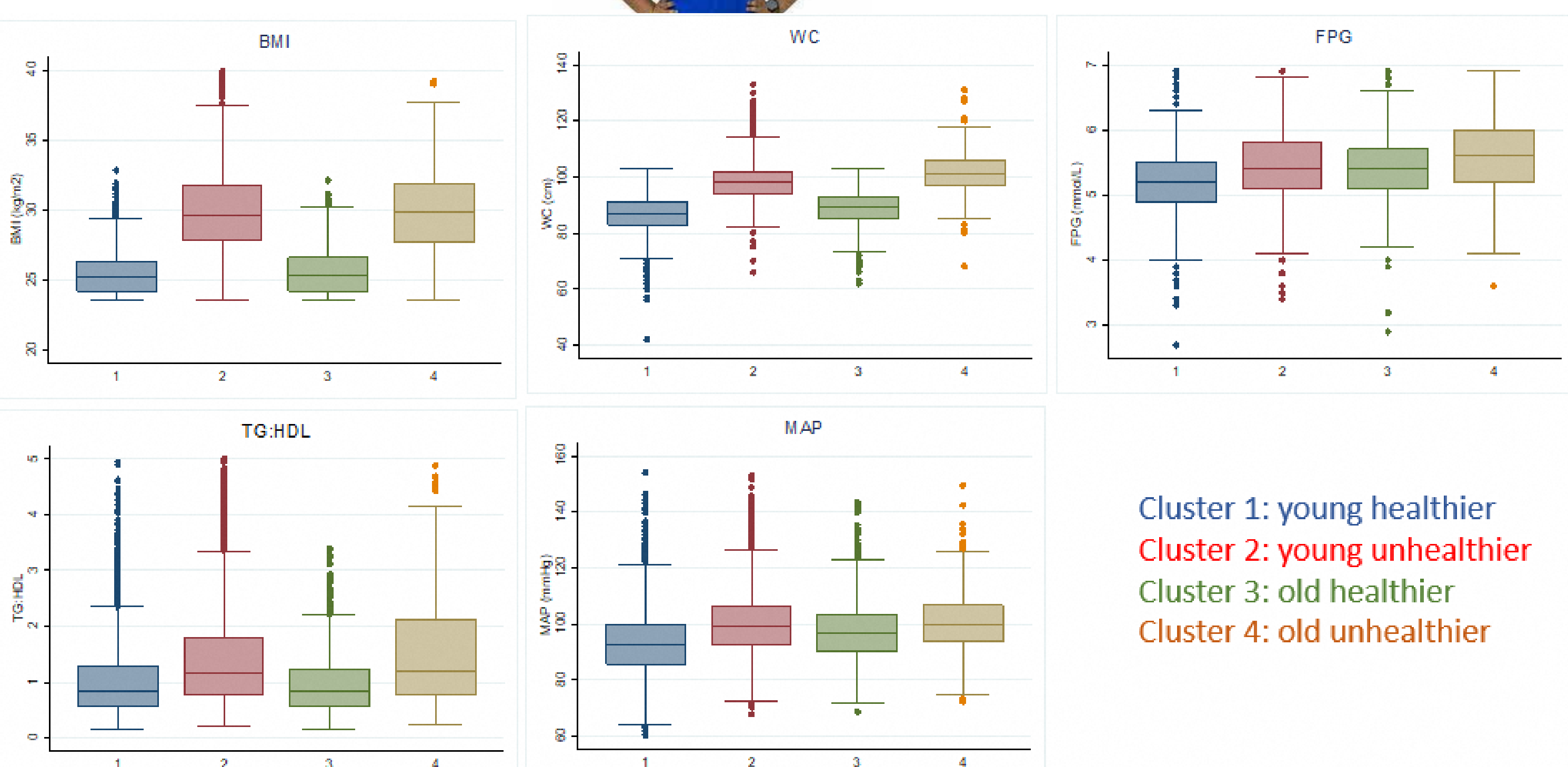
Approach: 2-step clustering based on

- BMI – **excess fat**
 - Waist circumference (WC) – **unhealthy fat distribution**
 - Ratio of triglyceride (TG) is to high-density lipoprotein cholesterol (HDL)
 - Fasting plasma glucose (FPG)
 - Mean arterial pressure (MAP)
- Metabolic distress**

Results

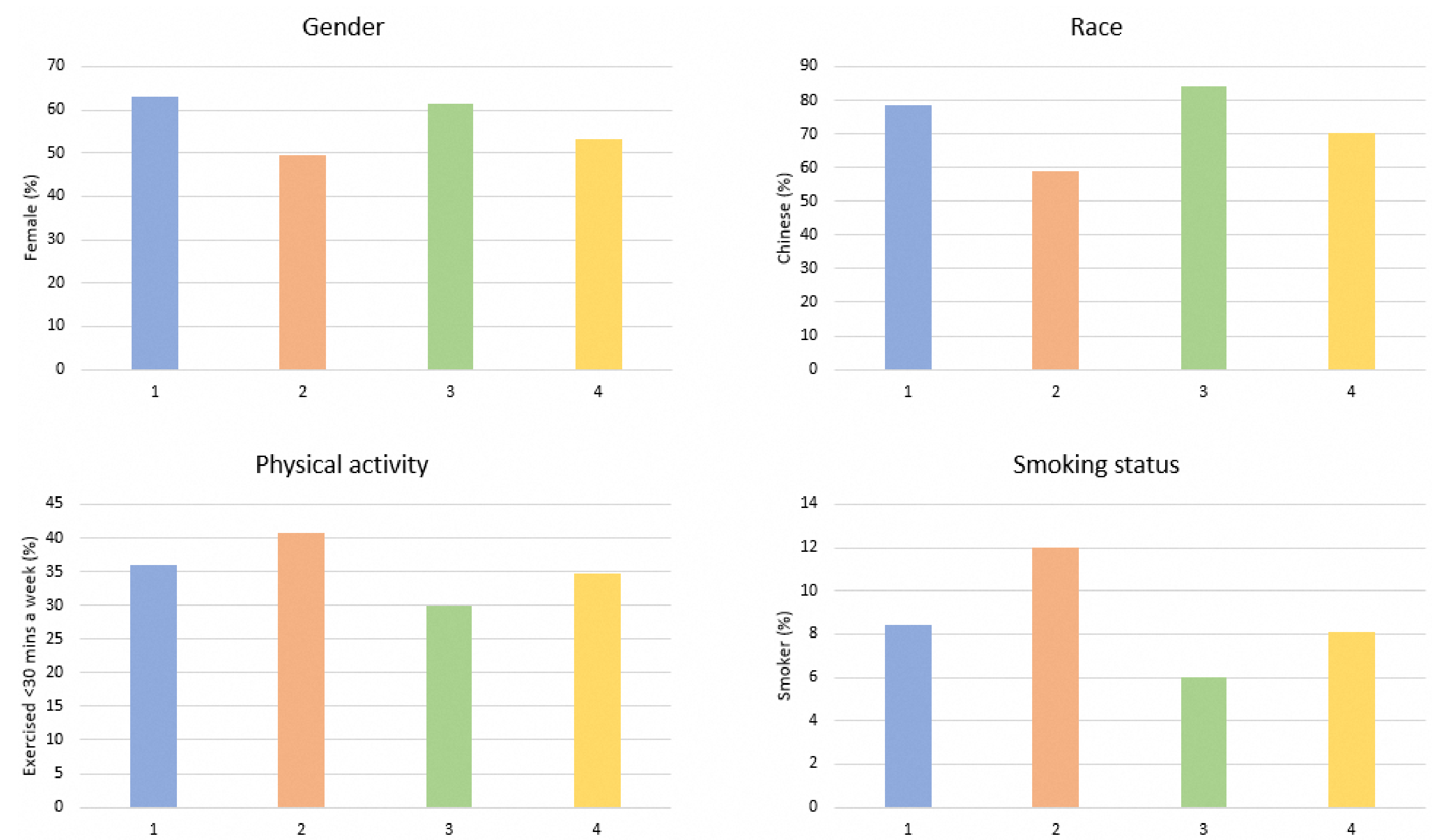
The participants were classified into 4 clusters – 2 clusters with differing metabolic health in each age group

Young healthier N=5418	Young unhealthier N=1769	Old healthier N=1160	Old unhealthier N=451
High proportions of female and Chinese	<ul style="list-style-type: none"> High median BMI, WC, TG:HDL, MAP High proportions of sedentary lifestyle and smoker 	High proportions of female and Chinese	High median BMI, WC, TG:HDL, MAP, FPG



Cluster 1: young healthier
 Cluster 2: young unhealthier
 Cluster 3: old healthier
 Cluster 4: old unhealthier

Results (continued)



Cluster 1: young healthier, Cluster 2: young unhealthier, Cluster 3: old healthier, Cluster 4: old unhealthier

The risk of subsequent DM within study period was higher in the unhealthier than healthier cluster for both age groups, with bigger disparity among the old participants

Cluster	N (%)	Risk ratio of getting DM (95% confidence interval)
Young healthier	39 (0.7%)	2.0 (1.2 – 3.2), p=0.008
Young unhealthier	25 (1.4%)	
Old healthier	9 (0.8%)	5.1 (2.3 – 11.4), p<0.001
Old unhealthier	18 (4.0%)	

Higher FPG and TG:HDL among participants who developed DM than those who did not in each cluster

	Young healthier		Young unhealthier		Old healthier		Old unhealthier	
	No DM	Got DM	No DM	Got DM	No DM	Got DM	No DM	Got DM
N	5379	39	1744	25	1151	9	433	18
BMI in kg/m ² , median	25.4	26.0	30.5	29.8	25.2	25.2	29.4	30.5
WC in cm, median	88	89	100	101	89	91	100	102
MAP in mmHg, median	93	96	99	102	97	96	99	102
FPG in mmol/L, median	5.2	6.1	5.4	6.4	5.3	6.0	5.6	6.3
TG:HDL, median	0.86	1.26	1.20	1.27	0.82	0.87	1.17	1.23

Discussion & Conclusions

- BMI, WC, FPG, TG:HDL and MAP could differentiate individuals with high BMI by their metabolic health, which is more informative of their future risk of DM
- Adiposopathy could be modified by age-driven sarcopenia and there are other differences by cluster beyond the data captured in this study
- FPG and lipids were more strongly associated with DM incidence and high BMI itself may not be harmful initially
- Clustering can guide right-siting of primary care

Healthier (lower-risk) cluster

- More individuals
- Require less intensive lifestyle modification program to prevent or slow down their high BMI from affecting their metabolic health

Unhealthier (higher-risk) cluster

- Fewer individuals
- Require more intensive intervention as high BMI has already affected their metabolic health to prevent further complications



Acknowledgement: This study was supported by Alexandra Health Fund (Pte Ltd) Program Grant.