REVIEW ARTICLE

Factors Associated With Hydration Status Among Adults in South-east Asia: A Scoping Review

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ABSTRACT

The aim of this paper is to identify the sociodemographic, anthropometric, lifestyle and environmental factors that affect hydration status among adults in South-East Asia. A scoping review was conducted using PubMed, Scopus, and Ovid databases. Studies published between 2018 and 2023 from South-East Asian countries were included, focusing on adults aged 18-59. Factors analyzed included sociodemographic characteristics, body weight and composition, dietary intake, physical activity, and environmental conditions. Out of 2913 articles screened, only 11 met the inclusion criteria. These studies were from Malaysia, Indonesia, Thailand, and Singapore. The review found several factors that are significant associations to hydration status which are gender, body fat and weight, water intake, physical activity intensity and duration and temperature. This scoping review revealed the limited recent research on hydration and its associated factors in Southeast Asia, indicating the need for more in-depth research to explore these factors further. Addressing these factors can improve hydration levels among adults in the region.
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Keywords: Hydration status, Factors associated hydration, Water intake, Adults, South-East Asia

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INTRODUCTION

Water makes up 40–62% of the human body and is crucial for life (1). It is a primary component of cells, tissues, and organs, playing a key role in reactions, nutrient transport, and waste removal (2). People get water from drinking, eating, and their body's production, with beverages and drinking water accounting for 70–80% of intake and solid foods for 20–30% (3).

Maintaining water balance is essential for proper hydration, and disruption can lead to dehydration (4). Thirst drives water intake, but food consumption, habits, and water availability also play roles (5). Besides, the sources, management, and quality of water also contribute to water intake (6). Water loss occurs through urine, respiration, faeces, and sweat and is influenced by physical activity and environmental factors like temperature and humidity. Dehydration can cause heat stroke, kidney issues, and impaired cognitive and physical performance (7).

In Southeast Asia, Indonesia is the largest water consumer, followed by the Philippines and Malaysia (8). A study by Laksmi et al. (2016) (9) found that 72% of Indonesian adults met fluid intake requirements, though many consumed sugary drinks. Another study showed that most Indonesian medical students were well hydrated, with only a small percentage severely dehydrated (10). In Malaysia, a national survey (National Health Morbidity Survey 2019) found that 26% of adults drank less than 6 glasses of water per day, despite guidelines recommending 6–8 glasses daily (11,12). A study on Malaysian adolescents found that over half were moderately dehydrated, affecting their cognitive performance (13). The studies found that not drinking enough water was the main reason for dehydration. Therefore, drinking enough water is crucial for maintaining water balance and preventing dehydration.

Previous studies have argued that various factors such as sociodemographic, anthropometric, lifestyle and environmental might have significant influences on hydration level. Studies have shown that individuals with higher incomes and education tend to consume more water (14) while differences in total water intake between men and women can be influenced by socioeconomic and housing factors (15). Overweight adults in Malaysian universities were found to drink more water than their underweight or normal-weight peers. Lifestyle factors such as diet and physical activity also play a role; for example, high carbohydrate intake, glycaemic load, and sodium have been linked

to improved body water conservation (16), including water from food sources is essential for a complete understanding of hydration status. Physical activity increases the need for adequate hydration, especially in sports and cardiovascular activities, though its impact on water consumption is under-researched (17,18). Environmental factors like population growth and urbanization exacerbate water shortages, with access to safe drinking water varying widely in ASEAN countries. For instance, Singapore achieves 100% access (19), while countries like Cambodia and Laos lag behind. In Malaysia, piped water access was 95.9% in 2019 but lower in rural areas (84.7%) compared to urban regions (98.7%) (20). These disparities highlight the need to address hydration issues among adults in Southeast Asia. Additionally, there is a lack of research on the factors influencing hydration status and their impact on this population.

This study is a scoping review to identify and summarize gaps in knowledge of factors affecting hydration status among adults in South-East Asia, such as sociodemographic, anthropometric, lifestyle and environmental factors. The review aims to map the existing data and synthesize the findings. Understanding these factors can help plan and implement programs to improve hydration status in the region.()()()

MATERIAL AND METHODS

Protocol

This review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses protocol for scoping reviews (PRISMA-ScR) (21). The protocol of this review has not been pre-registered.

Eligibility criteria

The inclusion and exclusion criteria for eligible study were developed as follows:

- Inclusion: South-East Asia country (Brunei; Cambodia; Indonesia; Laos; Malaysia; Myanmar; Philippines; Singapore; Thailand; East Timor; Vietnam), population (men and women), adults (aged 18 – 59 years old); and reported on hydration status
- Exclusion: Population had health condition that would impact hydration status (e.g., diabetes mellitus, hypertension, gastrointestinal diseases, kidney disorders and cardiovascular disorders).
- Concept: Hydration status factors.
- Context: Adults in South-East Asia.

Full-text articles were obtained and included in this scoping review according to the above inclusion criteria. Duplicate were excluded. Additionally excluded were opinion pieces, editorials, reviews, conference abstracts and protocol papers. As the focus of this review was to know the breadth of hydration status factors research in South-East Asia, hence the data on the year of publication, authors, the country in South-East Asia where the research was conducted, area of hydration tackled and summary of findings were extracted.

Information sources and search strategy

Three electronic bibliographic databases were used for the search which are the PubMed, Scopus, and the Ovid. The search terms used in each database are shown in Table I. These keywords were restricted to English language. The searches were restricted to the last 5 years of publication (2018–2023) to obtain the most recent advances. Next, the citations were exported into Mendeley. The reference lists of included sources and relevant reviews were reviewed.

Table I: Search terms used in databases

Categories	Search term/keywords
Hydration	- Hydration - Hydration status
Southeast Asia country	- Brunei - Cambodia - Indonesia - Laos - Malaysia - Myanmar - Philippines - Singapore - Thailand - East Timor
Population	- Adults - Young adults - Middle adults - Older adults
Sociodemographic characteristics	- Sociodemographic characteristics - Sociodemographic factors - Sociodemographic - Demographic
Body weight and composition	- Body composition - Body weight - Body mass index
Dietary intake	- Dietary intake - Dietary consumption - Nutrient intake - Nutrient consumption - Food consumption - Food and water intake
Physical activity level	- Physical activity - Level of physical activity
Environmental factors	- Environment - Surrounding - Seasons - Humidity - Temperature

Variables in the database were determined both a priori and as relevant variables were identified during the process of data extraction. The variables were identified: 1) sociodemographic characteristics 2) body weight and composition 3) dietary intake 4) physical activity level 5) environmental factors.

Selection of relevant and reliable articles

To ensure consistency, all reviewers screened the same 2913 articles, discussed their findings, and updated the screening and data extraction manual before starting the review. The main and second authors evaluated the

titles, abstracts, and full texts of all potentially relevant articles. Disagreements were resolved through consensus and discussion with other reviewers if needed.

Data charting and extraction from included studies

The details on data management were shown as in Table II. Once the articles were selected, the following data were recorded in a spreadsheet: author(s), year, location, characteristics of participants, study purpose, study design, measurement methods, and key findings (Table III). Two authors independently collected and extracted the data. Other authors checked for completeness.

Table II: Details on data management

Searching keywords	Sources databases	Articles retrieved (n)	Articles excluded (n)	Full-text assessment (n)	Articles included (n=11)
(Sociodemographic) OR (Demographic) OR (Sociodemographic characteristics) OR (Sociodemographic factors) AND (hydration status) OR (hydration) OR (hydration level)	PUBMED	530	- Not in Southeast Asia (n=506) - Not adults (n=14) - Not on hydration (n=7) - Wrong type of study (n=1) - Population with disease (n=1)	1	1
	SCOPUS	117	- Not in Southeast Asia (n=112) - Not adults (n=2) - Not on hydration (n=1)	2	
	OVID	2870	- Not in Southeast Asia (n=2298) - Not adults (n=109) - Not on hydration (n=26) - Wrong type of study (n=400) - Population had disease (n=22) - Duplicate (n=13)	2	
(Body composition) OR (Body weight) OR (Body mass index) OR (body mass index factor) AND (hydration status) OR (hydration) OR (hydration level)	PUBMED	157	- Not in Southeast Asia (n=154) - Not adults (n=2) - Not on hydration (n=1)	0	3
	SCOPUS	316	- Not in Southeast Asia (n=308) - Not adults (n=4) - Wrong type of study (n=1)	3	
	OVID	2120	- Not in Southeast Asia (n=1688) - Not adults (n=37) - Not on hydration (n=15) - Wrong type of study (n=366) - Population had disease (n=4) - Duplicate (n=9)	1	
(diet intake) OR (food and water intake) OR (diet consumption) OR (nutrient intake) OR (nutrient consumption) AND (hydration status) OR (hydration) OR (hydration level)	PUBMED	451	- Not in Southeast Asia (n=425) - Not adults (n=14) - Not on hydration (n=4) - Duplicate (n=1)	7	2
	SCOPUS	457	- Not in Southeast Asia (n=439) - Not adults (n=7) - Not on hydration (n=2)	9	
	OVID	1250	- Not in Southeast Asia (n=1037) - Not adults (n=24) - Not on hydration (n=7) - Wrong type of study (n=176) - Population had disease (n=4) - Duplicate (n=2)	0	
(physical activity) OR (physical activity level) AND (hydration status) OR (hydration) OR (hydration level)	PUBMED	278	- Not in Southeast Asia (n=257) - Not adults (n=10) - Not on hydration (n=5) - Duplicate (n=1)	5	2
	SCOPUS	839	- Not in Southeast Asia (n=782) - Not adults (n=47) - Not on hydration (n=3) - Duplicate (n=1)	6	
	OVID	1641	- Not in Southeast Asia (n=1038) - Not adults (n=29) - Not on hydration (n=9) - Wrong type of study (n=290) - Population had disease (n=4) - Duplicate (n=271)	0	

CONTINUE

Table II: Details on data management (CONT.)

Searching keywords	Sources databases	Articles retrieved (n)	Articles excluded (n)	Full-text assessment (n)	Articles included (n=11)
(environment) OR (environmental factor) OR (surrounding) OR (temperature) OR (seasons) OR (humidity) AND (hydration status) OR (hydration) OR (hydration level)	PUBMED	801	- Not in Southeast Asia (n=780) - Not adults (n=13) - Not on hydration (n=2) - Duplicate (n=1)	5	3
	SCOPUS	4687	- Not in Southeast Asia (n=4531) - Not adults (n=136) - Not on hydration (n=1) - Wrong type of study (n=11)	8	
	OVID	7662	- Not in Southeast Asia (n=6908) - Not adults (n=246) - Not on hydration (n=61) - Wrong type of study (n=419) - Population had disease (n=5) - Duplicate (n=23)	0	

Table III: Summary of included studies

Author(s)	Location	Aim	Study Design	Setting	Methods	Results
Sociodemographic characteristics						
Fan et al 2022 [5]	Malaysia; China	To determine the present status of hydration among the athlete's population and the factors influencing the hydration status of the athletes	Prospective cohort design	N = 325 subjects (165 males and 160 (females), aged 18-35 years	Urine sample measures: - sodium (mEq/day) - urine volume (L) - specific gravity Blood sample measures: - Hemoglobin (g/dL) - glucose (mmol/L) - sodium (mEq/L) Food diary: - A notebook to record daily water intake, activities, and diet	- Sodium levels, urine specifc gravity and osmolality differed significantly between genders in both seasons. - Glucose and hemoglobin levels differ significantly between males and females in both winter and summer. - Urine osmolality differs significantly between males and females in both summer and winter (p=0.000), while urine specific gravity is significantly different only in summer (p<0.001). - Combined data from summer and winter shows significant differences in serum osmolality. - Overhydrated participants had higher urine volumes, lower specific gravity, and lower sodium levels (all p<0.001). - Female participants were 14.5% hyper-hydrated, 59% euhydrated, and 26.5% dehydrated. Male participants were 17.57% hyper-hydrated, 69.69% euhydrated, and 17.74% dehydrated.
Body Weight and Composition						
Prasetyo et al 2022 [20]	Indonesia; Malaysia	To ascertain the effects of body age, hydration, and fat percentage on quality of life and physical activity	Observational study with cross sectional approach	N = 35 (25 males & 10 females; aged 18-21 years)	Quality of life: - measured with the health-Related Quality of Life Survey Physical activity: - Measured with the Global Physical Activity Questionnaire Body age; hydration; fat percentage: -use Omron Karada Scan Digital Body Composition - Calculated with bioimpedance anthropometric methods	- There is a strong negative correlation between hydration and fat percentage (p=-0.990), meaning higher hydration levels are associated with lower fat percentage. - Increasing water intake can help control body fat and aid in weight loss for obesity. - Physical activity is not correlated with hydration (p=0.447). - Meeting water intake needs is as important as physical activity for maintaining a healthy body. - Increased hydration improves quality of life.

CONTINUE

Table III: Summary of included studies (CONT.)

Author(s)	Location	Aim	Study Design	Setting	Methods	Results
Body Weight and Composition						
Mulyani et al 2022 [16]	West Jakarta, Indonesia	To determine the relationship between gestational weight gain (GWG) and maternal hydration status	Longitudinal study	N = 50 pregnant women (18-35 years)	Questionnaires: - Gather information on age, parity, household expenses Measurements: - Weight: Omron digital scale - MUAC: Measuring tape - Height: Microtoise Blood test: - assess on hemoglobin (11g/dL or higher) Urine test: - measure urine specific gravity (<1.015); urine osmolality (≤500mOsm/kg) Nutritional intake: assessed through 24h food recall interviews conducted over three days	- High total water intake (r=0.65) is positively correlated with gestational weight gain (GWG). - A significant difference (p<0.01) was found between total water intake and GWG across different hydration statuses. - Adequately hydrated mothers consume more water on average compared to dehydrated mothers. - Mothers who consume less water have a higher risk of excessive GWG than well-hydrated mothers. - Adequate water intake might help reduce appetite, beneficial for weight loss, diabetics, and overweight individuals due to changes in osmolality.
Mulyani et al 2021 [15]	West Jakarta, Indonesia	To identify how dehydration during pregnancy might affects the birth weight and length of babies	Cohort- prospective study	N = 66 pregnant women	Questionnaires: - Collect information on maternal age, weight before and during pregnancy, height, upper arm circumference, waist circumference, hip circumference, nutritional status before pregnancy, body temperature, pulse, fundus height, blood pressure and hydration status Hydration status biomarkers: - Check urine color, urine specific gravity, serum sodium, and borh urine and serum osmolality Nutrition and water intake: - Assessed through 24h recall interviews for 6 days	- 52.6% of the subjects were dehydrated. - Babies of dehydrated mothers had lower weight, height, head circumference, and chest circumference compared to those of adequately hydrated mothers. - Mild dehydration occurs with a 2% weight loss, repeatedly and over a long period.
Dietary intake						
Taim et al 2021 [28]	Singapore; Australia	To assess the impact of artificial sweetened flavored water without carbohydrates and with small amount of sodium vs plain water on fluid intake of male collegiate basketball players	Randomized between subject design	N = 18 male basketball players (age 23.1 ± 1.3 years)	Temperature & humidity: - assessed using calibrated handheld environmental meter Sensory questionnaire: - measured the intensities of sweetness, saltiness and sourness Hydration status: - urine specific gravity (USG); measured by using refractometer - blood serum osmolality - percentage changes in body mass Fluid consumption: - the different between initial mass of bottle and the final mass of the bottle post-game (formula) Sweat rate: - urine output (formula)	- Participants drink more plain water than flavored water. - Fluid palatability does not significantly increase consumption compared to plain water unless it contains added carbohydrates or electrolytes. - Players who drank water had a lower risk of dehydration.

CONTINUE

Table III: Summary of included studies (CONT.)

Author(s)	Location	Aim	Study Design	Setting	Methods	Results
Dietary intake						
Mansor et al 2019 [13]	Malaysia	- To assess on how hydration practices influenced the severity of heat related illness during a heat wave episode among municipal workers in Negeri Sembilan. - To determine the dehydration level and outdoor workplace temperature.	Cross sectional study	N = 320 subjects (mean ± SD = 43 ± 9.49 years)	Sociodemographic factors, current medication usage, alcohol intake, history of previous heat related illness: - Self-administered questionnaire HRI symptoms - Validated Heat Illness Symptoms Index, measured using a five-point Likert Scale Hydration status: - Observation of the urine color using a standard validated urine color scale of eight points Hydration practices: - Volume and type of fluid consumed Body Mass Index: - weight (kg)/height (m^2) Outdoor temperature - 3M™ QUESTemp™ 34 WBGT meter was used to record wet-bulb globe temperature (temperature; humidity; wind speed; sun angle; clod cover) - The measurement method was based on - ISO 7234:1989	- The average water intake during working hours was 2150ml (SD 933ml). - Most respondents drank plain water (80.6%) at irregular times (89.4%) and had adequate hydration (56.6%). - Outdoor workers were more likely to experience moderate to severe heat-related illness (HRI) symptoms due to irregular fluid intake [OR: 16.11, 95% CI: 4.11-63.20], drinking non-plain water (OR: 5.92, 95% CI: 2.79-12.56), dehydration (OR: 3.32, 95% CI: 1.92-5.74), and increasing outdoor temperatures (OR: 1.85, 95% CI: 1.09-3.11). - The severity of HRI was significantly influenced by hydration habits, such as irregular fluid intake and drinking non-plain water.
Physical Activity						
Kamaruddin et al 2019 [8]	Malaysia; New Zealand; Singapore	To investigate the effects of mouth rinsing with carbohydrate on the actions and performance of athletes during treadmill running in both hydrated and dehydrated status	Experimental study design	N= 12 runners (23 ± 2 years)	Five visits to laboratory: 1: A submaximal pace for the TTE exercise that is tailored to each subject's VO2 peak, as well as equipment orientation and mouth-rinsing techniques, are used. 2 until 5: Two experimental trials: a) Two dehydrated mouth-rinsing TTE runs (with and without CHO) b) Two euhydrated mouth-rinsing TTE runs (with and without CHO) Exercise test: - running economy test - maximal exercise test on treadmill - TTE run were performed - calibrated respiratory gas system was used to collect CO2 - the heart rate was recorded Urine sample: - urine specific gravity (USG) was determine using refractometer Blood collection: - a 22G IV catheter was inserted into a radial vein to collect 4ml of whole blood Perceived thirst and psychological scales: - assessed using visual analogue scale (VAS), straight line of 100mm	- Carbohydrate mouth rinse significantly improved time to exhaustion (TTE) in dehydrated individuals compared to euhydrated trials (78.2 ± 4.3 vs. 76.9 ± 3.8, p = 0.02), likely due to increased sensitivity of oral thirst receptors and central activation.

CONTINUE

Table III: Summary of included studies (CONT.)

Author(s)	Location	Aim	Study Design	Setting	Methods	Results
Physical Activity						
Surapongchai et al 2021 [26]	Thailand; Singapore; United Kingdom	To assess the recreational native tropical runners' level of hydration, fluid consumption, sweat production and sodium content in sweat.	Observational cohort study	N = 166 (102 males and 64 females); aged 21-68 years	Assessment of heart rate and blood pressure (<110/180mmHg): - monitor on upper arm blood pressure Aural temperature(<38°C): - Ear thermometer Mid -stream urine samples: - urine specific gravity (USG); measured by refractometer Body Mass: - measured using bench scale To collect sweat: - an absorbent patch was applied to the mid-forearm Temperature & Humidity: - 10min interval using data logger was recorded Whole body sweat sodium concentration: - ion-selective electrode was used to analyse Na^+ and K^+	- During the race, 7% of men and 3.1% of women did not drink water. - The average fluid intake during running was similar for both genders ($p<0.05$). - However, male runners drank less water relative to their body mass compared to female runners ($p<0.05$).
Environmental factors						
Suryadi et al 2018 [27]	Indonesia	To examine the correlation between Tirtonadi Bus Station worker's hydration level, physical workload and heat stress in Surakarta, Indonesia	Cross- sectional study design; Observational	N = 48 respondent (18-64 years old)	- Heat Stress Area Tool was used to measured heat stress - Instruments based on SNI 7269 of 200 was used to determine the level of calorie expenditure (physical workload) - Laboratory tests (urine specific gravity) determine hydration status	- The Tirtonadi Bus Station's temperature was 34.5°C, exceeding the safe limit. - 10.4% of workers had heavy physical workloads, while 77.1% had medium workloads. - Among workers, 20.8% were adequately hydrated, 41.7% had mild dehydration, and 37.5% had moderate dehydration. - Heat stress and hydration are strongly negatively correlated ($r=-0.799$, $p<0.05$), meaning higher heat stress leads to lower hydration. - Physical workload and hydration level are positively correlated ($r=0.317$, $p<0.05$), indicating that more physical work leads to better hydration. - Physical workload also affects energy expenditure.
Lestantyo & Suroto 2020 [10]	Indonesia	To evaluate the effects of electrolyte water supplementation on urine osmolality and worker's performance in conditions of high heat.	Experimental studies with Randomized Controlled Trial (RCT)	N = 70 participants (age 20-40 years)	- The Digital Quest temp Heat Area Monitor measured the workplace temperature - Sodium chloride intake was determine using 3 x 24-hour recall questionnaire - Nutritional status was measured using BMI - Urine: - assess on urine specific gravity; measured by Urinometer Flicker fusion test was used to identify general fatigue	- The indoor temperature was 26.7°C, which is also above the threshold limit. - Dehydrated individuals are more prone to heat exhaustion, heat stroke, and cramps. - Workers showed moderate dehydration (USG=1.0258; Osmolality=893.5mOsm/kg) and lacked sufficient water replenishment. - 47% of workers had a USG of 1.030, highlighting the need for regular health monitoring and quick fluid replacement. - 80% of workers experienced excessive sweating and dehydration during work. - Most workers reported moderate fatigue, including headaches, excessive sweating, and tiredness in hot conditions. - Completing tasks took longer in extremely hot environments.

CONTINUE

Table III: Summary of included studies (CONT.)

Author(s)	Location	Aim	Study Design	Setting	Methods	Results
Environmental factors						
Poon et al 2022 [23]	Singapore	To assess the thermal strain, fluid and electrolyte balance on troops who have gotten used to the heat while they are marching a 72km military route in a field surroundings	Cohort study	N = 38 male (18-23 years old)	Height and body composition: - measured by anthropometric measurements Thermal and cardiovascular strain: - core temperature measured using VitalSense temperature - heart rate was tracked using a heart rate sensor & heart rate monitoring watch Blood samples: - a handheld analyzer measured electrolytes, glucose, and urea concentrations - radioimmunoassay was used to determine aldosterone and arginine-vasopressin (AVP) - formula was used to calculate serum osmolality (mOSM/kg) Fluid intake: - The amount of water consumed and the mass of water bags at rest stops were recorded, as well as fluids from canned drinks during meals. Environmental conditions: - A portable climate data logger measured wet bulb, dry bulb, globe temperature, relative humidity, and wind velocity.	- The moderate climate did not cause significant thermal strain. - Core temperatures ranged from 36.7°C to 38.7°C, cause hyperthermia. - There was a negative correlation between sweat loss and serum sodium concentration (r=-0.36, p<0.05). - 28 of 34 subjects had decreased serum sodium levels. - AVP levels increased in those with exercise-associated hyponatremia (EAH), even though serum sodium and osmolality decreased. - Fluid intake was based on thirst, and overhydration posed a risk for hyponatremia. - EAH risks include prolonged low-intensity exercise and warm, humid conditions.

Data synthesis and analysis

The data are presented as a narrative overview because the studies used different outcome measures and statistical methods. Detailed descriptions are provided for studies that examined factors influencing hydration status among adults in South-East Asia, including their design, objectives, sample characteristics, measurements, and key findings. The findings are summarized to highlight significant aspects related to the current study.

RESULTS

Study selection and characteristics

Figure 1 shows the flow chart of the studies identification and selection process. The search from three databases found a total of 24,176 papers, that led to a total of 23,810 titles and abstracts that were screened after the removal of duplicates. After excluding studies not focused on South-East Asia, 2,547 articles were reviewed for full-text assessment but 880 articles were potential to full-text screening. Additional articles were excluded after full-text assessment for the reason mentioned in the flowchart (Figure 1). Therefore, a total of 11 articles were met the inclusion criteria and included in this review.

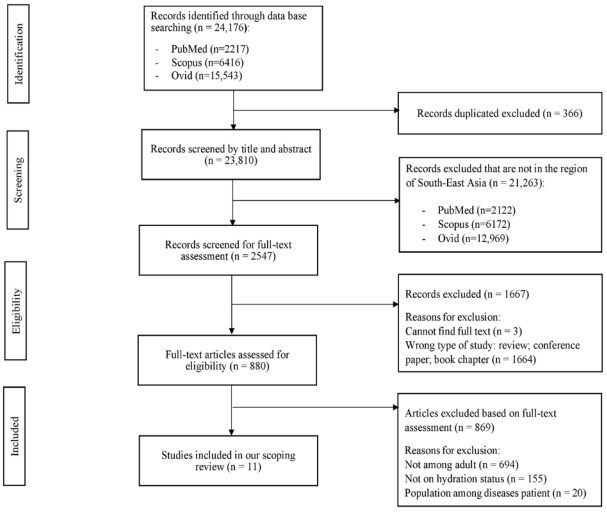

Figure 1: Flow chart of the studies identification and selection process

Data extraction and synthesis

Table III summarizes the reviewed articles. Nine used a quantitative design, and two used a qualitative design. One study focused on sociodemographic characteristics (22). Three studies focused on body weight and

composition (23-25) and environmental factors (30-32). Two studies focused on dietary intake (26-27) and physical activity (28-29). Most studies were conducted in Indonesia (n=5), followed by Malaysia (n=4), Singapore (n=4), and Thailand (n=1). Studies in Malaysia focused on sociodemographic, body composition, dietary intake, and environmental factors, while research in Indonesia examined BMI and environmental influences. Thailand's study addressed physical activity, and Singapore's research covered dietary intake, physical activity, and environmental factors. Additionally, five multi-country studies compared hydration findings in Southeast Asia with other regions. However, no studies on hydration status and its factors were found for other South-East Asia country namely Brunei, Cambodia, Laos, Myanmar, Philippines, Timor-Leste, and Vietnam.

Synthesis of results

The articles were categorized into five key areas related to hydration status: sociodemographic characteristics (1 article), body weight and composition (3 articles), dietary intake (2 articles), physical activity (2 articles), and environmental factors (3 articles). The most recent articles were from 2022 (3 articles), while the earliest was from 2018 (1 article).

Sociodemographic and hydration status

Only one study by Fan et al. (2022) (22) were included, that examined hydration status and its influencing factors among 325 Chinese athletes in Malaysia using a prospective cohort design over two years (2021–2022). Hydration levels were assessed through urine and blood tests, while daily diets were tracked using food diaries. The study found that females were more hydrated than males and that hydration status varied by season, with higher urine osmolality observed in summer compared to winter ($p<0.001$). Hence, we can observe that men and women had different level of hydration.

Anthropometric and hydration status

This review included three studies from Indonesia. Prasetyo et al. (2022) (23) found a negative correlation between body fat percentage and hydration levels among 35 adults, suggesting that higher water intake could support weight loss. Two studies by Mulyani et al. focused on maternal hydration during pregnancy. The 2022 (24) study found that excessive gestational weight gain was linked to lower water intake, while the 2021 (25) study reported that weight loss during pregnancy could lead to dehydration. Both studies emphasized the importance of adequate water intake and weight monitoring during pregnancy to ensure optimal hydration.

Dietary intake and hydration status

Taim et al. (2021) (26) studied the impact of flavoured water (low sodium, no carbohydrates) versus plain water on hydration among 18 basketball players in Singapore. Using urine and blood assessments, they found no effect of flavoured water on total water intake but reported a lower risk of dehydration among those drinking plain water, suggesting it is more effective for hydration. Mansor et al. (2019) (27) examined water consumption and dehydration among 320 outdoor workers in Malaysia. Using urine color scales, they found 80.6% of respondents had adequate hydration, with hydration levels influenced by habits like irregular fluid intake and preference for non-plain water. Both studies highlight the importance of sufficient plain water intake for optimal hydration.

Physical activity and hydration status

Kamaruddin et al. (2019) (28) investigated the effects of carbohydrate mouth rinses on endurance and performance in hydrated and dehydrated athletes through a collaborative study between Malaysia, Singapore, and New Zealand. Using running tests to measure performance and urine specific gravity to assess hydration, the study found that carbohydrate mouth rinsing significantly improved endurance in dehydrated athletes, especially after prolonged training. The findings highlight the risk of dehydration due to body mass loss during endurance training and emphasize the role of carbohydrate intake in enhancing hydration. Surapongchai et al. (2021) (29) studied the relationship between recreational activity, hydration, fluid intake, and sweat production among 166 adults in Thailand. Using urine specific gravity, they found that 7% of men and 3.1% of women were dehydrated as they did not consume water during running. However, men showed greater fluid balance deficits, higher sweat rates, and greater sodium loss than women, likely due to body mass differences. This study also highlighted the link between exercise intensity in which running pace was slower in tropical running compared to normal marathon. Therefore, both studies concluded that characteristics of physical activity such as endurance, intensity, duration plays a role on hydration status.

Environmental factors and hydration status

This review included two studies from Indonesia and one from Singapore, all highlighting the impact of heat on hydration. Suryadi et al. (2018) (30) found a strong negative correlation between heat stress and hydration among 48 bus station workers in Indonesia, with hydration decreasing as heat stress increased ($r = -0.799$, $p < 0.05$). Lestantyo & Suroto (2020) (31) reported that 80% of 70 workers experienced dehydration, excessive sweating, and heat-related symptoms like headaches and cramps in high-temperature conditions. Poon et al. (2022) (32) studied 38 male military personnel in Singapore, finding hyperthermia and lower serum osmolality at temperatures ranging from 36.7 to 38.7°C. These studies collectively show that high temperatures significantly affect hydration levels.

DISCUSSION

This scoping review examined how sociodemographic, anthropometric, lifestyle, and environmental factors influence hydration among Southeast Asian adults. Out of 24,176 papers, only 11 (0.05%) met the criteria, highlighting a lack of recent research on hydration in this region. The review identified key factors affecting hydration: gender, body fat and weight, water consumption, physical activity intensity and duration, and temperature. These findings provide valuable insights into hydration and its influencing factors in Southeast Asia.

This review included only one study on sociodemographic factors, limiting the generalizability of its findings. It noted that males were more hydrated than females due to differences in energy expenditure, muscle mass, and body fat. However, other factors like race, religion, marital status, education, and household income were not explored in Southeast Asia. This lack of attention to hydration issues is concerning, especially as disparities in rural and urban household incomes affect access to water and essential services, influencing water consumption (33,34). There is a pressing need to investigate sociodemographic factors beyond gender to address hydration challenges effectively. Next, the studies on body fat and weight in this review focused on pregnant women, limiting their applicability to the general population, as hormonal and physiological changes during pregnancy differ from those in non-pregnant adults. Additionally, key variables like BMI were not explored. While high body fat and weight are linked to health issues like obesity, type 2 diabetes, heart disease, and cancer, these topics have not been prioritized in hydration research. This review suggests that improving hydration to reduce fat percentage could help lower the risk of these diseases.

The reviewed studies focused on water intake as a contributor to hydration but overlooked other beverages and food sources, which also significantly affect hydration status (35,36). The Malaysian Dietary Guidelines recommend 1.5–2.0 L of plain water daily for adults (37). However, fluid intake varies globally, and food moisture contributes to total water intake depending on diet type and quantity. With limited research on dietary contributions to hydration in Southeast Asia, future studies are needed to address this gap. As for physical activity, the two studies included in this review focused on athletes, not non-athletic adults, making it difficult to generalize the relationship between physical activity and hydration status for the broader population. Athletes typically require more water to maintain euhydration, depending on their sport type and intensity (38). There is a lack of research on how physical activity affects hydration in sedentary adults. Nonetheless, it is important to educate people on the benefits of fluid intake during physical activity to improve performance and reduce potential risks. Temperature were mainly variables that explored in this review. This is might because of increased temperatures may alter regional water supply and demands, exacerbating the water scarcity situation (39). As discussed in the paper reviewed, the water intake was higher when the temperature is higher, indicates there were increase in thirsty stimulation and sweating. However, no studies explored other environmental factors, such as seasonal variation, weather, or humidity in relation to hydration. This review had several strengths, including following an a priori protocol and adhering to best practices. Broad search terms were used to address the inconsistent vocabulary in the literature. However, there were limitations. Only three databases were used, which might have led to overlaps. Additionally, the small number of papers reviewed for each factor made it challenging to determine definite relationships between the factors and hydration. Future research should include more databases and cover a longer time frame to address these limitations.

CONCLUSION

This scoping review highlights the limited recent research on hydration in Southeast Asia over the past five years. It identified several factors potentially linked to hydration status, including gender, body fat and weight, water intake, physical activity intensity and duration, and temperature. These findings can help nutritionists and health planners create targeted interventions to improve hydration among adults by addressing these factors.

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