



Review Article

Risk factors of hazardous alcohol use among adult males: A systematic review

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ABSTRACT

Background & Aim: Hazardous alcohol use is the most prevalent form of alcohol misuse, distinct from harmful or dependent use. This drinking behavior is a widespread practice among males, leading to a myriad of health and social challenges. Preventing hazardous alcohol use is crucial to reducing negative consequences and avoiding more severe forms of alcohol misuse. There has been no systematic review of its risk factors. This study aims to provide comprehensive information on hazardous alcohol use risk factors in adult males by systematically summarizing current evidence.

Methods & Materials: The protocol was registered with PROSPERO. PubMed, Scopus, Science Direct, EBSCOhost (APA PsycArticles), and Google Scholar were searched. The inclusion criteria were English-language observational studies published between 2012 and 2022 with male participants aged 18 to 65. Two reviewers carried out the quality assessment. A narrative synthesis was conducted to synthesize the findings.

Results: Out of 6,842 records yielded from the systematic search, 20 studies were included. All of these were cross-sectional studies with 19 out of 20 classified as high quality and one as moderate. The included studies identified several factors that increased the risk of hazardous alcohol use including lower education level, positive family history of alcohol use, smoking, high alcohol density neighborhoods, depressive symptoms, drinking motives, and negative life events. Little research has been done on other variables that may also play a role.

Conclusion: Several risk factors for hazardous alcohol use were identified. Future research, particularly longitudinal studies, is recommended to validate these findings.

Introduction

Alcohol misuse is a drinking pattern that can cause harm to both the user and others around them. Depending on its severity, alcohol misuse can be classified into three groups. Hazardous alcohol use (HAU) is defined as a pattern of drinking that increases the risk of negative outcomes for the user or others. Meanwhile, harmful alcohol use is a pattern of drinking that already has adverse physical or psychological impacts. The most severe drinking pattern is alcohol dependence, characterized by a strong desire for alcohol and impaired control of drinking (1). Alcohol misuse is a widespread problem in many countries, with HAU being the most prevalent. In the United States, 37.5% of people reported HAU, while 14.1% reported harmful alcohol use and dependence (2).

In Southeast London, 16.1% reported HAU, while 4.4% reported harmful use and alcohol dependence (3). Among Australian workers, 34.2% used alcohol hazardously, while 11.4% used it harmfully or were dependent (4).

Although HAU is considered the least severe level of alcohol misuse, it still poses a significant public health concern (5). People with HAU do not experience negative outcomes, so they may not normally receive health check-ups and outpatient care (6). As a result, they are at an increased risk of developing harmful use and alcohol dependence (7). Moreover, HAU is linked to a range of non-communicable diseases and mental health disorders (8). In addition, alcohol misuse caused economic burdens.

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For instance, a systematic review and meta-analysis estimated that annual alcohol-attributable costs per adult accounted for up to 2.6% of a country's Gross Domestic Product (9). Overall, men consume more alcohol and account for more alcohol-related harms than women (10). For instance, men used nearly three times as much pure alcohol per year compared to women (8). In addition, males were more likely to be arrested for driving, treated in hospitals, and died from alcohol-related harm (10). Therefore, prevention strategies that reduce alcohol use in men should be a priority.

Currently, many studies that explore the risk factors of alcohol misuse tend to focus on either male (11) or female samples exclusively (12). Previous studies have revealed that there are differences in alcohol use and factors related to alcohol use between genders (13, 14). For example, educational level was associated with alcohol use only in men, while marital status was associated with alcohol use only in women (13). Therefore, to avoid any potential confounding factors, a separate review of risk factors for alcohol use should be conducted for men and women.

To our knowledge, there has not been a systematic review of factors associated with HAU among men. Although there was a systematic review and meta-analysis of the prevalence of HAU in trauma-exposed occupations, the risk factors were not examined (15). Similarly, a scoping review on HAU and alcohol-related harm was conducted, but this study did not focus specifically on gender (16). To address this gap, we conducted a systematic review to identify the risk factors of HAU among men. The objective was to provide comprehensive information on HAU risk factors that could be utilized to develop interventions for preventing HAU.

Methods

The review protocol was registered with PROSPERO (CRD42023400212) and was reported following the Preferred Reporting for Items of Systematic Reviews and Meta-Analyses - PRISMA 2020 (17).

Search strategy

The search was conducted in PubMed, Scopus, ScienceDirect, EBSCOhost (APA PsycArticles), and Google Scholar, considering the population, exposure, and outcomes. The search syntax was formed as follows: (male* OR men) AND ("young adult*" OR "emerging adult*" OR "early adult*" OR "middle age*" OR adult*) AND (predict* OR factor* OR determinant*) AND ("hazardous alcohol use" OR "hazardous alcohol consumption" OR "hazardous drinking"). Supplementary File 1 offered a detailed description of the search terms in each database.

Eligibility criteria

Observational studies reporting factors associated with HAU in adult males aged 18 to 65 were included. All definitions and measurements of HAU used in the primary studies were accepted. In addition, studies must be written in English and published between 2012 and 2022. Studies that focused solely on students, older people, men who have sex with men, and prisoners were excluded since these populations might have unique risk factors that were not comparable to those of other adult males.

The selection of studies

All relevant studies were imported into EndNote 20 and duplicates were removed. One reviewer (TN) conducted the screening process twice and then independently checked by another reviewer

(NW). Any discrepancies were resolved through discussion for agreement (PU). Screening involved three steps (see Figure 1): excluding irrelevant titles and abstracts, searching for full-text articles, and reading full-text articles to identify those meeting inclusion criteria. Studies with a small percentage of participants outside the age range of 18 to 65 were included. Additionally, studies reporting factors related to HAU separately for males, regardless of the gender of the overall sample, were also included.

Quality assessment

The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for cross-sectional studies (Table 1) was used to assess potential bias in study design, conduct, and analysis (18). Two reviewers (TN and NW) independently evaluated the study quality, resolving discrepancies through discussion. Any unresolved disagreements were arbitrated by a third reviewer (PU). Studies scoring over 70% were deemed high quality, those between 50% and 70% were medium quality, and those below 50% were considered low quality (19).

Data extraction

An Excel spreadsheet was utilized for data extraction. The first sheet contained study details such as author names, publication year, design, location, participants, age, sample size, and HAU measurement. The second sheet focused on the relationship between HAU and associated factors, documenting both significant and non-significant associations. Adjusted odd ratios and multivariate findings took precedence over unadjusted odd ratios and bivariate results. The data extraction was carried out by TN, and cross-checked by NW, with any disparities resolved through discussion (PU).

Data synthesis

Following data extraction, the data was synthesized by a reviewer (TN) to

identify HAU risk factors, which were then independently validated by another reviewer (NW). In case of any disagreements, a consensus was reached with the help of a third reviewer (PU). Due to the heterogeneity of participants in the included studies, a meta-analysis of the data was not conducted. Instead, a narrative synthesis was conducted following the reporting guideline of Synthesis without meta-analysis (SWiM) (see Supplementary File 2) (20). The primary studies were categorized based on various factors associated with HAU, including demographic, occupational-related, social, and psychological factors. Studies reporting multiple factors were included in each relevant category.

We determined HAU risk factors based on previous studies (21, 22). A risk factor was identified if it showed a significant increase in HAU risk reported by at least two studies, without any study indicating the opposite (22), or if the ratio between positive and negative associations with HAU was at least four to one (21). Factors reported by only one study were considered to have limited evidence. At the same time, those showing both positive and negative associations (with a ratio not meeting the four-to-one criterion) were classified as controversial evidence. For clarity, tables were created to show the association between each factor and HAU.

Results

Identification and selection of studies

A total of 6,842 records were found in the database. After removing 1,069 duplicate records, the remaining 5,773 records were screened for titles and abstracts. Out of these, 5,440 reports were excluded as their titles and abstracts were irrelevant. The full text of 333 studies was searched, out of which 6 studies were eliminated. As a result, 327 studies were eligible for consideration, out of which 307 studies were excluded. Finally, 20 studies were included.

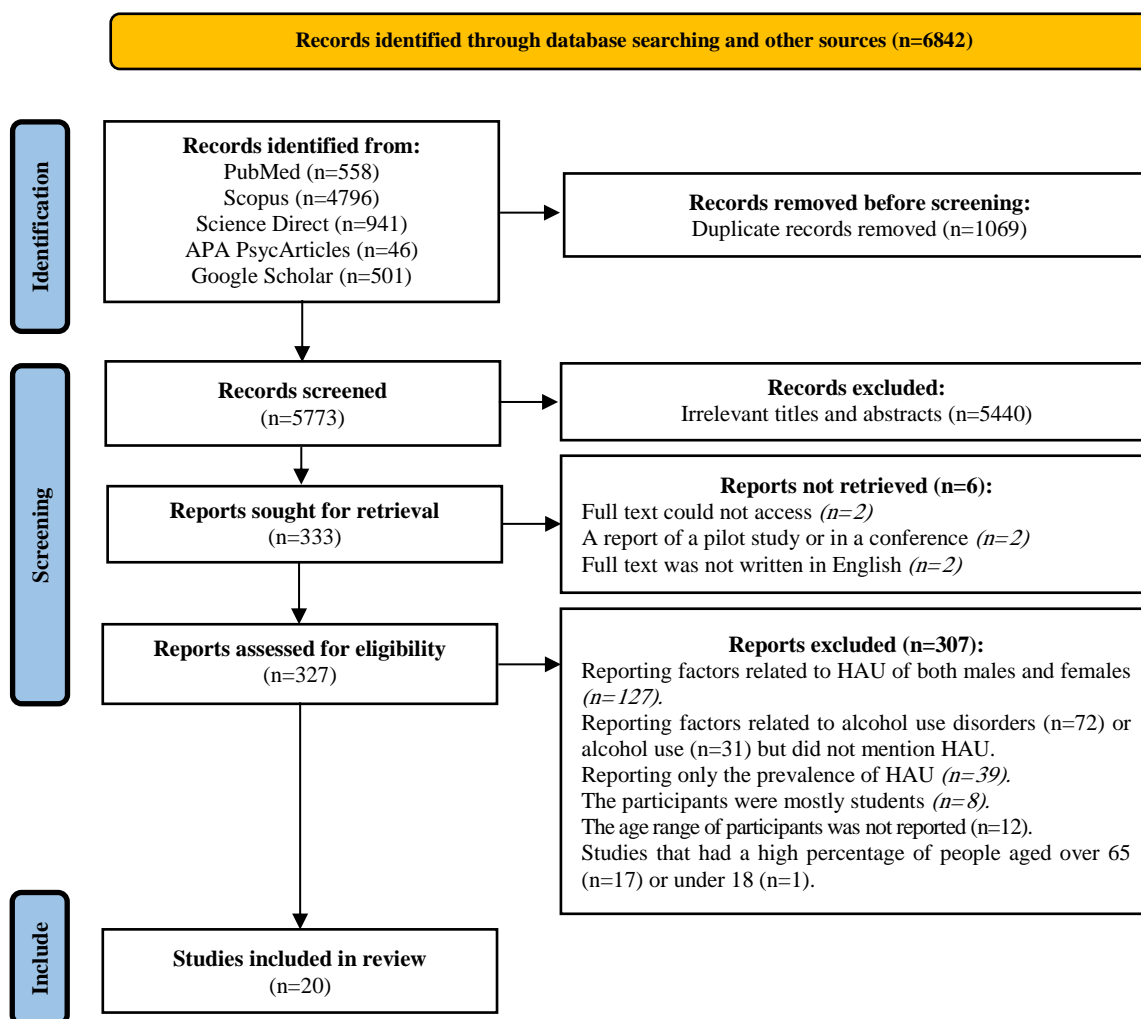


Figure 1. The PRISMA flow diagram of studies included in the systematic review

Characteristics of included articles

The included studies are summarized in Table 1. All these studies were cross-sectional studies. They were conducted in various regions with seven in Asian countries, five in the United States, four in

Europe, three in Africa, and one in South America. Nine of these studies were conducted solely among men. Meanwhile, eleven studies included both genders (separately reporting factors associated with HAU among males).

Table 1. Description of the included studies

First author, year	Study design (Data collection period)	Country	Participants (Mean age ± SD)	Sample size	Measurement of HAU (Cut point)
Abikoye, 2012	CSS (NR)	Southwest Nigeria	Adult males (27.54±5.35)	1,315	AUDIT (8-15)
Åhlin, 2015	CSS (February 2011-January 2013)	Sweden	Patients diagnosed with depression* (43.0±12.8)	1566 (men=533)	AUDIT (≥8)
Ansoleaga, 2013	CSS (April-July 2010)	Chile	Workers* (NR)	3010 (men=1956)	AUDIT (≥6)
Blair, 2020	CSS (August 2017-March 2018)	The USA	Cisgender military men (Median age: 26)	292	AUDIT-C (≥4)
Bosque-Prous, 2015	CSS (2010-2012)	16 European countries	50-64-year-old residents* (NR)	26017 (men=11457)	AUDIT-C (≥5)
Chen, 2018	CSS (June-November 2013)	Taiwan	Adult male immigrants (43.47±11.67)	185	AUDIT (≥8)
Deguchi, 2018	CSS (2013)	Japan	Teachers* (46.9±10.9 for males)	1199 (men=723)	Gram Ethanol/week (≥280g)

First author, year	Study design (Data collection period)	Country	Participants (Mean age ± SD)	Sample size	Measurement of HAU (Cut point)
Hanwella, 2013	CSS (May 2009)	Sri Lanka	Male Navy Special and Regular Forces (27.63±5.02)	671	AUDIT (≥8)
Houdmont, 2022	CSS (2015)	The UK	Police officers* (42.56±7.42)	1200 (men=707)	AUDIT-C (≥5)
Jang, 2019	CSS (January 2016 - November 2017)	Korea	Male drinkers (35.6±11.3)	295	Standard drinking (>21/week or >7/day)
Kinjo, 2018	CSS (July 2013)	Japan	Japanese adults* (46.4 for males)	2696 (men=1193)	Gram alcohol/week (≥210g)
Kitua, 2019	CSS (August 2018)	Tanzania	Male motorcycle Taxi Riders (NR)	210	AUDIT (≥8)
Lee, 2016	CSS (NR)	The USA	Hispanics* (43.0±12.24 for males)	100 (men=67)	AUDIT (≥8)
Lopez, 2021	CSS (NR)	The USA	People working in the STEM fields* (37.24±7.96)	1228 (men=614)	AUDIT-C (≥4)
Mahmood, 2017	Cross-sectional data from a cohort study (1993-2014)	Norway	Medical doctors* (43.0±2.8)	450 (men=264)	AUDIT-9 items (≥6)
Rose, 2021	CSS (NR)	India	Men in the tribal population (37.56±10.92)	1200	AUDIT (≥8)
Scott, 2013	Cross-sectional data from a cohort study (NR)	The USA	Veterans* (39.1±10.3 for males)	634 (men=290)	AUDIT (≥8)
Theall, 2019	Cross-sectional data from a cohort study (October 2015-October 2017)	The USA	In-care people living with HIV* (NR)	358 (men=247)	AUDIT (≥8)
Tran, 2019	CSS (April-May 2014)	Republic of the Congo	Military men in the Armed Forces (37.2±7.0)	703	AUDIT (≥8)
Tse, 2015	CSS (NR)	Hong Kong	Male Indian and Pakistani migrants (NR)	202	AUDIT (≥8)

*Both genders; ^{NR} Not report; ^{CSS} Cross-sectional study
^{STEM} Science, Technology, Engineering, and Mathematics
^{AUDIT} Alcohol Use Disorders Identification Test
^{AUDIT-C} Alcohol Use Disorders Identification Test-Consumption

Out of the 20 studies included, 10 reported the average age of male participants, which ranged from 27.54 to 46.90 years old. Four studies reported the average age of both genders, which ranged from 37.24 to 43.0 years old. One study reported the median age of men as 26 years old, while five studies did not report the mean age of participants. The sample size of male participants ranged from 67 to 11457 with a total of 23,124 males who were included.

The HAU measurement was based on various criteria, including AUDIT scores in 13 studies, AUDIT-C in 4, ethanol consumption in 2, and standard drinking in 1. Various HAU cut-off points were observed across studies, including AUDIT scores ≥8 (10 studies), AUDIT scores ≥6 (2 studies), AUDIT scores ranging from 8 to 15 (1 study), AUDIT-C scores ≥5 (2 studies), AUDIT-C scores ≥4 (2 studies),

weekly ethanol consumption of ≥280 grams (1 study), weekly alcohol consumption of ≥210 grams (1 study), and consumption of more than 21 standard drinks per week or 7 per day (1 study).

Table 2 shows the quality assessment of the studies included in this research. Out of the 20 studies, 19 were classified as high quality, while one was considered moderate quality. Most of the studies (18/20) clearly defined the criteria for selecting the participants. All the studies (20/20) accurately described the subjects and settings, used standard measurements to validly and reliably measure the factors associated with HAU and the outcomes, and used appropriate statistical analysis to analyze the outcome of these studies. However, only three studies reported confounding factors. Among these, only one study described the strategies to address these confounding factors.

Table 2. Risk of bias assessment of each included study (n=20)

First author, year	Criteria of JBI								Overall appraisal	Quality
Abikoye, 2012	No	Yes	Yes	Yes	No	No	Yes	Yes	5/8	Medium
Ählin, 2015	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Ansoleaga, 2013	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	7/8	High
Blair, 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8/8	High
Bosque-Prous, 2015	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Chen, 2018	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Deguchi, 2018	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Hanwella, 2012	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Houdmont, 2022	No	Yes	Yes	Yes	Yes	No	Yes	Yes	6/8	High
Jang, 2019	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Kinjo, 2018	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Kitua, 2019	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Lee, 2016	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Lopez, 2021	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Mahmood, 2017	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Rose, 2021	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Scott, 2013	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Theall, 2019	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Tran, 2019	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High
Tse, 2015	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6/8	High

Yes low risk of bias; No high risk of bias

Factors associated with HAU among the included studies

*** Demographic factors**

The relationship between demographic factors and HAU is summarized in Table 3. This

category included 10 factors. Among these, lower education level, a positive family history of alcohol use, and smoking were classified as risk factors for HAU, while other factors were controversial or limited evidence.

Table 3. The association between demographic factors and HAU

Factors/First author, year	Abikoye, 2012	Ansoleaga, 2013	Blair, 2020	Chen, 2018	Deguchi, 2018	Hanwella, 2013	Jang, 2019	Kinjo, 2018	Kitua, 2019	Rose, 2021	Scott, 2013	Theall, 2019	Tran, 2019	Tse, 2015
Age	-		x		+	x						x	x	x
<40		+						-						
≥40		x						x						
Marital status											x			
Single		+			-			-	x				x	x
Bereaved or divorced						x		+	x				x	
Married						x			x					
Education level	-									x	x			x
Less than high school						x		+	-			+	+	
High school or higher			x			x						x		
Income					+									x
Low														
High										+				
Working status														
Unemployment		+												x
Being employed														
Self-employment								x						
Social economic status (SES)														
Low SES		+												
High SES				+										
Occupations														
Construction and Industry		+												
Agriculture		+						x						
Transport		x						x						
Labor		x												x
Sales work and service work								x						x
Clerk and manager								x						
Personal history of alcohol use														
Younger age at first blackout							+							
Age at first drink							x							
Family history of alcohol use									+	+	+			
Smoking						+					+			

(+) Increase the risk of HAU; (-) Decrease the risk of HAU; (x) No association.

*** Risk factors of HAU**

Education level: Ten studies out of 20 investigated this factor, but only five studies reported a significant association. Among these, four studies found higher rates of HAU among individuals with lower education levels (23-26), while one study showed the opposite trend (27).

Family history of alcohol use: Three studies out of 20 examined this factor and reported a significant association. They found that having a positive family history of alcohol use increased the likelihood of HAU (24, 27, 28).

Smoking: Two studies out of 20 investigated the relationship between smoking and HAU, both indicating that smoking increased the risk of HAU (28, 29).

***Factors with limited evidence or controversial**

Age of participants: Eleven studies out of 20 investigated this factor, but only six studies reported a significant association. Three studies indicated a higher involvement of younger individuals in HAU (23, 30, 31), while three others found older individuals to be more involved (24, 27, 32).

Marital status: Eight studies out of 20 examined this factor, but only three studies found a significant association. One study indicated that being single increased the risk of HAU (30), while two others found the opposite (24, 32). Furthermore, bereaved or divorced status increases the risk of HAU (24).

Income: Four studies out of 20 examined this factor; however, only three studies reported a

significant association. One study found that low family income was associated with a higher risk of HAU (33). However, another study revealed the opposite (24). A third study found HAU to be more prevalent among those with higher incomes (28).

Working status: Four studies out of 20 explored this factor, whereas only three studies reported a significant association. Unemployment was reported to increase the risk of HAU in one study (30), while another indicated the opposite (24). Additionally, being employed has been reported to decrease the risk of HAU (27).

Social economic status (SES): Only two studies out of 20 examined this factor, with both low SES (30) and high SES (33) being associated with an increased risk of HAU.

Occupations: Three studies out of 20 examined this factor, but only one study reported a significant association. Specifically, individuals employed in the construction, industry, and agriculture sectors were found to have a higher risk of HAU (30).

Personal history of alcohol use: A study reported that younger age at first blackout increased the risk of HAU (34).

*** Occupational-related factors**

Table 4 presents the relationship between occupational-related factors and HAU. This category consisted of four factors, but none of them were identified as a risk factor for HAU. In contrast, these factors showed limited evidence or controversy.

Table 4. The association between occupational-related factors and HAU

Factors/First author, year	Ansoleaga, 2013	Blair, 2020	Deguchi, 2018	Hanwella, 2013	Houdmont, 2022	Lopez, 2021	Scott, 2013	Tran, 2019
Job quality								
Longer position tenure	-							
Unskilled work and precarious contract	+							
Higher position at work			+					
Shift work	x							
Job control			x		x			
Job stressors								
Effort-reward imbalance	+							
Low decision latitude, high psychological demands, and job strain	x							
Strained relationships at work			x		x			
Role ambiguity			x		+			
Workload			x					
Work-life balance								
Higher work-life balance						-		
Work-family interference	x							
Family-work conflict, work-family conflict						x		

Factors/First author, year	Ansoleaga, 2013	Blair, 2020	Deguchi, 2018	Hanwella, 2013	Hondmont, 2022	Lopez, 2021	Scott, 2013	Tran, 2019
Military-related factors								
Navy		x						+
Special Forces				x				
Army and Marine Corps		x						
Air Force and Gendarmerie								x
Soldier/corporal								+
Middle and Senior enlisted		x						
Commissioned and Non-commissioned officer		x		x				x
Combat exposure							x	

(+) Increase the risk of HAU; (-) Decrease the risk of HAU; (x) No association

Job quality: Three studies out of 20 explored this factor, but only two studies reported a significant association. Longer job tenure reduced HAU risk, while unskilled work and precarious contracts increased the risk (30). Additionally, Japanese teachers in higher positions, like Vice-principals and Principals, were more likely to have HAU (32).

Job stressors: Three studies out of 20 examined this factor; however, only two studies reported a significant association. Effort-reward imbalance (30) and role ambiguity (35) were found to increase the risk of HAU.

Work-life balance: Two studies out of 20 investigated this factor, whereas only one study reported a significant association.

Individuals who maintained a better work-life balance were at a lower risk of HAU (36).

Military-related factors: Four studies out of 20 investigated this factor but only one study reported a significant association. Specifically, male Navy personnel and males with the rank of soldier/corporal in the Armed Forces were more likely to engage in HAU (26).

*** Social factors**

Table 5 shows the association between social factors and HAU. This category included four factors. Among these, only one factor was classified as a risk factor for HAU, while other factors showed limited evidence or controversy.

Table 5. The association between social factors and HAU

Factors/First author, year	Abikoye, 2012	Ansoleaga, 2013	Blair, 2020	Bosque-Proux, 2015	Chen, 2018	Deguchi, 2018	Lee, 2016	Rose, 2021	Scott, 2013	Theall, 2019
Social network characteristics										
A higher number of social networks	+									
Having a drinking social network	+									
Younger age of members of social network	+		x							
Lower education and more unemployment status of members of social network	+									
Network size and network density			x							
Contextual factors										
More restrictions on alcohol advertising				-						
High alcohol-density neighborhoods								+		+
GDP, GEM, the unemployment rate				x						
Other alcohol control policies				x						
Neighborhood poverty										x
Cultural-related factors										
Acculturation							x			
Having a wet drinking culture and a low level of adaptation					+					
Having a wet drinking culture and a high level of adaptation					x					
Having a dry drinking culture					x					
Social support										
Low social support		+				x			x	
Moderate social support						-				
High social support			+							

(+) Increase the risk of HAU; (-) Decrease the risk of HAU; (x) No association

GDP Standardized gross domestic product per capita; GEM Standardized gender empowerment measure

*** Risk factors of HAU**

Contextual factors: Three studies out of 20 explored this factor and reported a significant association. High-density alcohol neighborhoods were linked to increased HAU risk in two studies (25, 28). Moreover, a study across 16 European nations found that having more restrictions on alcohol advertising reduced the risk (37).

*** Factors with limited evidence or controversial**

Social network characteristics: Two studies out of 20 examined this factor but only one study reported a significant association. This study found that a higher number of social networks, particularly those with drinking associations and comprising younger, less educated, and unemployed individuals, increased the risk of HAU (23).

Cultural-related factors: Two studies out of 20 investigated this factor but only one study

reported a significant association. Among male immigrants in Taiwan, the risk of HAU was higher among people with a wet drinking culture and a low level of adaptation to the host culture (33).

Social support: Four studies out of 20 examined this factor but only three studies reported a significant association. Both low social support (30) and high social support (38) were found to increase the risk of HAU. However, a study of Japanese teachers revealed that moderate social support reduced the risk (32).

*** Psychological factors**

Table 6 shows the details of the association between psychological factors and HAU. This category consisted of five factors. Among these, depressive symptoms, drinking motives, and negative life events were considered risk factors for HAU, whereas other factors showed controversial or limited evidence.

Table 6. The association between psychological factors and HAU

Factors/First author, year	Abikoye, 2012	Áhlin, 2015	Ansoleaga, 2013	Blair, 2020	Hanwella, 2013	Houdmont, 2022	Jang, 2019	Mahmood, 2017	Rose, 2021	Scott, 2013	Tran, 2019	Tse, 2015
Mental disorders												
Having common mental disorders					+							
Depressive symptom		+	+									x
PTSD				+						x	x	
Assaultive trauma										+		
Receiving mental health services				-								
Drinking motives												
Coping motives							+					+
Social motives							+					+
Enhancement motives							x					+
Impulsiveness												
Non-planning impulsiveness							+					
Motor impulsiveness							x					
Perception												
Perceived discrimination												+
Perceived drinking norms	+											
Negative life events												
			x					+	x	+		

(+) Increase the risk of HAU; (-) Decrease the risk of HAU; (x) No association

*** Risk factors of HAU**

Mental disorders: Six studies out of 20 investigated this factor but only five studies reported a significant association. Depressive symptoms were linked to increased HAU risk in two studies (30, 39). Furthermore, common mental disorders (29), PTSD (38), and assaultive trauma (31) were found to increase the risk.

Drinking motives: Two out of the 20 studies examined the association between drinking motives and HAU. These studies reported that coping and social motives were more likely to increase the risk of HAU (34, 40), while one study found enhancement motives to be a risk factor for HAU (40).

Negative life events: Four studies out of 20 investigated this factor but only two studies reported a significant association.

Among medical professionals and veterans, negative life events (41) or interpersonal conflicts (31) increased the risk of HAU.

*** Factors with limited evidence or controversial**

Impulsiveness: Only one study out of 20 examined this variable. The findings showed that non-planning impulsiveness increased the risk of HAU (34).

Perception: Only two studies out of 20 investigated this variable. In particular, perceived drinking norms (23) and perceived discrimination (40) increased the risk of HAU.

Receiving mental health services: Only one study out of 20 reported that receiving mental health services in the past year decreased the risk of HAU (38).

Discussion

We found some important factors that increase the risk of HAU in adult males. Our study is the first to look at these factors systematically. These findings offer valuable insights into the current knowledge of HAU risk factors and provide significant recommendations for future research.

Characteristics of the included studies

In total, twenty cross-sectional studies with 23,124 adult males were included. It suggests that the included studies were primarily interested in describing the HAU risk factors rather than explaining them. Although cross-sectional studies do not directly solve HAU, they offer valuable insights for developing effective interventions (42).

The included studies recruited a variety of male populations with different occupations. This implies that HAU is prevalent across a wide range of cultures and occupations, consistent with a previous study that found HAU in a variety of professional categories (15).

The sample sizes of the included studies varied greatly, with the smallest being 67 (43) and the largest being 11457 (37). A sample size that is too small may not accurately reflect the population (44).

Therefore, the inconsistent findings of HAU risk factors in this review may be explained by the varying sample sizes. The average age of the participants was between 26 and 47 years old. This indicates that the individuals involved in this review were adults and middle-aged.

AUDIT emerged as the predominant measurement tool. It assesses alcohol consumption and detects potential alcohol use disorders (45). The WHO recommends using a specific cut-off score to assess HAU (AUDIT=8-15) (1). This systematic review supported that since its first publication, AUDIT has been used in various countries (46). In addition, a shorter version of the AUDIT, known as AUDIT-C, was frequently used. This questionnaire was administered among individuals working in STEM fields (36), police officers (35), military personnel (38), and middle-aged adults (37), indicating its common use in populations with potentially elevated HAU prevalence.

HAU definitions varied across studies, with eight different cut-off scores observed. Most studies employed a broad range of scores, like $AUDIT \geq 8$, while only one used a specific cut-off (AUDIT=8-15). These findings corresponded to a systematic review of AUDIT's cut-off scores, which reflected cultural differences (47). However, wider score ranges may indicate not only HAU but also harmful use and alcohol dependence. Hence, adhering to specific cut-off scores per WHO guidelines is advisable.

Factors associated with HAU among adult males in the included studies

This systematic review comprised high-quality studies, making the identified risk factors for HAU more accurate (48). Several factors were identified as more likely to increase the risk of HAU including lower education level, a positive family history of alcohol use, smoking, high alcohol density neighborhoods, depressive symptoms, drinking motives, and negative life events. The details of these findings are discussed below.

When it comes to demographic characteristics, having a lower education can

increase the risk of HAU, as indicated by four studies. This aligns with a previous scoping review which found a strong correlation between low education levels and HAU (16). Moreover, three studies reported that having a positive family history of alcohol use increases the likelihood of HAU (24, 27, 28). No study showed the opposite. This supports the idea that familial alcohol use may increase the risk of HAU (49). Additionally, two studies reported that people who used cigarettes were more likely to engage in HAU (28, 29). The finding was consistent with the previous review, which identified smoking as a significant risk factor for HAU (50).

The evidence remains controversial or is limited regarding other demographic factors. For example, both younger and older participants were found to be at risk of HAU, indicating that HAU can affect individuals of all ages. A possible explanation is that other contextual factors, with disparities between high-income and low-income countries, may influence the relationship between participant age and HAU (51). The findings aligned with a previous scoping review, which highlighted the complex relationship between participant age and HAU (16). Additionally, the relationship between marital status, income, working status, socioeconomic status, and occupation has been a topic of disagreement due to conflicting findings.

For occupational-related factors, many factors were investigated but none were classified as risk factors for HAU. Each factor was only studied once, so no definitive conclusions can be drawn. For example, unskilled work and precarious contracts (30), a higher position at work (32), and role ambiguity (35) were reported as more likely to increase the risk of HAU. Although these findings were based on just one study each, they seemed congruent with previous systematic reviews. For instance, previous studies revealed that job stressors such as longer working hours were more likely to increase alcohol use (52, 53). Similarly, male-dominated occupations, such as police officers and military personnel, showed higher levels of HAU (15). In conclusion,

the findings of this study contributed to the current knowledge of the association between occupational-related factors and alcohol use.

Regarding social factors, the findings highlighted the importance of the neighborhood alcohol environment for HAU. Specifically, high alcohol density neighborhoods were the risk factor for HAU (25, 28). It suggests that alcohol availability and accessibility might increase HAU. In contrast, there is limited evidence or ongoing debate regarding other social factors. For example, one study suggested that having a habit of drinking and struggling to adapt to the host culture increased the risk of HAU (33). This finding implied that a lack of adaptation may lead to increased stress and psychological issues, ultimately resulting in higher alcohol use. However, another study showed the opposite as a lack of adaptation was not associated with HAU (43).

Finally, among psychological factors, having depressive symptoms, drinking motives, and negative life events were considered risk factors for HAU. For example, two studies showed that individuals experiencing symptoms of depression were at a higher risk for HAU (30, 39). This might be because individuals with such disorders might turn to alcohol as a form of self-medication. These findings were consistent with a previous systematic review that found a positive association between depression and alcohol use (54). This finding supported the existing literature on the prevalence of co-occurring disorders and alcohol use.

Similarly, drinking motives such as coping motives and social motives were found to be risk factors for HAU (34, 40). It suggests that adult males with HAU were more likely to drink alcohol to regulate negative emotions and to improve parties or gatherings. This finding is supported by a systematic review of qualitative studies involving middle-aged men, who reported drinking to relax, socialize, develop, and sustain friendships as their reasons for alcohol use (55). Moreover, two studies showed a positive association between negative life events and HAU (31, 41).

These findings suggested that people may turn to alcohol to cope with such events, confirming previous findings that coping motives were the risk factor for HAU. These results are consistent with other studies (56, 57).

In addition, other psychological factors such as having common mental disorders, PTSD, assaultive trauma, non-planning impulsiveness, perceived discrimination, and perceived drinking norms showed a positive association with HAU. However, as there were not enough studies available, we could not make a definitive conclusion about the association with HAU.

Limitation

Our inclusion criteria were limited to English publications from 2012 to 2022, possibly introducing selection bias. Additionally, some studies with a small percentage of participants outside the 18 to 65 age range potentially influence results. The measurement of HAU varied among studies, with some employing a broad range of scores instead of a specific cut-off, possibly encompassing other alcohol use disorders.

Implications

For HAU interventions, consider tailoring programs based on education levels and involving family members. Effective strategies include addressing depression, coping with negative life events, modifying

drinking motives, and tackling smoking. Implementing policies to regulate alcohol availability and advertising could also mitigate HAU risk.

Future research should prioritize investigating identified risk factors for HAU and explore longitudinal associations. Using specific cut-off scores to define HAU instead of broad ranges is recommended for more precise evaluations.

Conclusion

The included studies reported a wide range of factors related to HAU. Although it was challenging to draw definite conclusions, certain factors should be given more attention, as they are more likely to increase the risk of HAU including lower education level, a positive family history of alcohol use, smoking, high alcohol density neighborhoods, depressive symptoms, drinking motives, and negative life events.

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This paper is part of the dissertation of Mr. Trieu Van Nhat, a Ph.D. student in the Faculty of Nursing at Chulalongkorn University, Thailand entitled “The effects of an intervention-based protective behavioral strategies on alcohol use among adult men with hazardous alcohol use in Vietnam: A randomized controlled trial”.

Conflict of interest

The authors declare no conflict of interest.

Supplementary file 1. Searching strategy

I. PubMed (date of searching: 13/2/2023)

((male*[All Fields] OR (men[MeSH Terms] OR men[All Fields])) AND ("young adult*[All Fields] OR "emerging adult*[All Fields] OR "early adult*[All Fields] OR "middle age*[All Fields] OR "adult*[All Fields]) AND (predict*[All Fields] OR factor*[All Fields] OR determinant*[All Fields]) AND ("hazardous alcohol use"[All Fields] OR "hazardous alcohol consumption"[All Fields] OR "hazardous drinking"[All Fields])) AND ((english[Filter]) AND (2012:2022[pdat]))

II. Scopus (date of searching: 13/2/2023)

((ALL (male*) OR ALL (men))) AND ((ALL ("young adult*") OR ALL ("emerging adult*") OR ALL ("early adult*") OR ALL ("middle age*") OR ALL (adult*))) AND ((ALL (predict*) OR ALL (factor*) OR ALL (determinant*)) AND ((ALL ("hazardous alcohol use") OR ALL ("hazardous alcohol consumption") OR ALL ("hazardous drinking")) AND (LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO(PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR, 2012)) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (DOCTYPE, "ar"))

III. ScienceDirect (date of searching: 13/2/2023)

(male OR men) AND ("young adult" OR "emerging adult" OR "early adult" OR adult) AND ("hazardous alcohol use" OR "hazardous alcohol consumption" OR "hazardous drinking"). Filtered: years: 2012-2022, Article type: research articles

IV. EBSCOhost (APA PsycArticles) (date of searching: 13/2/2023)

S1	TX male* OR TX men
S2	TX "young adult*" OR TX "early adult*" OR TX "emerging adult*" OR TX "middle age*" OR TX adult*
S3	S1 AND S2
S4	TX "predict*" OR TX "factor*" OR TX "determinant"
S5	TX "hazardous alcohol use" OR TX "hazardous alcohol consumption" OR TX "hazardous drinking"
S6	TX S3 AND S4 AND S5
Limiters	Full Text; Date Published: 20120101-20221231 Narrow by Language: - English

V. Google Scholar (date of searching: 13/2/2023)

With exact phrase	"hazardous alcohol use", "hazardous alcohol consumption", "hazardous drinking"
With at least one of the words	"male*", "men"
without the words	"men who have sex with men", "MSM"
Where my words occur	Anywhere in the article
Return articles dated between	2012-2022

Supplementary file 2. Prefer Synthesis without Meta-analysis (SWiM) Reporting Items

SWiM is intended to complement and be used as an extension to PRISMA		
Reporting item	Item description	Reported on Page #
Methods		
Grouping studies for synthesis	1a) Provide a description of, and rationale for, the groups used in the synthesis (e.g., groupings of populations, interventions, outcomes, study design)	4
	1b) Detail and provide rationale for any changes made subsequent to the protocol in the groups used in the synthesis	NA
Describe the standardized metric and transformation methods used	Describe the standardized metric for each outcome. Explain why the metric(s) was chosen, and describe any methods used to transform the intervention effects, as reported in the study, to the standardized metric, citing any methodological guidance consulted	4
Describe the synthesis methods	Describe and justify the methods used to synthesize the effects for each outcome when it was not possible to undertake a meta-analysis of effect estimates	4
Criteria used to prioritize results for summary and synthesis	Where applicable, provide the criteria used, with supporting justification, to select the particular studies, or a particular study, for the main synthesis or to draw conclusions from the synthesis (e.g., based on study design, risk of bias assessments, directness in relation to the review question)	NA
Investigation of heterogeneity in reported effects	State the method(s) used to examine heterogeneity in reported effects when it was not possible to undertake a meta-analysis of effect estimates and its extensions to investigate heterogeneity	4
Certainty of evidence	Describe the methods used to assess the certainty of the synthesis findings	NA
Data presentation methods	Describe the graphical and tabular methods used to present the effects (e.g., tables, forest plots, harvest plots). Specify key study characteristics (e.g., study design, risk of bias) used to order the studies, in the text and any tables or graphs, clearly referencing the studies included	4
Results		
Reporting results	For each comparison and outcome, provide a description of the synthesized findings, and the certainty of the findings. Describe the result in language that is consistent with the question the synthesis addresses, and indicate which studies contribute to the synthesis	8-14
Discussion		
Limitations of the synthesis	Report the limitations of the synthesis methods used and/or the groupings used in the synthesis, and how these affect the conclusions that can be drawn in relation to the original review question	NA

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