The clusters of health-risk behaviours and mental wellbeing and their sociodemographic correlates: a study of 15,366 ASEAN university students

Apichai Wattanapisit, Hanif Abdul Rahman, Josip Car, Khadizah Haji Abdul-Mumin, Ma. Henrietta Teresa O. de la Cruz, Michael Chia, Michael Rosenberg, Moon-ho Ringo Ho, Surasak Chaiyasong, Trias Mahmudiono, Yuvadee Rodjarkpai, Ivo D. Dinov, Mohammad Ottom and Areekul Amornsriwatanakul*

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Editorial Board

Natalie Pafitis, Senior Editor

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Natalie joined BMC after having completed an MSc in Environmental Health at the Cyprus International Institute, in Association with the Harvard School of Public Health, USA where she completed courses including global climate change, environmental epidemiology, sustainable development and exposure assessment. Prior to this, she gained her BSc in Environmental Science at the University of Indianapolis, USA. Natalie has been Editor of *BMC Public Health* since 2007, also having worked on several biology and medical journals since this time. She has a keen interest in the use of research evidence to underpin public health policy and to advance the Sustainable Development Agenda. She is an Editor of the BMC Series blog and an ambassador of the Sustainable Development Goals for the BMC Series journals.

Lorena Verduci, Associate Editor

Lorena has a master's degree in Biomolecular Sciences and Technologies (University of Pisa, Pisa, Italy) and a PhD in Innovative Strategies in Biomedical Research (Scuola Superiore Sant'Anna, Pisa, Italy). After her PhD she worked in research institutes, universities and life science companies in Italy and in the UK, including the Italian

National Cancer Institute "Regina Elena" in Rome, "Sapienza" Università di Roma, Rome, Italy, and the University of Cambridge, Cambridge, UK. Her research focused on cardiovascular regeneration, role of microRNAs and circRNAs in cancer, assessment of new cancer drug *in vitro* and *in vivo*, and development of new technologies. Before joining *BMC Public Health* in September 2022, Lorena was an Associate Editor at *PLOS ONE* in the Public Health and Medicine Team.

Senior Editorial Board Members

Chris I. Ardern

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Chris I. Ardern is an Associate Dean of Research and Innovation in the Faculty of Health at York University (Toronto, Canada) and Associate Professor in the School of Kinesiology and Health Science. Chris' primary interest is in the epidemiology of obesity and 24-hour movement behaviors (sleep, sedentary time, and physical activity) in relation to cardiometabolic risk, microvascular dysfunction, and dementia. Most recently, his work has focused on the health risks associated with weight stigma, and the use of risk algorithms and behavioral profiling for the identification of high-risk subgroups of the population. This work incorporates both social and physical determinants, drawing on large scale open data infrastructure, national surveys, and administrative healthcare data to conduct time-to-event and geospatial analyses, to move knowledge into action with collaborating healthcare groups. He holds a Research Scientist position at Southlake Regional Health Centre, is member of the York University Centre for Aging Research and Education (YU-CARE), and is active in obesity organizations at the local to national level. Professor Ardern joined the Editorial Board of *BMC Public Health* in 2017, and has been a Senior Editor since 2019.

Noriko Cable

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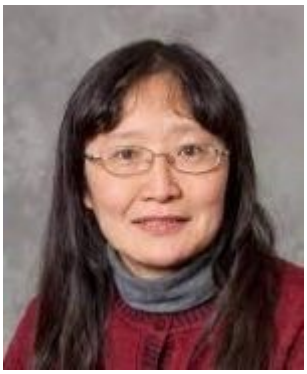
Noriko is a Senior Research Fellow at the Department of Epidemiology and Public Health, University College London. She works on social relationships, alcohol use and



mental health from childhood to late adulthood as well as on cross-national examinations of mental health. Her work appears in the booklets Life gets under your skin and Never too early, never too late published by her research group, the International Centre for Lifecourse Studies in Society and Health (ICLS). She currently works on her ESRC funded project, UK-Japan Social relationships and well-being across ageing nations (UK-Japan SWAN) to establish early career researchers' networks between the UK and Japan. Dr. Cable joined the Editorial Board of *BMC Public Health* as Section Editor in 2019.

Jennifer Emond

Jennifer is Associate Professor in the Departments of Biomedical Data Science and Pediatrics at the Geisel School of Medicine at Dartmouth College and co-Director of the Media & Health Behaviors Laboratory at Dartmouth College. Jennifer's research focuses on the development of health behaviors during early childhood including dietary behaviors, physical activity and sleep. Jennifer's research also examines the role of child-directed food marketing on shaping children's dietary behaviors. She is actively involved in teaching in the Quantitative Biomedical Sciences graduate program at Dartmouth College and greatly enjoys mentoring others within statistical methodology.

Youcheng Liu

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Youcheng is currently an Associate Professor at Wayne State University School of Medicine. He trained in medicine and public health with specialties in industrial hygiene, environmental health, occupational health and epidemiology. His research focuses on assessing occupational and environmental exposures to chemical hazards and biological agents, evaluating the resultant health outcomes (asthma, COPD, cardiovascular diseases and diabetes) and identifying effective and feasible measures and strategies to reduce exposures and prevent diseases. Current research projects include dermal exposure to nicotine in migrant tobacco farm workers in Kentucky and the development of a barrier cream

and other intervention methods to reduce exposure and green tobacco sickness, isocyanate exposure in neonates and the identification of user barriers of Powered Air-Purifying Respirators (PAPRs) in health care workers. He joined the Editorial Board of *BMC Public Health* in 2010.

Carol Maher

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Carol is a Research Professor and Deputy Director of the Alliance for Research in Exercise, Nutrition and Activity (ARENA) at the University of South Australia. Her research focuses on the links between lifestyle behaviors (particularly physical activity, sedentary behavior and sleep) and health and obesity in children and adults. She is particularly interested in technology-based approaches for measuring and improving health behaviors, including wearables, smart devices, apps and online social media. Professor Maher joined the Editorial Board of *BMC Public Health* in May of 2014.

Monica Malta

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Dr. Monica Malta is a researcher at the Centre for Addiction and Mental Health (CAMH) and a professor at the University of Toronto. She has been engaged in global health research focusing on social and structural factors influencing health inequalities and the impact of gender-based violence among female-identified persons from Latin America. Her work contributed to change local legislations and informed several interventions protecting the rights of people living with HIV, survivors of gender-based violence and the LGBTQ2S community.

Isabelle Niedhammer

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Isabelle is a Research Director at the French National Institute for Health and Medical Research (INSERM, France). She is currently working at the Research Institute for Environmental and Occupational Health (IRSET-INSERM U1085). Her background is in

occupational health epidemiology. Her research topics are related to occupational and social epidemiology and she is particularly interested in job stress, psychosocial work exposures and workplace violence, and their impact on health, as well as in the contribution of these occupational exposures to social inequalities in health. She is the author of more than 100 publications in international peer-reviewed journals and participated in the writing of 8 books. She joined the Editorial Board of *BMC Public Health* in 2011.

Patrick Palmieri

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Dr. Patrick Palmieri is a global health expert and research methodologist with more than 20 years work experience in academia and industry. Dr. Palmieri leads two research centers based in South America including the EBHC South America: A JBI Affiliated Group and the South American Center for Qualitative Research. He is a full professor and senior research scientist at the Universidad Norbert Wiener (Peru), where he previously served as Vice Chancellor for Research and Dean of the School of Nursing. In addition, Dr. Palmieri is an adjunct professor in doctoral programs at A.T. Still University and Texas Woman's University. Previously in Peru, he co-led a $300+ million project resulting in the largest private vertically integrated health delivery system and led the first successful international hospital accreditation. His research interests include generating evidence to guide clinical practice through scoping and systematic reviews, applied psychometrics for cross-cultural research, quality improvement projects, and qualitative inquiry. Dr. Palmieri is certified as a senior researcher by the Peruvian National Committee for Science, Technology, and Innovation, and he is a fellow of the American Academy of Nurses and the Royal College of Surgeons in Ireland.

Louisa Peralta

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Louisa is a Senior Lecturer in the Sydney School of Education and Social Work at the University of Sydney, Australia. With a background in health and physical education,

her research focuses on the design, implementation, and evaluation of school- and community-based health promoting programs (particularly focusing on physical activity) in children, adolescents and postpartum women. She is particularly interested in the implementation processes, including technology platforms, and the impact of these interventions on a range of health knowledge, capabilities, and behaviours. Dr Peralta joined the Editorial Board of *BMC Public Health* in 2018.

David Rehkopf

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David is an Assistant Professor of Medicine at Stanford University, in the Division of Primary Care and Population Health, with an appointment in Health Research and Policy, and affiliations with the Stanford Center on Poverty and Inequality and the Stanford Center for Population Health. He received his Masters in Public Health in Epidemiology and Biostatistics from the University of California, Berkeley, and his doctorate at the Harvard School of Public Health in the Department of Health and Social Behavior. He was a Robert Wood Johnson Health and Society Scholar at the University of California, Berkeley and the University of California, San Francisco. His research focus is on understanding the health effects of income and work policy on health, as well as understanding the biological pathways through which the social and economic environment impacts disease and death. He joined the Editorial Board of *BMC Public Health* in 2016.

Akira Shibanuma

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Akira is a Lecturer at the Department of Community and Global Health, Graduate School of Medicine, the University of Tokyo. As a social scientist, he has been involved in community health research studies in low- and middle-income countries and Japan. His research mainly focuses on health and healthcare service-seeking behaviors, social determinants of health, and inequity in health in the field of reproductive, maternal, newborn, child, and

adolescent health as well as migration and health. He currently works on research projects regarding discrimination and wellbeing and the quality of healthcare service provisions. He joined the Editorial Board of *BMC Public Health* in 2020.

Henri Tilga

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Henri is a Research Fellow of Sports Sciences in the Institute of Sport Sciences and Physiotherapy, University of Tartu. The theoretical background of his work is based mainly on the self-determination theory. More specifically, he works on the topic of teachers' multidimensional autonomy-supportive and controlling behaviours, students' psychological need satisfaction and frustration, and students' autonomous and controlled forms of motivation in the context of physical education. He has also developed and tested the effectiveness of several intervention programs with the aim to improve psychological need satisfaction and autonomous forms of motivation among students in the context of physical education. He joined the Editorial Board of *BMC Public Health* in 2021.

Shankar Viswanathan

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Shankar is an Assistant Professor of Biostatistics at the Albert Einstein College of Medicine, in the Department of Epidemiology and Population Health. He received his doctoral degree in Biostatistics from the University of North Carolina at Chapel Hill. His methods research focuses on multivariate survival analysis, longitudinal data, and missing data analysis. His applied area focusses on Global Health, Injury Epidemiology, and Chronic Disease Epidemiology. He joined the Editorial Board of *BMC Public Health* in 2018.

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Reliability and predictive validity of two scales of self-rated health in China: results from China Health and Retirement Longitudinal Study (CHARLS)

Despite the widespread use of the single item self-rated health (SRH) question, its reliability has never been evaluated in Chinese population.

Yuwei Pan, Jitka Pikhartova, Martin Bobak and Hynek Pikhart

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Investigating patients' preferences for new anti-diabetic drugs to inform public health insurance coverage decisions: a discrete choice experiment in China

Diabetes is a major public health concern with a considerable impact on healthcare expenditures. Deciding on health insurance coverage for new drugs that meet patient needs is a challenge facing policymakers. ...

Jinsong Geng, Haini Bao, Zhe Feng, Jingyi Meng, Xiaolan Yu and Hao Yu

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Research | Published on: 5 October 2022

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Association between obese phenotypes and risk of carotid artery plaque among chinese male railway drivers

China has the world's highest rail transportation network density, and the prevalence of obesity among railway workers in China is more than twice that of adults in the world. Carotid artery plaque (CAP) is a ...

Jia Pan, Zihang Wang, Chaohui Dong, Bo Yang, Lei Tang, Peng Jia, Shujuan Yang and Honglian Zeng

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Violence against women from partners and other household members during COVID-19 in Burkina Faso and Kenya

Global evidence indicates increases in gender-based violence (GBV) during the COVID-19 pandemic following mitigation measures, such as stay at home orders. Indirect effects of the pandemic, including income lo...

Michele R. Decker, Shannon N. Wood, Haley L. Thomas, Mary Thiongo, Georges Guiella, Bazie Fiacre, Yentéma Onadja and Peter Gichangi

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Status of Iranian schools' psycho-social environment: cultural adaptation and validation of the Persian version of the W.H.O profile to create Child-Friendly Schools

Creating an environment for emotional and social well-being is an important responsibility of Health-Promoting and Child-Friendly Schools. Thus, the present study aimed to assess cultural adaptation and valida...

Amin Ahrari, Fatemeh Salmani, Tayebeh Zeinali, Kimia Izadi, Azam Yousefi, Fatemeh Rahimi and Ensiyeh Norozi

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Research | Published on: 4 October 2022

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Designing physical activity interventions for women aged 50+: a qualitative study of participant perspectives

The *Active Women over 50* trial tested a scalable program for increasing physical activity among women aged 50+. The program included information, activity tracker and email support. This study sought to describe ...

Geraldine Wallbank, Abby Haynes, Anne Tiedemann, Catherine Sherrington and Anne C. Grunseit

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Community health worker intervention improves early childhood vaccination rates: results from a propensity-score matching evaluation

Arizona's Health Start Program is a statewide community health worker (CHW) maternal and child health home visiting intervention. The objective of this study was to test if participation in Health Start during...

Patrick Wightman, Kelly McCue, Samantha Sabo, Rebecca Annorbah, Dulce Jiménez, Vern Pilling, Matthew Butler, Martín F. Celaya and Sara Rumann

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Knowledge, attitudes, perceptions, and COVID-19 hesitancy in a large public university in Mexico city during the early vaccination rollout

Vaccination against COVID-19 is a primary tool for controlling the pandemic. However, the spread of vaccine hesitancy constitutes a significant threat to reverse progress in preventing the disease. Studies con...

Norma Mongua-Rodríguez, Mauricio Rodríguez-Álvarez, Daniela De-la-Rosa-Zamboni, María Eugenia Jiménez-Corona, Martha Lucía Castañeda-Cediel, Guadalupe Miranda-Novales, Gustavo Cruz-Pacheco, Elizabeth Ferreira-Guerrero, Leticia Ferreyra-Reyes, Guadalupe Delgado-Sánchez, Maribel Martínez-Hernández, Arturo Cruz-Salgado, Rogelio Pérez-Padilla, Samuel Ponce-de-León and Lourdes García-García

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Research | Published on: 4 October 2022

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Perspectives on delivering safe and equitable trauma-focused intimate partner violence interventions via virtual means: A qualitative study during COVID-19 pandemic

The COVID-19 pandemic has been linked with increased rates of intimate partner violence (IPV) and associated experiences of compounded trauma. The emergence of this global pandemic and the public health measur...

Winta Ghidei, Stephanie Montesanti, Lana Wells and Peter H. Silverstone

BMC Public Health 2022 22:1852

Research | Published on: 4 October 2022

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Knowledge and awareness about and use of iodised salt among students in Germany and Greece

Iodine is an essential trace element, which is important for human metabolism, growth and mental development. Iodine deficiency may still occur in Europe and the use of iodised salt is an effective measure to ...

Katharina Heimberg, Annett Martin, Anke Ehlers, Anke Weißenborn, Karen Ildico Hirsch-Ernst, Cornelia Weikert, Britta Nagl, Antonios Katsioulis, Lamprini Kontopoulou and Georgios Marakis

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Research | Published on: 4 October 2022

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Weight misperception and substance use: Brazilian Study of Cardiovascular Risks in Adolescents (ERICA)

Adolescence is a crucial period for body image formation. Weight misperception is the discrepancy between individuals' body weight perception and their actual nutritional status. Both weight concerns and subst...

Simoni Urbano da Silva, Vivian Siqueira Santos Gonçalves, Laura Augusta Barufaldi and Kenia Mara Baiocchi de Carvalho

BMC Public Health 2022 22:1850

Research | Published on: 4 October 2022

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Nutrition-related diseases and cardiovascular mortality in American society: national health and nutrition examination study, 1999–2006

Despite many significant advances in treatment and management, cardiovascular disease remains the main cause of the global disease burden. Nutrition-related disease is a modifiable cardiovascular risk factor. ...

Weihua Chen, Shanshan Shi, Jiabin Tu, Lihua Liao, Ying Liao, Kaihong Chen, Liling Chen and Rongchong Huang

BMC Public Health 2022 22:1849

Research | Published on: 3 October 2022

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Correction: A content analysis of Canadian influencer crisis messages on Instagram and the public's response during COVID-19

Melissa MacKay, Caitlin Ford, Taylor Colangeli, Daniel Gillis, Jennifer E. McWhirter and Andrew Papadopoulos

BMC Public Health 2022 22:1848

Correction | Published on: 3 October 2022

The original article was published in *BMC Public Health* 2022 **22**:763

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The impact of an unemployment insurance reform on incidence rates of hospitalisation due to alcohol-related disorders: a quasi-experimental study of heterogeneous effects across ethnic background, educational level, employment status, and sex in Sweden

Many Western countries have scaled back social and health expenditure, including decreases in the generosity and coverage of unemployment insurance, resulting in negative effects on general health and well-bei...

Ylva B. Almquist and Alexander Miething

BMC Public Health 2022 22:1847

Research | Published on: 3 October 2022

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How a generally well-accepted measles vaccine mandate may lead to inequities and decreased vaccine uptake: a preregistered survey study in Germany

In Germany, a measles vaccine mandate came into effect in March 2020, requiring proof of measles immunization for children attending kindergarten or school and for staff in a variety of facilities. Mandates ca...

Julia Neufeind, Nora Schmid-Küpke, Eva Rehfuess, Cornelia Betsch and Ole Wichmann

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Research | Published on: 3 October 2022

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A cross-sectional national investigation of COVID-19 outbreaks in nurseries during rapid spread of the Alpha (B.1.1.7) variant of SARS-CoV-2 in England

In England, the emergence the more transmissible SARS-CoV-2 variant Alpha (B.1.1.7) led to a third national lockdown from December 2020, including restricted attendance at schools. Nurseries, however, remained...

Felicity Aiano, Kelsey McOwat, Chinelo Obi, Annabel A. Powell, Jessica Flood, Shivraj Bhardwaj, Kelly Stoker, Donna Haskins, Brian Wong, Marta Bertran, Maria Zavala, Johanna Bosowski, Samuel E. I. Jones, Zahin Amin-Chowdhury, Laura Coughlan, Mary Sinnathamby...

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Research | Published on: 2 October 2022

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HIV awareness, pre-exposure prophylaxis perceptions and experiences among people who exchange sex: qualitative and community based participatory study

People who exchange sex for money, favors, goods or services, combat higher risk of acquiring sexually transmitted diseases (STDs) and human immunodeficiency virus (HIV). Understanding barriers to STD and HIV ...

Yasaswi Kislovskiy, Sarah Erpenbeck, Jamie Martina, Courtney Judkins, Elizabeth Miller and Judy C. Chang

BMC Public Health 2022 22:1844

Research article | Published on: 1 October 2022

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Flight crew fatigue risk assessment for international flights under the COVID-19 outbreak response exemption policy

In response to the COVID-19 outbreak, the Civil Aviation Administration of China (CAAC) has formulated Implementation Measures for Exemption of Crew Duty Periods and Flight Time Restrictions during the COVID-1...

Junya Sun, Ruishan Sun, Jingqiang Li, Ping Wang and Nan Zhang

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Research | Published on: 1 October 2022

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On the effectiveness of COVID-19 restrictions and lockdowns: Pan metron ariston

Early evaluations of the effectiveness of non-pharmaceutical intervention (NPI) mandates were constrained by the lack of empirical data, thereby also limiting model sophistication (e.g., models did not take in...

Leonidas Spiliopoulos

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Research | Published on: 1 October 2022

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The spatio-temporal dynamics of infant mortality in Ecuador from 2010 to 2019

The infant mortality rate (IMR) is still a key indicator in a middle-income country such as Ecuador where a slightly increase up to 11.75 deaths per thousand life births has been observed in 2019. The purpose ...

Karina Lalangui, Karina Rivadeneira Maya, Christian Sánchez-Carrillo, Gersain Sosa Cortéz and Emmanuelle Quentin

BMC Public Health 2022 22:1841

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The clusters of health-risk behaviours and mental wellbeing and their sociodemographic correlates: a study of 15,366 ASEAN university students

This study investigated, through cluster analysis, the associations between behavioural characteristics, mental wellbeing, demographic characteristics, and health among university students in the Association o...

Apichai Wattanapisit, Hanif Abdul Rahman, Josip Car, Khadizah Haji Abdul-Mumin, Ma. Henrietta Teresa O. de la Cruz, Michael Chia, Michael Rosenberg, Moon-ho Ringo Ho, Surasak Chaiyasong, Trias Mahmudiono, Yuvadee Rodjarkpai, Ivo D. Dinov, Mohammad Ottom and Areekul Amornsriwatanakul

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Research | Published on: 1 October 2022

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Development and psychometric properties of a tool to assess Media Health Literacy (MeHLit)

Media play an important role in shaping and changing the attitudes, thoughts, and behaviors of their audiences regarding health issues. Therefore, there is a need to explore and identify media health literacy ...

Mahsa Nazarnia, Fatemeh Zarei and Nasrin Rozbahani

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Tracing coalition changes in knowledge in and engagement with childhood obesity prevention to improve intervention implementation

While most coalition research focuses on studying the effects of peer relationship structure, this study examines the coevolution of coalition structure and behavior across three communities in the U.S. with t...

Travis R. Moore, Mark C. Pachucki, Erin Hennessy and Christina D. Economos

BMC Public Health 2022 22:1838

Research | Published on: 30 September 2022

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The hidden burden of medical testing: public views and experiences of COVID-19 testing as a social and ethical process

In May 2020, the Scottish Government launched Test and Protect, a test, trace and isolate programme for COVID-19 that includes a PCR testing component. The programme's success depended on the willingness of me...

Alice Street, Shona J. Lee and Imogen Bevan

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Research | Published on: 30 September 2022

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How socioeconomic status, social capital and functional independence are associated with subjective wellbeing among older Indian adults? A structural equation modeling analysis

Subjective well-being (SWB) is of particular interest among gerontologists and health researchers with important implications for interventions especially in poor-resource settings. This study aimed to explore...

T. Muhammad, Pradeep Kumar and Shobhit Srivastava

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Financial risk protection against noncommunicable diseases: trends and patterns in Bangladesh

Demographic and epidemiological transitions are changing the disease burden from infectious to noncommunicable diseases (NCDs) in low- and middle-income countries, including Bangladesh. Given the rising NCD-re...

Taslima Rahman, Dominic Gasbarro and Khurshid Alam

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Research | Published on: 30 September 2022

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Atypical working hours are associated with tobacco, cannabis and alcohol use: longitudinal analyses from the CONSTANCES cohort

This study examined prospective associations between atypical working hours with subsequent tobacco, cannabis and alcohol use as well as sugar and fat consumption.

Nadine Hamieh, Guillaume Airagnes, Alexis Descatha, Marcel Goldberg, Frédéric Limosin, Yves Roquelaure, Cédric Lemogne, Marie Zins and Joane Matta

BMC Public Health 2022 22:1834

Research | Published on: 29 September 2022

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The psychometric properties and the factorial structure of COVID-19 Vaccines Acceptance scale (VAC-COVID-19) within the Arabic language in a Palestinian contex

The COVID-19 Vaccines Acceptance scale (VAC-COVID-19) is an international measure designed to evaluate vaccination acceptance against the COVID-19 virus. The current scale was translated from English to Arabic...

Fayez Mahamid and Guido Veronese

BMC Public Health 2022 22:1833

Research | Published on: 29 September 2022

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Socio-behavioral correlates of pre-exposure prophylaxis use and correct adherence in men who have sex with men in West Africa

Multiple barriers compromise pre-exposure prophylaxis (PrEP) engagement (i.e., use and adherence) in men who have sex with men (MSM). In low/middle-income countries, little is known about PrEP engagement in th...

August Eubanks, Bakary Coulibaly, Bintou Dembélé Keita, Camille Anoma, Ter Tiero Elias Dah, Ephrem Mensah, Sékou Kaba, Kpassou Julien Lokrou, Faïçal Rodrigue Ouedraogo, Alèda M. Fidèle Badjassim, Gwenaëlle Maradan, Michel Bourrelly, Marion Mora, Lucas Riegel, Daniela Rojas Castro, Issifou Yaya...

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Descriptive study of foodborne disease using disease monitoring data in Zhejiang Province, China, 2016–2020

This study aimed to identify the epidemiology, seasonality, aetiology and clinical characteristics of sporadic foodborne diseases in Zhejiang province during 2016–2020.

Xiaojuan Qi, Xialidan Alifu, Jiang Chen, Wenliang Luo, Jikai Wang, Yunxian Yu and Ronghua Zhang

BMC Public Health 2022 22:1831

Research | Published on: 28 September 2022

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A temporal analysis on patient and health service delays in pulmonary tuberculosis in Portugal: inter and intra-regional differences and in(equalities) between gender

and age

Tuberculosis (TB) diagnosis and treatment delays increase the period of infectiousness, making TB control difficult and increasing the fatality rates. This study aimed to determine the evolution of health care...

Bhaswar Chakma, Dulce Gomes, Patrícia A. Filipe, Patrícia Soares, Bruno de Sousa and Carla Nunes

BMC Public Health 2022 22:1830

Research | Published on: 28 September 2022

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Correction: A comparison of interpreters' wellbeing and work-related characteristics in the care of refugees across different work settings

Angelika Geiling, Maria Böttche, Christine Knaevelsrud and Nadine Stammel

BMC Public Health 2022 22:1829

Correction | Published on: 28 September 2022

The original article was published in *BMC Public Health* 2022 **22**:1635

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All-cause and cause-specific mortality rates for Kisumu County: a comparison with Kenya, low-and middle-income countries

Understanding the magnitude and causes of mortality at national and sub-national levels for countries is critical in facilitating evidence-based prioritization of public health response. We provide comparable ...

Wanjiru Waruiru, Violet Oramisi, Alex Sila, Dickens Onyango, Anthony Waruru, Mary N. Mwangome, Peter W. Young, Sheru Muuo, Lilly M. Nyagah, John Ollongo, Catherine Ngugi and George W. Rutherford

BMC Public Health 2022 22:1828

Research | Published on: 27 September 2022

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Double-counting of populations in evidence synthesis in public health: a call for awareness and future methodological development

There is a growing interest in the inclusion of real-world and observational studies in evidence synthesis such as meta-analysis and network meta-analysis in public health. While this approach offers great epi...

Humaira Hussein, Clareece R. Nevill, Anna Meffen, Keith R. Abrams, Sylwia Bujkiewicz, Alex J. Sutton and Laura J. Gray

BMC Public Health 2022 22:1827

Research | Published on: 27 September 2022

The Correction to this article has been published in *BMC Public Health* 2022 **22**:2301

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Internet addiction and relationships with depression, anxiety, stress and academic performance among Egypt pharmacy students: a cross-sectional designed study

Pharmacy students represent the future of healthcare professionals and with daily use of the internet for different activities has made internet addiction (IA) of a growing concern. The main objectives of this...

Moustafa Sayed, Christina Medhat Naiim, Marina Aboelsaad and Michael Kamal Ibrahim

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Research | Published on: 26 September 2022

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Risk factors for upper limb fractures due to unintentional injuries among adolescents: a case control study from Sri Lanka

Injuries are the number one cause for morbidity and mortality among adolescents. Adolescent fractures are a hidden public health problem in Sri Lanka. Upper limb fractures are common in adolescents due to vari...

Hemali Jayasekera, Samitha Siritunga, Upul Senarath and Paramjit Gill

BMC Public Health 2022 22:1825

Research | Published on: 26 September 2022

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Profile of judicialization in access to antineoplastic drugs and their costs: a cross-sectional, descriptive study based on a set of all lawsuits filed between 2016 and 2018 in a state in the Northeast Region of Brazil

The judicialization of the acquisition of medication for healthcare is not restricted to Brazil but can also be found in other Latin American countries, despite the existence of a universal health system in th...

Fábio Henrique Cavalcanti de Oliveira, José Eudes de Lorena Sobrinho, Antônio da Cruz Gouveia Mendes, Haynne Magalhães Santos Gutman, Geraldo Jorge Filho and Ulisses Ramos Montarroyos

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Young people's health and well-being during the school-to-work transition: a prospective cohort study comparing post-secondary pathways

At the end of secondary education, young people can either start vocational training, enter university, directly transition to employment or become unemployed. Research assumes that post-secondary pathways hav...

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Exploring changes in temporary abstinence in increasing and higher risk drinkers in England and Dry January participation in users of the Try Dry app in the UK

between 2020 and 2021

We looked at changes in the prevalence of increasing and higher risk drinkers reporting a reduction attempt motivated by temporary abstinence and changes in prevalence of use of the official app accompanying D...

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Drivers of respiratory health care demand in Acre state, Brazilian Amazon: a cross-sectional study

The scarce knowledge about the drivers of demand for respiratory health care in the Brazilian Amazon, where the gap of human and physical health care resources is wide, is expanded with two surveys conducted i...

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Socioeconomic position and adverse childhood experiences as risk factors for health-related behaviour change and employment adversity during the COVID-19 pandemic: insights from a prospective cohort study in the UK

Non-pharmaceutical interventions to reduce the spread of COVID-19 may have disproportionately affected already disadvantaged populations.

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Seasonal influenza vaccine uptake among healthcare workers in tertiary care hospitals, Bangladesh: Study protocol for influenza vaccine supply and awareness intervention

Healthcare workers (HCWs), such as doctors, nurses, and support staffs involved in direct or indirect patient care, are at increased risk of influenza virus infections due to occupational exposures. Vaccinatio...

Md Zakiul Hassan, Tahmina Shirin, Mahbubur Rahman, A. S. M. Alamgir, Nusrat Jahan, Md Abdullah Al Jubayer Biswas, Sazzad Hossain Khan, Md Ahmed Khairul Basher, Md Ariful Islam, Kamal Hussain, Md Nazrul Islam, Md Arif Rabbany, Md Azizul Haque, Shishir Ranjan Chakraborty, Syeda Rukhshana Parvin, Mahmudur Rahman...

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Co-design of an oral health intervention (HABIT) delivered by health visitors for parents of children aged 9–12 months

Dental caries (tooth decay) in children is a national public health problem with impacts on the child, their family and wider society. Toothbrushing should commence from the eruption of the first primary tooth...

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Public health genomics capacity assessment: readiness for large-scale pathogen genomic surveillance in Canada's public health laboratories

Along with rapid diagnostic testing, contact tracing, and public health measures, an effective pandemic response incorporates genomics-based surveillance. Large-scale SARS-CoV-2 genome sequencing is a crucial ...

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Impacts of life-events on sitting, TV viewing and computer use among women from disadvantaged neighbourhoods

Little is known about how life events such as changes in parental or employment status influence sedentary behaviour (SB). Women from disadvantaged neighbourhoods are at particular risk of poor health, therefo...

Minakshi Nayak, Karen Wills, Megan Teychenne and Verity Cleland

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Effects of intergenerational contact on social capital in community-dwelling adults aged 25–84 years: a non-randomized community-based intervention

Accumulating social capital in urban areas is essential to improve community health. Previous studies suggested that intergenerational contact may be effective for enhancing social capital. However, no study h...

Yuta Nemoto, Kumiko Nonaka, Masataka Kuraoka, Sachiko Murayama, Motoki Tanaka, Hiroko Matsunaga, Yoh Murayama, Hiroshi Murayama, Erika Kobayashi, Yoji Inaba, Shuichiro Watanabe, Kazushi Maruo and Yoshinori Fujiwara

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Patterns of multimorbidity in association with falls among the middle-aged and older adults: results from the China Health and Retirement Longitudinal Study

Chronic diseases are important risk factors of falls. However, most studies explored the effect of a single chronic disease on falls and few studies explored the combined effect of multiple chronic diseases on...

Jingzheng Yan, Meijuan Wang and Yingjuan Cao

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Impact of child disability on parental employment and labour income: a quasi-experimental study of parents of children with disabilities in Norway

Caring for children with disabilities has both immediate and long-term economic costs that affect the well-being of children, parents, and society. The purpose of this study was to investigate the impact of ch...

Michael Yisfashewa Wondemu, Pål Joranger, Åsmund Hermansen and Idunn Brekke

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Regional variation in long-term care spending in Japan

Health inequalities are widening in Japan, and thus, it is important to understand whether (and to what extent) there is a regional variation in long-term care (LTC) spending across municipalities. This study ...

Xueying Jin, Masao Iwagami, Nobuo Sakata, Takahiro Mori, Kazuaki Uda and Nanako Tamiya

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A healthy lifestyle text message intervention for adolescents: protocol for the Health4Me randomized controlled trial

Adolescence presents a window of opportunity to establish good nutrition and physical activity behaviours to carry throughout the life course. Adolescents are at risk of developing cardiovascular and other chr...

Rebecca Raeside, Karen Spielman, Sarah Maguire, Seema Mihrshahi, Katharine Steinbeck, Melissa Kang, Liliana Laranjo, Karice Hyun, Julie Redfern and Stephanie R. Partridge

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RESEARCH

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The clusters of health-risk behaviours and mental wellbeing and their sociodemographic correlates: a study of 15,366 ASEAN university students

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Abstract

Background: This study investigated, through cluster analysis, the associations between behavioural characteristics, mental wellbeing, demographic characteristics, and health among university students in the Association of Southeast Asian Nations (ASEAN) University Network – Health Promotion Network (AUN-HPN) member universities.

Methods: Data were retrieved from a cross-sectional self-administered online survey among undergraduate students in seven ASEAN countries. A two-step cluster analysis was employed, with cluster labels based on the predominant characteristics identified within the clusters. The 'healthy' cluster was assigned as the reference group for comparisons using multinomial logistic regression analysis.

Results: The analytic sample size comprised 15,366 university students. Five clusters of student-types were identified: (i) 'Healthy' ($n = 1957$; 12.7%); (ii) 'High sugary beverage consumption' ($n = 8482$; 55.2%); (iii) 'Poor mental wellbeing' ($n = 2009$; 13.1%); (iv) 'Smoker' ($n = 1364$; 8.9%); and (v) 'Alcohol drinker' ($n = 1554$; 10.1%). Being female (OR 1.28, 95%CI 1.14, 1.45) and being physically inactive (OR 1.20, 95%CI 1.04, 1.39) increased the odds of belonging to the 'High sugary beverage consumption' cluster. Being female (OR 1.21, 95%CI 1.04, 1.41), non-membership in a sports club (OR 1.83, 95%CI 1.43, 2.34) were associated with 'Poor mental wellbeing'. Obesity (OR 2.03, 95%CI 1.47, 2.80), inactively commuting to campus (OR 1.34, 95%CI 1.09, 1.66), and living in high-rise accommodation (OR 2.94, 95%CI 1.07, 8.07) were associated with membership in the 'Smoker' cluster. Students living in The Philippines, Singapore, Thailand, and Vietnam had a higher likelihood of being alcohol drinkers, compared with those who lived in Brunei.

Conclusions: ASEAN university students exhibited health-risk behaviours that typically clustered around a specific health behaviour and mental wellbeing. The results provided support for focusing interventions on one

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dominant health-risk behaviour, with associated health-risk behaviours within clusters being potential mediators for consideration.

Keywords: Diet, Drinking, Mental wellbeing, Physical activity, Smoking, Students, University

Background

Health-risk behaviours are defined as behaviours with potentially negative effects on health such as risks of diseases and injuries [1, 2]. Health-risk behaviours vary in different age groups, environments and cultures [3–5]. Specifically, undergraduate students are in early adulthood and are in transition from high school to university. Health behaviours in university life may have a long-term impact on health conditions and incidence of chronic diseases in later adulthood [6]. Several health-risk behaviours, such as, tobacco smoking, alcohol drinking, physical inactivity, and unhealthy diet, and also mental wellbeing are highlighted as important factors of health in early adulthood [7–9]. The cited lifestyle behaviours are known risk factors for non-communicable diseases (NCDs) such as diabetes mellitus, stroke, coronary heart disease, and some forms of cancer [10]. These health-risk behaviours are potentially modifiable and preventable [11, 12]. Modification of these health-risk behaviours can improve health and reduce risks of health problems in later adulthood [13].

Apart from health care agencies, Higher Education Institutions like universities have an essential role in promoting health [14, 15]. In Southeast Asia, the Association of Southeast Asian Nations (ASEAN), consists of 10-member countries: Brunei Darussalam, Cambodia, Indonesia, Lao, Malaysia, Myanmar, The Philippines, Singapore, Thailand, and Vietnam, advocates policies that emphasise the important role that universities play in health promotion [16]. In 2014, a new thematic network of the ASEAN, the ASEAN University Network - Health Promotion Network (AUN-HPN), was established for the purpose of health promotion in the ASEAN region [17]. The AUN-HPN focuses on health promotion among university students and staff under the healthy university framework [16]. The framework includes building systems and infrastructures to support health promoting environments and covers the thematic areas as (i) zero tolerance areas (i.e., smoking, alcohol consumption, illicit drug use, gambling, violence, bullying and sexual harassment, and road safety violations) and (ii) health promotion areas (i.e., health literacy, mental wellbeing, social interaction (e.g., student clubs), physical activity and active mobility, healthy diet and balanced nutrition, safe sexual behaviour, and work-life balance and healthy ageing [15]. To achieve these targets, several strategies have been implemented, and these included health education and health promotion research [16].

Individuals may have a single dominant health-risk behaviour or multiple health-risk behaviours. Previous research classified people with health-risk behaviours into single dominant or combined health-risk behavioural clusters [7–9, 18–20]. Health-risk behaviours often co-occur or cluster, and having many health-risk behaviours concurrently could increase the probability of mortality (e.g., from cancers), and therefore these lifestyle behaviours have significant public health implications. However, information about either single or combined health behaviours, such as smoking, alcohol drinking, fruit and vegetable consumption, and sugary beverage consumption is scarce and their associations with mental wellbeing among ASEAN university students are not clear. This first surveillance of the health behaviours among ASEAN university students is thus important for understanding the situation and better-informs the health promotion strategies of the AUN-HPN. The identification of the behavioural health-risk and mental wellbeing clusters including their sociodemographic correlates, provides helpful information for designing targeted health-enabling interventions that can tackle multiple health-risk behaviours at the same time for university students. The present study foregrounded the behavioural health-risk and mental wellbeing clusters among ASEAN university students and investigated the associations between the identified clusters and student sociodemographic information.

Methods

Study design and data source

Data analysed were retrieved from a cross-sectional online survey, called the AUN-HPN health behavioural survey. The survey was conducted between 2020 and 2021 and investigated the health-related behaviours and mental wellbeing of ASEAN students from 17 AUN-HPN member universities across seven ASEAN countries (Table 1). The online survey comprised seven sections: 1) Physical activity, 2) Social support for physical activity, 3) University's environment, 4) Health-related behaviours, 5) Mental wellbeing, 6) Opinion regarding university support, and 7) Sociodemographic information. The survey was developed based on previously tested instruments [21–24]. The survey, originally in English, was translated into

Table 1 Participating universities in seven ASEAN countries

Countries (n)	Total number of students n (%)	University names
Brunei Darussalam (1)	1020 (6.6)	Universiti Brunei Darussalam
Indonesia (3)	338 (2.2)	Universitas Airlangga
	3113 (20.3)	Universitas Indonesia
	979 (6.4)	Universitas Gadjah Mada
Malaysia (2)	76 (0.5)	University of Malaya
	213 (1.4)	Universiti Putra Malaysia
The Philippines (1)	322 (2.1)	Ateneo de Manila University
Singapore (1)	259 (1.7)	Nanyang Technological University
Thailand (8)	634 (4.1)	Burapha University
	253 (1.7)	Chiang Mai University
	265 (1.7)	King Mongkut's University of Technology North Bangkok
	312 (2.0)	Naresuan University
	267 (1.7)	Mahasarakham University
	619 (4.0)	Mahidol University
	1247 (8.1)	Thammasat University
	397 (2.6)	Walailak University
Vietnam (1)	5052 (32.9)	Vietnam National University

four languages: Bahasa Indonesia, Malaysian, Thai, and Vietnamese. A pilot test of the online survey that included garnering student feedback on the survey using Qualtrics platform (Qualtrics International Inc., WA, USA) was conducted a sub-sample of university students to ensure comprehension and functionality of the online survey.

Measures

Student demographic characteristics

Demographic characteristics including year of study (year 1, 2, 3, and 4 or above); age (18 years, 19 to 21 years, and ≥ 22 years); gender (male and female); country (Brunei Darussalam, Indonesia, Malaysia, The Philippines, Singapore, Thailand, and Vietnam); body mass index (BMI) ('underweight' (< 18.5 kg/m^2), 'normal' (18.5 to 22.9 kg/m^2), 'overweight' (23.0 to 24.9 kg/m^2), and 'obese' (≥25 kg/m^2) according to World Health Organization (WHO) Asian cut-offs) [25]; the different types of grading from each institution was standardised into a 5-point grade point average (GPA) scale, which was interpreted into three levels consisting of high GPA (> 3.9), moderate GPA (3.3 to 3.9), and low GPA (≤3.2); place of living (on-campus and off-campus); commute time to campus (< 15 min, 15 to 30 min, 30 to 45 min, 45 to 60 min, 60 to 90 min, and > 90 min); commute type (active and inactive transportation); housing type (single house, townhouse, apartment, high-rise condo), and member of sports club (yes and no) were collected.

Exercise/sport participation, physical activity, sedentary time, and sleep

Exercise/sport participation was classified into four categories: none, 1 to 3 days/week, 4 to 6 days, and > 6 days/week.

The Global Physical Activity Questionnaire (GPAQ) version 2.0, which had an acceptable concurrent validity ($r = 0.54$) and high level of repeatability (0.67–0.81) was used to collect data on physical activity levels [26, 27]. Physical activity levels were classified into 'inactive' (< 600 Metabolic Equivalent (MET)-min/week) and 'active' (≥600 MET-min/week) [28].

Sedentary time was collected from the last item of GPAQ 2.0 and divided into three groups: < 4 hours/day, 4 to 8 hours/day, and > 8 hours/day). Sleep time were dichotomised into < 7 hours/day and ≥ 7 hours/day, based on recommendations on sleep hours per night for healthy adults (18–60 years) (i.e., 7 or more sleep hours per night) [29].

Smoking and alcohol drinking

Students were identified as smokers or drinkers when they reported that they are current smokers or drinkers (drink/smoke daily).

Fruit and vegetable consumption, snacking, sugary beverage consumption, and salt intake

Students were classified as healthy (≥5 servings/day) or unhealthy (< 5 servings/day) fruit and vegetable consumer. Students, who ate snacks or fast food every day, were categorised into at-risk snacking category; and otherwise, were categorised as at lower risk of snacking. Sugary beverage consumption was classified into at-risk consumption (drink sugary beverage every day) and lower risk of sugary beverage consumption (did not drink every day). At-risk salt intake was defined as when a student added salt to their food before eating ≥1 teaspoon/day, and at a lower risk of salt intake meant adding < 1 teaspoon/day of salt.

Mental wellbeing

The shortened Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) that contained seven items, is a reliable and valid tool for assessing the mental wellness of university students, was used to assess mental wellbeing [22]. The WEMWBS score was dichotomized into negative (poor) and positive (good) mental wellbeing.

Statistical analysis

The R v4.1.1 and RStudio v1.4.1717 for Mac (RStudio, MA, USA) were used for all analyses. Incomplete survey records (i.e., missing demographic characteristics

or relevant health-risk behaviours) were removed from the analysis. A two-step cluster analysis using k-means and hierarchical clustering were employed. In step-one, the number of clusters was determined using k-means algorithm, which indicated that a five-cluster model was optimal [30]. In step-two, hierarchical clustering using Euclidean distance was used to subset the data based on the five-clusters [31]. Descriptive statistics were used to present sociodemographic characteristics of the samples and characteristics of the health-risk behaviours clusters. The cluster labels were based on the predominant characteristics within the clusters. The 'healthy' cluster was identified based on the least number of risk factors and was used as the reference group for comparison using multinomial logistic regression analysis, which was performed to assess the associations between health-risk behaviour clusters and demographic characteristics. McFadden's R-square was used to check for overall model fit. Statistical significance was set at $p < 0.05$.

Results

Sociodemographic characteristics of participants

A final sample of 15,366 ASEAN university students was used for analyses. The sample consisted about equal distribution of male (47.4%) and female (52.6%) students. A majority of the university students were from Vietnam (33.2%), followed by Indonesia (28.8%), and Thailand (25.6%). The participants were mostly in the first year (64.7%) of university life, had normal BMI (61.5%), achieved moderate GPA (69.2%), lived off-campus (65.2%), and commuted to the university using a physically inactive means of transportation (82.9%) (Table 2).

Table 2 Sociodemographic characteristics of the university students

Characteristics	n	%
Gender		
Male	7289	47.4
Female	8077	52.6
Age in years ($n = 13,597$)		
18	2496	18.4
19 to 21	9016	66.3
≥ 22	2085	15.3
Academic year		
1st	9940	64.7
2nd	2895	18.8
3rd	1800	11.7
4th or more	731	4.8
BMI ($n = 13,097$)		
Normal	8441	61.5
Underweight	2917	21.3
Overweight	1739	12.7
Obese	624	4.5
Country		
Brunei Darussalam	1020	6.6
Indonesia	4430	28.8
Malaysia	289	1.9
The Philippines	322	2.1
Singapore	259	1.7
Thailand	3940	25.7
Vietnam	5106	33.2
GPA ($n = 12,151$)		
≤ 3.2	2443	20.1
3.3 to 3.9	8406	69.2
> 3.9	1302	10.7
Place of living		
On-campus	5345	34.8
Off-campus	10,021	65.2
Commute time to university		
< 15 min	5917	38.5
15 to 30 min	4127	26.9
30 to 45 min	1973	12.8
45 to 60 min	1692	11.0
60 to 90 min	1059	6.9
> 90 min	598	3.9
Commute type to university		
Active	2639	17.1
Inactive	12,727	82.9
Housing type		
Single house	11,319	73.7
Townhouse	2773	18.0
Apartment	1201	7.8
High rise condo	73	0.5
Member of sports club		
Yes	9054	58.9
No	6312	41.1

Cluster outputs and characteristics

After data cleaning, the analytical sample comprised 15,366 students. The two-step cluster analysis grouped respondents with similar health-risk behaviours and mental wellbeing resulted in 4 to 15 solutions, and it emerged that the five-cluster model was the most optimal (Fig. 1). Table 3 presents the characteristics of each cluster where the greater proportion of health-risk behaviours or mental wellbeing exhibited by the cluster determined the cluster label.

The largest cluster ($n = 8482$; 55.2%) of the sample that exhibited the highest proportion of high sugary beverage consumption was labelled as 'High sugary beverage consumption'. The other four clusters according to size were labelled as 'Poor mental wellbeing' ($n = 2009$; 13.1%), 'Healthy' ($n = 1957$; 12.7%), 'Alcohol drinker' ($n = 1554$; 10.1%), and 'Smoker' ($n = 1364$; 8.9%). The 'Healthy' cluster exhibited mostly safe health behaviours and was used as the reference group

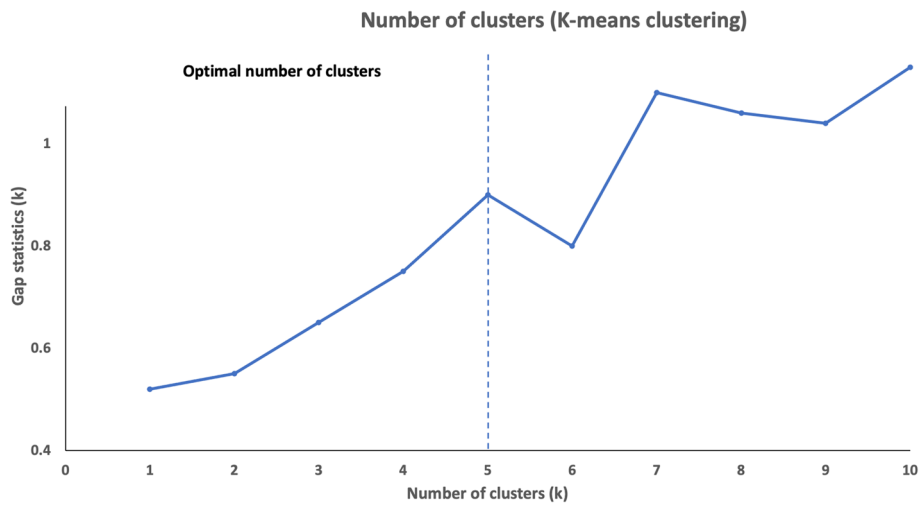

Fig. 1 Number of clusters determined by k-means clustering method

for multinomial logistic regression. The healthy, high sugary beverage consumption, poor mental wellbeing and alcohol drinker clusters were each comprised entirely of non-smokers, with those who smoked clustering into their own smoking cluster. The healthy, high sugary beverage consumption and poor mental wellbeing clusters comprised all non-alcoholic drinkers, with the alcohol drinkers comprising all drinkers and 63% of the smoking group cluster also drinking alcohol. Members of the healthy cluster did not drink sugary beverages, and all had positive mental wellbeing. Members of the high sugary beverage consumption cluster were also non-smokers, non-drinkers and had positive mental wellbeing. Members of the smoking cluster also had high sugary beverage consumption with almost 80% having positive mental wellbeing. Members of the alcohol cluster were all non-smokers with 87% with high sugary beverage consumption, 83% positive mental wellbeing and 72% in the high physically active group. The level of exercise/sport participation, physical activity, sedentary time, sleeping hours and high salt intake did not appear to differentiate clusters.

Associations between clusters and demographic characteristics

To further understand the similarities and differences of the 5 clusters, multinomial logistic regression analyses were run with the demographic characteristics as the predictors and the cluster membership as the outcome variable. The 'Healthy' cluster was chosen as the reference group in the analysis. Table 4 shows the likelihood of university students falling into the unhealthy or health-risk clusters.

Students in Year 2 (OR 1.24, 95%CI 1.04, 1.46) and Year 3 (OR 1.28, 95%CI 1.01, 1.63), being female (OR 1.28, 95%CI 1.14, 1.45) living in Thailand (OR 1.71, 95%CI 1.16, 2.52), and being inactive (OR 1.20, 95%CI 1.04, 1.39) had a higher likelihood of falling into 'High sugary beverage consumption' cluster (cluster 2), compared to the 'Healthy' cluster. Meanwhile, students living in The Philippines (OR 0.38, 95%CI 0.24, 0.69), being underweight (OR 0.85, 95%CI 0.74, 0.99) or overweight (OR 0.82, 95%CI 0.68, 0.97), and staying in a townhouse (OR 0.82, 95%CI 0.68, 1.00) had less likelihood of being in the 'High sugary beverage consumption' cluster.

In comparison to the healthy group, being in 2nd year (OR 1.24, 95%CI 1.01, 1.52), females (OR 1.21, 95%CI 1.04, 1.41), non-membership to a sports club (OR 1.83, 95%CI 1.43, 2.34), and travelling between 30 to 45 minutes to campus (OR 1.33, 95%CI 1.95, 1.70) were significantly more likely to fall into the 'Poor mental wellbeing' cluster (cluster 3). Students who were underweight (OR 0.74, 95%CI 0.61, 0.90) and resided in Indonesia (OR 0.34, 95%CI 0.24, 0.49), Malaysia (OR 0.32, 95%CI 0.16, 0.67), The Philippines (OR 0.4, 95%CI 0.24, 0.67), or Vietnam (OR 0.62, 95%CI 0.44, 0.86) compared to students from Brunei were less likely to be in the 'Poor mental wellbeing' cluster.

Belonging to the 'Smoker' cluster (cluster 4), was associated with being in 2nd year (OR 1.37, 95%CI 1.09, 1.72), overweight (OR 1.58, 95%CI 1.23, 2.04), obese (OR 2.03, 95%CI 1.47, 2.80), travelling 30–45 minutes to campus (OR 1.40, 95%CI 1.08, 182), inactively commuting to campus (OR 1.34, 95%CI 1.09, 1.66), and living in

Table 3 Characteristics of the naturally occurring clusters extracted from the dataset ($n = 15,366$)

	Total	Cluster 1 Healthy	Cluster 2 High sugary beverage consumption	Cluster 3 Poor mental wellbeing	Cluster 4 Smoker	Cluster 5 Alcohol drinker
	(*n* = 15,366)	(*n* = 1957)	(*n* = 8482)	(*n* = 2009)	(*n* = 1364)	(*n* = 1554)
Health behaviours and mental wellbeing	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Exercise/sport participation						
None	2131 (13.87)	309 (15.79)	1123 (13.24)	409 (20.36)	174 (12.76)	116 (7.46)
1–3 days/week	8081 (52.59)	1111 (56.77)	4596 (54.19)	1068 (53.16)	678 (49.71)	628 (40.41)
4–6 days/week	2937 (19.11)	319 (16.30)	1548 (18.25)	260 (12.94)	330 (24.19)	480 (30.89)
> 6 days/week	2217 (14.43)	218 (11.14)	1215 (14.32)	272 (13.54)	182 (13.34)	330 (21.24)
Physical activity						
Inactive (< 600 MET-min/week)	6097 (39.68)	807 (41.24)	3390 (39.97)	962 (47.88)	504 (36.95)	434 (27.93)
Active (≥600 MET-min/week)	9269 (60.32)	1150 (58.76)	5092 (60.03)	1047 (52.12)	860 (63.05)	1120 (72.07)
Sedentary time						
< 4 hours/day	2376 (15.46)	360 (18.40)	1272 (15.00)	278 (13.84)	226 (16.57)	240 (15.44)
4–8 hours/day	6213 (40.43)	742 (37.92)	3605 (42.50)	685 (34.10)	569 (41.72)	612 (39.38)
> 8 hours/day	6777 (44.10)	855 (43.69)	3605 (42.50)	1046 (52.07)	569 (41.72)	702 (45.17)
Sleeping hours						
< 7 hours/day	10,566 (68.76)	1232 (62.95)	5965 (70.33)	1377 (68.54)	875 (64.15)	1117 (71.88)
≥ 7 hours/day	4800 (31.24)	725 (37.05)	2517 (29.67)	632 (31.46)	489 (35.85)	437 (28.12)
Smoking						
Smoker	1365 (8.88)	0	0	0	**1364 (100)**	1 (0.06)
Non-smoker	14,001 (91.12)	**1957 (100)**	**8482 (100)**	**2009 (100)**	0	**1553 (99.94)**
Alcohol drinking						
Drinker	2420 (15.75)	0	0	0	866 (63.49)	**1554 (100)**
Non-drinker	12,946 (84.25)	**1957 (100)**	**8482 (100)**	**2009 (100)**	498 (36.51)	0
Fruit and vegetable consumption						
Unhealthy (< 5 servings/day)	7339 (47.76)	908 (46.40)	4052 (47.77)	797 (39.67)	683 (50.07)	899 (57.85)
Healthy (≥5 servings/day)	8027 (52.24)	1049 (53.60)	4430 (52.23)	1212 (60.33)	681 (49.93)	655 (42.15)
Snacking						
At-risk (every day)	10,019 (65.20)	1098 (56.11)	5539 (65.30)	1283 (63.86)	1027 (75.29)	1072 (68.98)
Lower risk (not every day)	5347 (34.80)	859 (43.89)	2943 (34.70)	726 (36.14)	337 (24.71)	482 (31.02)
High sugary beverage consumption						
Yes	12,598 (81.99)	0	**8482 (100)**	1622 (80.74)	1148 (84.16)	1346 (86.62)
No	2768 (18.01)	**1957 (100)**	0	387 (19.26)	216 (15.84)	208 (13.38)
High Salt intake						
Yes	8305 (54.05)	804 (41.08)	4682 (55.20)	1063 (52.91)	815 (59.75)	941 (60.55)
No	7061 (45.95)	1153 (58.92)	3800 (44.80)	946 (47.09)	549 (40.25)	613 (39.45)
Mental wellbeing						
Negative mental wellbeing	2559 (16.65)	0	0	**2009 (100)**	290 (21.26)	260 (16.73)
Positive mental wellbeing	12,807 (83.35)	**1957 (100)**	**8482 (100)**	0	1074 (78.74)	1294 (83.27)

Bold numbers represent dominant health behaviours and mental wellbeing in each cluster

high-rise accommodation (OR 2.94, 95%CI 1.07, 8.07) compared to members of the healthy cluster.

The alcohol drinker cluster (cluster 5) was associated with being in 2nd year (OR 1.28, 95%CI 1.03, 1.60) or 3rd year (OR 1.46, 95%CI 1.08, 1.98) compared to the healthy cluster and 1st year students. Students living in The Philippines (OR 3.11, 95%CI 1.47, 6.56), Singapore (OR 14.70, 95%CI 6.28, 34.42), Thailand (OR 7.06, 95%CI 3.64, 13.70), or Vietnam (OR 6.34, 95%CI 3.51, 11.43) had higher odds of being a drinker compared with students

Table 4 Factors associated with the healthy cluster (Cluster 1) using multinomial logistic regression analysis ($n = 15,366$)

Demographic characteristics	Cluster 2 High sugary beverage consumption OR (95%CI)	Cluster 3 Poor mental wellbeing OR (95%CI)	Cluster 4 Smoker OR (95%CI)	Cluster 5 Alcohol drinker OR (95%CI)
Gender (Ref. = Male)				
Female	1.28 (1.14, 1.45)**	1.21 (1.04, 1.41)*	0.93 (0.78, 1.10)	1.14 (0.96, 1.36)
Age (years) (Ref. = 18)				
19 to 21	0.94 (0.81, 1.10)	0.99 (0.81, 1.22)	1.06 (0.84, 1.34)	1.29 (0.98, 1.70)
≥ 22	0.90 (0.70, 1.15)	0.76 (0.55, 1.05)	1.09 (0.77, 1.54)	1.24 (0.85, 1.81)
Year of study (Ref. = Year 1)				
Year 2	1.24 (1.04, 1.46)*	1.24 (1.01, 1.52)*	1.37 (1.09, 1.72)**	1.28 (1.03, 1.60)*
Year 3	1.28 (1.01, 1.63)*	1.15 (0.85, 1.55)	1.19 (0.86, 1.64)	1.46 (1.08, 1.98)*
Year 4 or above	1.36 (0.92, 2.03)	1.37 (0.84, 2.25)	1.22 (0.72, 2.06)	1.57 (0.96, 2.59)
BMI (Ref. = Normal)				
Underweight	0.85 (0.74, 0.99)*	0.74 (0.61, 0.90)**	1.09 (0.86, 1.37)	1.01 (0.81, 1.25)
Overweight	0.82 (0.68, 0.97)*	0.87 (0.70, 1.09)	1.58 (1.23, 2.04)**	1.22 (0.95, 1.56)
Obese	0.91 (0.72, 1.17)	1.01 (0.75, 1.36)	2.03 (1.47, 2.80)**	0.99 (0.70, 1.40)
Country (Ref. = Brunei Darussalam)				
Indonesia	0.86 (0.63, 1.16)	0.34 (0.24, 0.49)**	1.17 (0.78, 1.75)	0.75 (0.40, 1.42)
Malaysia	0.45 (0.24, 0.77)**	0.32 (0.16, 0.67)**	0.23 (0.09, 0.57)**	0.20 (0.04, 0.98)*
Philippines	0.38 (0.24, 0.69)**	0.40 (0.24, 0.67)**	1.05 (0.58, 1.89)	3.11 (1.47, 6.56)**
Singapore	1.11 (0.58, 2.12)	0.91 (0.43, 1.92)	1.23 (0.53, 2.88)	14.70 (6.28, 34.42)**
Thailand	1.71 (1.16, 2.52)**	0.95 (0.60, 1.52)	1.18 (0.70, 1.99)	7.06 (3.64, 13.70)**
Vietnam	1.32 (0.98, 1.77)	0.62 (0.44, 0.86)**	0.86 (0.58, 1.30)	6.34 (3.51, 11.43)**
GPA (Ref. = ≤ 3.2)				
3.3 to 3.9	1.05 (0.90, 1.23)	0.97 (0.80, 1.18)	0.85 (0.69, 1.05)	0.76 (0.62, 0.92)**
> 3.9	0.91 (0.72, 1.14)	0.91 (0.68, 1.22)	0.72 (0.52, 1.01)	0.64 (0.48, 0.86)**
Place of living (Ref. = On-campus)				
Off-campus	1.18 (0.94, 1.49)	1.05 (0.79, 1.40)	1.10 (0.78, 1.56)	0.91 (0.67, 1.24)
Commute time (Ref. = less than 15 min)				
15 to 30 min	1.06 (0.92, 1.24)	1.04 (0.86, 1.26)	1.06 (0.86, 1.31)	1.04 (0.85, 1.27)
30 to 45 min	1.07 (0.88, 1.30)	1.33 (1.05, 1.70)*	1.40 (1.08, 1.82)*	1.04 (0.78, 1.38)
45 to 60 min	0.84 (0.69, 1.01)	0.83 (0.65, 1.07)	0.81 (0.61, 1.08)	0.76 (0.57, 1.02)
60 to 90 min	0.96 (0.76, 1.20)	0.95 (0.71, 1.27)	0.76 (0.53, 1.07)	0.57 (0.39, 0.83)**
> 90 min	0.88 (0.67, 1.16)	1.27 (0.90, 1.79)	0.71 (0.46, 1.10)	0.55 (0.32, 0.94)*
Commute type (Ref. = Active)				
Inactive	1.20 (1.04, 1.39)*	1.13 (0.93, 1.36)	1.34 (1.09, 1.66)**	1.05 (0.85, 1.30)
Housing type (Ref. = Single house)				
Townhouse	0.82 (0.68, 1.00)*	0.80 (0.63, 1.02)	1.03 (0.80, 1.33)	1.12 (0.89, 1.40)
Apartment	1.01 (0.81, 1.26)	0.92 (0.70, 1.22)	1.28 (0.95, 1.73)	1.25 (0.93, 1.68)
High rise condo	1.18 (0.48, 2.88)	1.20 (0.42, 3.44)	2.94 (1.07, 8.07)*	2.34 (0.78, 6.97)
Member of sports club (Ref. = Yes)				
No	0.99 (0.83, 1.18)	1.83 (1.43, 2.34)**	0.45 (0.35, 0.56)**	0.70 (0.54, 0.90)**

95%CI 95% Confidence interval, *BMI* Body Mass Index, *GPA* Grade Point Average, *OR* Adjusted odds ratio, *Ref.* Reference group

*$p < 0.05$, **$p < 0.01$

living in Brunei. Students with a higher GPA were less likely to belong to the alcohol cluster (OR 0.76, 95%CI 0.62, 0.92 for GPA 3.3 to 3.9; and OR 0.64, 95%CI 0.48, 0.86 for GPA > 3.9) compared to students in the healthy cluster. Students who spent more time travelling to campus (> 60 min) were less likely to be in the alcohol drinker cluster (OR 0.57, 95%CI 0.39, 0.83 for 60 to 90 min; and OR 0.55, 95%CI 0.32, 0.94 for > 90 min) compared to

students in the healthy cluster. Students who were not members of a sports club had 30% lower odds of belonging to the alcohol drinker cluster than the 'healthy' cluster and students who belonged to a sports club.

Discussion

The research investigated the health-risk behaviours and mental wellbeing among university students in seven ASEAN countries and it emerged that five behavioural clusters (i.e., healthy, high sugary beverage consumption, smoker, and alcohol drinker) and mental wellbeing, were identified. The results showed that among ASEAN university students, consuming sugary beverages was the dominant health behaviour across all clusters. This finding is consistent with the findings reported by Pengpid and Pletzer (2019) who observed that a high proportion of ASEAN university students consumed sugary soft drinks and this was associated with other unhealthy behaviours, such as smoking and drinking alcohol [32]. The present finding added to a small body of evidence linking the consumption of sugary beverages with a range of unhealthy behaviours among ASEAN university students. Therefore, it may be important to consider sugary beverage consumption behaviour when targeting other health-risk behaviours for improvement.

This research showed that several characteristics of university students were related to health-risk behaviours and mental wellbeing. Students in the second year of university study had a higher likelihood of having poor mental wellbeing and falling into the 'high sugary beverage consumption', 'smoker', and 'alcohol drinker' clusters, compared to the 'healthy' cluster. These results were in line with the findings of a Chinese study that showed that second year students suffered relatively higher levels of depression and stress, compared to students in the first, third, and fourth years of university study [33]. Another study conducted in Korea also supported the present results, where Korean university students in the second year experienced more mental health problems than the students in other years of study [34]. The academic demands of year 2 of university life might present greater stress and mental health challenges for year 2 students. Many universities usually set general courses for freshmen and introduce more specialised courses from the second year onwards [33]. Higher levels of stress, coupled with mental health challenges in year 2 students may relatively predispose them to getting involved in other health-risk behaviours compared to year 1 students.

Our results showed that more than half of ASEAN university students consumed sugary beverages. Paradoxically, both underweight and overweight students were less likely to consume sugary beverages compared to university peers of normal body weight. Our findings contrasted with those of a previous study on Saudi Arabian adolescents showing that intake of sugar-sweetened carbonated beverage was positively associated with BMI [35]. It appears that both socio-economic and environmental factors, are associated with high sugar diets and sugary beverage consumption in university students [36–38]. Of interest, university students' perceptions regarding sugar intake were explored in a qualitative study and although students perceived that excessive sugar intake affected their body image because of weight-gain, the students, nonetheless thought that they were not at risk of negative health outcomes as they were young [39]. Our findings alluded that the strategies to reduce sugary beverage consumption so as to reduce obesity among ASEAN university students should be applied to all students regardless of their body weight status.

The present study revealed that poor mental wellbeing was the second most prevalent health-risk characteristic among university students. Mental health issues among university students increased the burden on campus counselling resources, and have received great attention from educators within the AUN-HPN as poor mental wellbeing could lead to significant psychological problems and tragedies (i.e. suicide) [40]. We found that students who were not a member of any sports clubs had 83% increased risk of poor mental wellbeing. Non-membership to a sports club presented the highest odds of having poor mental health, albeit be it this is only an association and may not causative. Nonetheless, mental health promotion and helping students become physically active on a regular basis are recommendations for improvement in mental wellbeing among students [40–42]. A US-based study showed that sports club participation in college students is associated with positive health-related outcomes [41]. Also aligned, Australian students with higher sports club involvement have a positive and significant association with social-emotional wellbeing indicators, such as happiness, resilience, and body image, whereas low involvement in sports club is associated with a greater incidence of mental health diagnosis [43]. There is compelling evidence for the benefits of sports involvement and participation in university students. Involvement in team sports is also associated with reduced depressive mood because sport participation protects students against social isolation [44, 45]. Other research shows that lower depression scores are reported in the moderate sports involvement group, compared to the low sports involvement group [46]. Students who are active in sports clubs have a better self-concept because sports participation helps students build confidence,

acquire competent behaviours such as social skills, and release energy and aggression in socially accepted ways [47]. Joining and playing on team sports is also associated with greater life satisfaction, higher self-image, and less distress than students who are not involved in sport [48–50]. By being a member of a sports club, students are more psychologically resilient, confident, assertive, have better social skills, self-esteem, self-efficacy, self-control, self-concept, and competent [49]. Participating in sports clubs can be a means of improving mental wellbeing. Therefore, encouraging students to join sports clubs might be considered as part of strategies to promote mental wellbeing among the ASEAN university students.

Participation in sports clubs also seemed to influence the likelihood of being smokers or drinkers among ASEAN university students. The present study showed that not being sports club members was associated with less likelihood to smoke and drink alcohol. These results are consistent with evidence where university students who joined sports groups or organisational sports are more likely to smoke and drink alcohol [51–54]. A systematic review by Lisha et al. showed that university students in sports clubs reported higher levels of drinking and smoking than those who were not in any sports clubs [55]. Plausible explanations for these observations are that university students were in a transition period of their lives and were exposed to substantial changes in terms of environmental (living on their own away from families, gaining independence) and social aspects (making new friends with a need to belong). This kind of adolescent-adulthood transition is often associated with an increase in heavy and risky alcohol use [56, 57]. Theory and empirical findings suggest that peer pressure is a combination of three distinct influences: overt offers of alcohol, modelling, and social norms [58]. Overt offers of alcohol can range from polite gestures to intense goading or commands to drink [58]. Modelling occurs when the student's behaviour corresponds to another student's concurrent drinking behaviour [58]. Perceived social norms can serve to make excessive alcohol use appear common and acceptable to the students [58]. In the present case, making a recommendation for university students to join a sports club may seem contradictory since on the one hand, it could safeguard mental wellbeing, yet on the other hand, this could expose students to pressures and risks of high drinking and smoking. Therefore, comprehensive strategies that address these paradoxical observations and promote health among ASEAN university students should be considered. For instance, having trained student ambassadors in sports clubs and incentivising healthier activities among sports teams that are in keeping with the culture and context of each country are ideas that are worthy of exploration.

In the present research, the country of residence was associated with specific health-risk behaviours such as alcohol drinking. University students in all countries except Indonesia and Malaysia had higher odds of being current drinkers, whereas university students in Indonesia and Malaysia had lower odds, compared to those in Brunei. A majority of the population in Brunei, Malaysia, and Indonesia is Islamic and alcohol drinking is considered haram (prohibited or sinful) for consumption and therefore alcohol consumption is not likely to be high [59]. Research shows that alcohol consumption is associated with religion [60]. Moreover, some research suggested that religious commitment among the pious and those who are faithful to the teachings of religion (e.g. advocating abstinence from alcohol consumption), is associated with reduced likelihood of alcohol drinking [61]. We are of the view that differences in culture and context within each country in ASEAN pose challenges in the implementation of a common intervention programme to address alcohol consumption in university students. Further research is required to tease out factors that might play a role in alcohol consumption among university students in each country and how these county and culture-specific contexts might be built into future interventions to reduce alcohol abuse for positive results to be accomplished and sustained.

Overall, our results showed that, during the COVID-19 pandemic, only 12.7% of university students exhibited multiple healthy behaviours, with over 85% exhibiting at least one dominant unhealthy behaviour (e.g., high sugary beverage consumption, alcohol consumption and smoking). These results showed that a majority of ASEAN university students was at risk of developing multiple health problems, if their present health behaviours are not improved over time. The AUN-HPN Healthy University Framework highlighted smoking, alcohol consumption, and mental wellbeing as important areas to address [16]. A majority of smokers also drank alcohol. Health promotion policies and interventions targeting smoking behaviours should combine strategies to prevent or reduce alcohol drinking concomitantly. In need of urgent attention and action is to reduce the consumption of sugary beverages, as this habit is most prevalent among other identified health-risk behaviours and should be considered as a priority health promotion issue among ASEAN university students. Although cause-and-effect cannot be determined in the associations between the cluster of high sugary consumption and other health-risk behaviour clusters identified in our cross-sectional analyses, the results suggested that clusters of health-risk behaviours tend to 'reinforce' each other, and future research should examine if moderating high sugary consumption

among university students might have a significant impact on other health-risk behaviours.

This cross-sectional descriptive research provided some insights into the potential areas of concern and actions for health promotion among university students in the seven ASEAN countries. First, university policy makers should focus on the transition from the 1st to 2nd year of university study. This period provides an opportunity for health advocates to intervene and prevent adolescents transiting into early adulthood from adopting high risk and unhealthy behaviours and habits. Data from the present research provided useful finer-grain information and specificity in terms of areas for intervention. Specifically, health promotion interventions should be targeted at reducing sugary beverage consumption and relatively poor mental health, especially among female students. To prevent and reduce the prevalence of smoking, interventions should focus on students who are overweight and obese as well as those who travelled to the campus by motorised transport. Some consideration and attention are needed to attend to alcohol drinking in students living in the non-Islamic countries to reduce the likelihood of alcohol abuse. While mental health may be safeguarded by joining sports clubs, the risks of picking up unhealthy behaviours of alcohol consumption and smoking in sports clubs also need to be moderated and monitored. The key results of our study established some demographic characteristics with specific health-risk behaviour and showed that health-risk behaviours were clustered and co-existed with each other. Policy makers should formulate health-enabling programmes that can best address multiple health risk behaviours at the same time such as adopting a socio-ecological model interventionist approach [62].

The present research had a number of strengths. Firstly, the research was conducted in seven countries in the Southeast Asian region and involved a sizeable sample. Secondly, the use of a self-reported online questionnaire allowed more university students to be polled in the COVID-19 pandemic when online interactions and travel restrictions were the norm. The research also had two notable limitations. The research design was cross-sectional and descriptive in nature and therefore only associations among demographic characteristics and health-risk behaviours could be established and cause-and-effect among the associations cannot be determined. Causal inference may require future research based on the longitudinal monitoring of university students. Another potential limitation was that the research was conducted during the COVID-19 pandemic, which could have a disproportionate impact on many health behaviours.

Conclusion

The majority of ASEAN university students exhibited one common health-risk behaviour. A large proportion of the university students had a habit of sugary beverage consumption. This was followed by poor mental coping strategies, alcohol drinking, and tobacco smoking. The transition from the 1st to 2nd year of university life was particularly challenging and 2nd year university students had higher odds of exhibiting several health-risk behaviours. Health promotion strategies for healthy universities should focus on comprehensive interventions in addressing the dominant health-risk behaviour as well as the other associated health-risk behaviours within the identified clusters.

Abbreviations

ASEAN: Association of Southeast Asian Nations; AUN-HPN: ASEAN University Network - Health Promotion Network; BMI: Body mass index; COVID-19: Coronavirus disease 2019; GPAQ: Global Physical Activity Questionnaire; GPA: Grade point average; NCDs: Non-communicable diseases; WEMWBS: Warwick-Edinburgh Mental Wellbeing Scale; WHO: World Health Organization.

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Authors' contributions

AW, HAR, MR, and AA initiated the concepts of the study. AW, HAR, MR, and AA analysed and interpreted the study results. AW wrote and revised the manuscript. All authors provided critical comments on the drafts. AW, MR, MC and AA edited the manuscript. All authors read and approved the final version of the manuscript.

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Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to restrictions on intellectual property regulations of the funding organization. Data are however available provided that an application is submitted at info@thaihealth.or.th or areekulk@gmail.com and approved by the dataset custodians. No administrative permissions were required to access raw data.

Declarations

Ethics approval and consent to participate

This study protocols were undertaken in accordance with relevant local and international ethical guidelines and regulations; e.g., Declarations of Helsinki. The primary ethical approval for the whole study protocols was obtained from Mahidol University Central Institutional Review Board (MU-CIRB 2020/089.0704). Participating universities also obtained ethical approval from their institutional review board: University Research and Ethics Committee of Universiti Brunei Darussalam (UBD/OAVCR/UREC/OCTOBER2020–05), Universitas Gadjah Mada (KE/FK/1066/EC/2020), Universitas Indonesia (KET-126/UN2.F1/ETIK/PPM.00.02/2021), Universiti Putra Malaysia (JKEUPM-2020-156), Ateneo de Manila University (AdMUREC-20-010), National Institute of

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Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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