Original Article

Global epidemiology of cannabis use disorders and its trend from 1990 to 2019: Benchmarking analysis of the global burden of disease study

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Abstract

Introduction: Cannabis is one of the most widely used psychoactive substances globally, with an increasing trend in its legalization for both medical and recreational purposes in various countries. While cannabis offers potential therapeutic benefits, its regular use can lead to the development of Cannabis Use Disorders (CUDs). Understanding the epidemiology of CUDs is crucial in assessing the public health burden associated with cannabis use. **Methods:** Epidemiological parameters of CUDs were assessed using the Global Burden of Disease (GBD) methodology across different age-groups, years, sexes, and locations worldwide from 1990-2019. **Results:** Globally, for both sexes combined, prevalent cases of CUDs increased steadily from 17.1 million(95%UI=12.7-22.8million) in 1990 to 23.8-million(95%UI=17.8-30.9 million) in 2019. All age-adjusted highest number of incidence observed in High-Income-North-America(HINA)(121/100,000), followed by Australasia(100/100,000), Oceania(83.97/100,000), Tropical Latin America(69.59/100,000). Globally, age-standardized disability-adjusted life years rate(ASDR) observed higher in HINA, followed by Australasia, and Western-Europe. In male, all-age incidence counts increased from 1.7 million(95%UI=1.3-2.4million) in 1990 to 2.4 million(95%UI=1.8-3.2 million) in 2019. The highest annual percentage of change in age-standardized incidence rate(ASIR)

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Received: 18-05-2023 **Revised:** 16-07-2023
Accepted: 01-08-2023 **Published:** 04-04-2024

Access this article online

Quick Response Code:

Website: http://journals.lww.com/JFMPC

DOI: 10.4103/jfmpc.jfmpc_824_23

How to cite this article: Shah K, Farwa UE, Vanaparti A, Patel S, Kanumuri M, Vashishth O, *et al*. Global epidemiology of cannabis use disorders and its trend from 1990 to 2019: Benchmarking analysis of the global burden of disease study. J Family Med Prim Care 2024;13:881-9.

was found in East-Asia (22%) followed by Middle-East and North-Africa(MENA)(15%). The age group of 15-24 years exhibited the highest burden of CUDs. **Conclusion:** The widespread occurrence of CUDs on a global scale poses a substantial challenge to public health. Understanding the impact of CUDs and implementing evidence-based interventions is crucial in mitigating the associated individual, societal, and economic burdens. Continued research, collaboration, and knowledge dissemination are essential to inform policies, prevention efforts, and treatment strategies aimed at addressing CUDs on a global-scale.

Keywords: Cannabis burden, cannabis use disorder, cannabis use disorder statistics, epidemiology, marijuana

Introduction

Cannabis is the third most frequently used psychoactive substance worldwide, stemming from the cannabis sativa plant. It contains 60 distinct cannabinoids. In 2020, an estimated 209 million people, or 4.9% of the global population aged 15–64, used cannabis at least once in the previous year.[1] Of these, 23.8 million people were estimated to have cannabis use disorders (CUDs) in 2020.

Cannabis, the fourth psychotropic compound to be decriminalized, is subjected to varying legal regulations both internationally and within the United States. The strength of cannabis has risen over the past few decades, and this could be one of the reasons for the higher occurrence of negative outcomes associated with cannabis use.[2] State legalization of cannabis has increased cultivation demand, selective breeding for stronger strains, and competition in the cannabis dispensary industry. Cannabis is the plant material or extracts that contain 9-tetrahydrocannabinol (THC), which can produce a desire for repeated use and lead to CUDs. THC is detected in a viscous secretion present on the blooming apexes and upper foliage of the female cannabis plant, and it exerts its effects on a distinct class of cannabinoid receptor known as CB1, which is expressed in the brain, lungs, liver, and kidneys. On the other hand, CB2 receptors, which are more abundant in the immune hematopoietic cells, are also activated by THC.[3] Although a wealth of evidence points to various adverse effects of heavy cannabis consumption, including medical and systemic complications,[4] low quality of life,[5] negative emotionality,[6,7] psychiatric disorders,[8] and cognitive impairment,[9] underlying mechanisms causing long-term effects of cannabis on central nervous system remain unclear.[10] Primary care physicians play a crucial role in screening and assessing patients for cannabis use and related disorders. They should routinely ask about cannabis use during patient evaluations and be prepared to assess potential symptoms and signs of cannabis-induced disorders. This may involve assessing substance use patterns, withdrawal symptoms, mental health changes, and physical complications.

Over the past three decades, there has been a marked upswing in the incidence of CUDs, with a notable elevation of 39%, standing as the second most formidable spike in affliction frequency, surpassed solely by the magnitude of opioid use disorder (OUD), when compared to the incidence of other substance induced conditions, such as amphetamine and cocaine use disorder.[11] This study aimed to investigate the burden of CUDs at global, regional, and national levels in 204 countries and territories from 1990 to 2019. We examined the age-sex-year-location-specific burden of CUDs using estimates from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019.[11-14] We also investigated morbidity resulting from CUDs by means of disability-adjusted life years (DALYs), a comprehensive measure of disease burden that considers the incapacitation engendered by the malady.

Materials and Methods

Study design and data sources

The global burden of disease study 2019 (GBD 2019) estimates were generated for 369 causes of non-fatal burden, 87 risk factors, and 286 causes of death.[11-14] Relative to the prior estimates from GBD 2017, the GBD 2019 comprises an additional nine countries that have been categorized into 21 regions and seven super-regions. The diagnostic criteria for CUDs were based on the Diagnostic and Statistical Manual of Mental Disorders (DSM) and International Classification of Diseases (ICD-10)[15] (DSM: 304.30; ICD: F12.2).[16] The study investigated the burden of disease attributable to CUDs in 204 countries and their territories from 1990 to 2019, using the GBD, injuries, and risk factors study 2019, data analyzed by age, sex, year, region, and geographical location.[11] The GBD 2019 publications provide detailed information on the GBD estimating framework and the computation of all the indicators.[11-14]

In GBD 2019, input data from multiple sources such as verbal autopsy, vital registration, and sources of any use information including United Nations Office of Drugs and Crime reports (UNODC), government reports, surveys, news reports, published literature based on primary data using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline, and Meta-analyses of Observational Studies in Epidemiology (MOOSE) methodology was used to generate CUDs burden for GBD estimates. The GBD 2017 utilized an all-encompassing logarithmic ratio to calibrate regular cannabis use data into cannabis dependency estimations. In contrast, the more recent GBD 2019 adopted distinct logit-difference case definition adjustments for adults and adolescents. Every newly incorporated data source is accorded a distinctive identifier and integrated into the Global Health Data Exchange (GHDx).

Estimation method/model

The GBD age-specific ratios of prevalence, incidence, and DALYs were recorded for every 100,000 person-years, computed utilizing the GBD population estimates. In addition,

age-standardized rates were ascertained as weighted averages of age-specific ratios per 100,000 individuals, wherein the weights correspond to the proportion of individuals present in equivalent age groups as determined by the GBD global population age standard. For these estimates, we used DisMod-MR (a Bayesian meta-regression tool) to ensure internal consistency between separate estimates. DisMod-MR was also used to predict epidemiological estimates for regions with no available data. The GBD projections presented in this article are furnished with 95% uncertainty intervals (UIs). In each computational stage, one thousand samples are produced; the 95% UIs are derived by selecting the values at the 2.5th and 97.5th percentiles from the set of one thousand samples, which are subsequently presented along with the mean estimates.

Statistical analysis

The percentage alterations between the years 1990 and 2019 were considered to be statistically noteworthy if the 95% UI did not encompass the value of zero. Analysis and data visualization were performed using statistical software Stata (version 13), R (version 3.5.0), and Python (version 3.6.2).

Results

Overview of the global epidemiology of CUDs

Globally, for both sexes combined, incident cases of CUDs increased steadily from 2.82 million (95%UIs = 2.14–3.90 million) in 1990 to 3.73 million (95%UIs = 2.84–5.04 million) in 2019 [Figure 1b]. Between 1990 to 2019, DALYs increased from 498,056 (95%UI = 297,582–780-583) to 690,337 (95%UIs = 420,820–1,077,123) in 2019. The global annual percentage change of prevalence for CUDs increased by 0.39% (95%UIs = 0.32–0.46) from 1990–2019 [Figure 1b]. The global ASIR of CUDs slightly increased from an estimated 48.25 (95%UIs = 36.98–65.78) per 100,000 in 1990 to 48.78 (95%UIs = 37.09–65.76) per 100,000 in 2019 [Figure 1a].

Males found increases in CUDs incidence, prevalence, and DALYs than females in terms of absolute counts, and the age-standardized rates increased in males and decreased in females [Figure 1a]. In 2019, males accounted for 64% [2.4 million (95%UI = 1·8–3.2 million)] of CUDs incident cases, and 65.7% [453,787 (95%UIs = 275,654–707,594)] of DALYs due to CUDs in 2019, the ASIR was almost two times higher in males than in females 62·1 (95%UIs = 47·1–84·1) per 100,000 versus 34·9 (95%UIs = 26.6–46.6) per 100,000, with a similar disparity between males and females in terms of the ASDR 11.4 (95%UIs = 9.91–17·89) per 100,000 in males versus 6.09 (95%UIs = 3.67–9.49) per 100,000 in females and the age-standardized prevalence rate (ASPR) 393.4 (95%UIs = 294.9–513.7) per 100,000 in males versus 211.4 (95%UIs = 157.1–275) per 100,000 in females; [Figure 1].

CUDs burden by region

In 2019, South Asia was the worst affected region, with 1.03 million (95%UIs = 765,757–1.4 million) new cases, 6.09 million (95%UIs = 4.46–8.22 million) prevalence, and 175,618 (95%UIs = 101,694–273,026) DALYs due to CUDs.

HINA had the highest ASIR 149.35 (95%UIs = 114.69–203.81) per 100,000, ASPR 998.21 (95%UIs = 773–1301) per 100,000

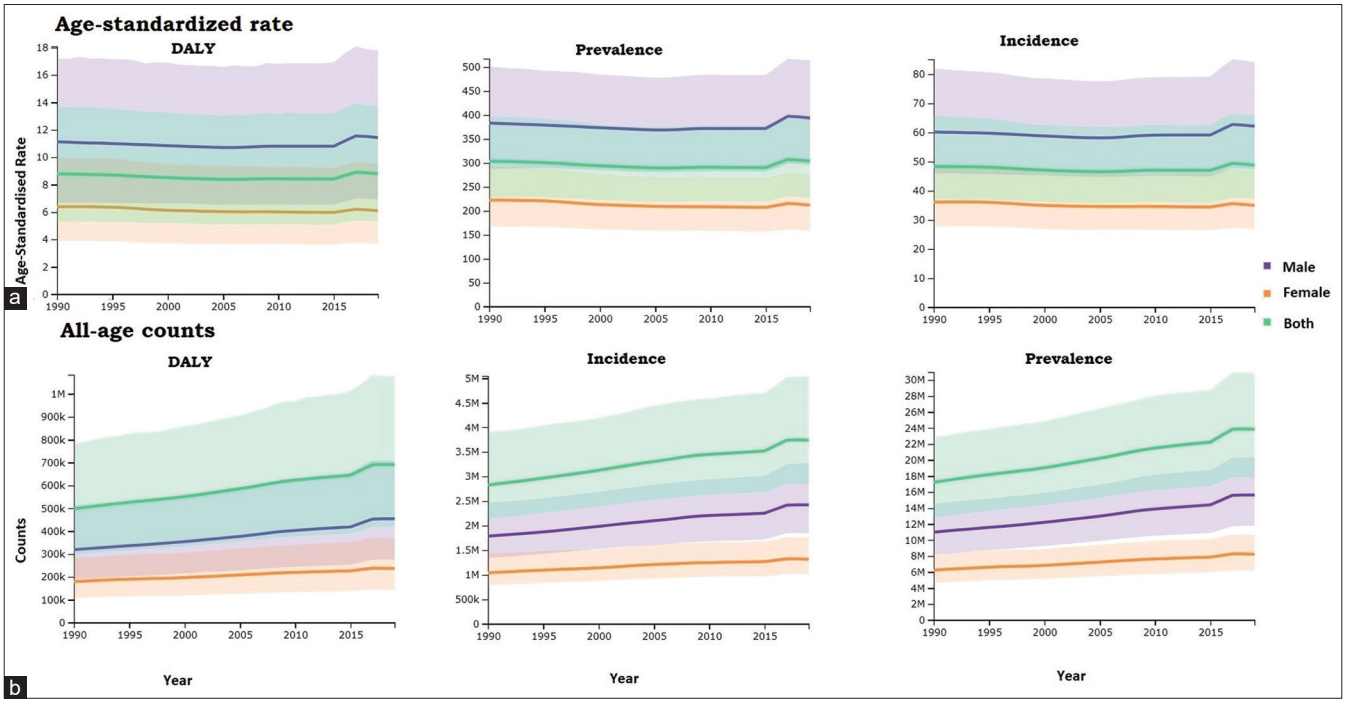

Figure 1: Global temporal patterns of CUDs burden, 1990–2019 (a) Age-standardized rates (per 100,000 population years) (b) All-age counts, Data source = Global burden of diseases, injuries, and risk factors study 2019, DALYs = disability-adjusted life-years

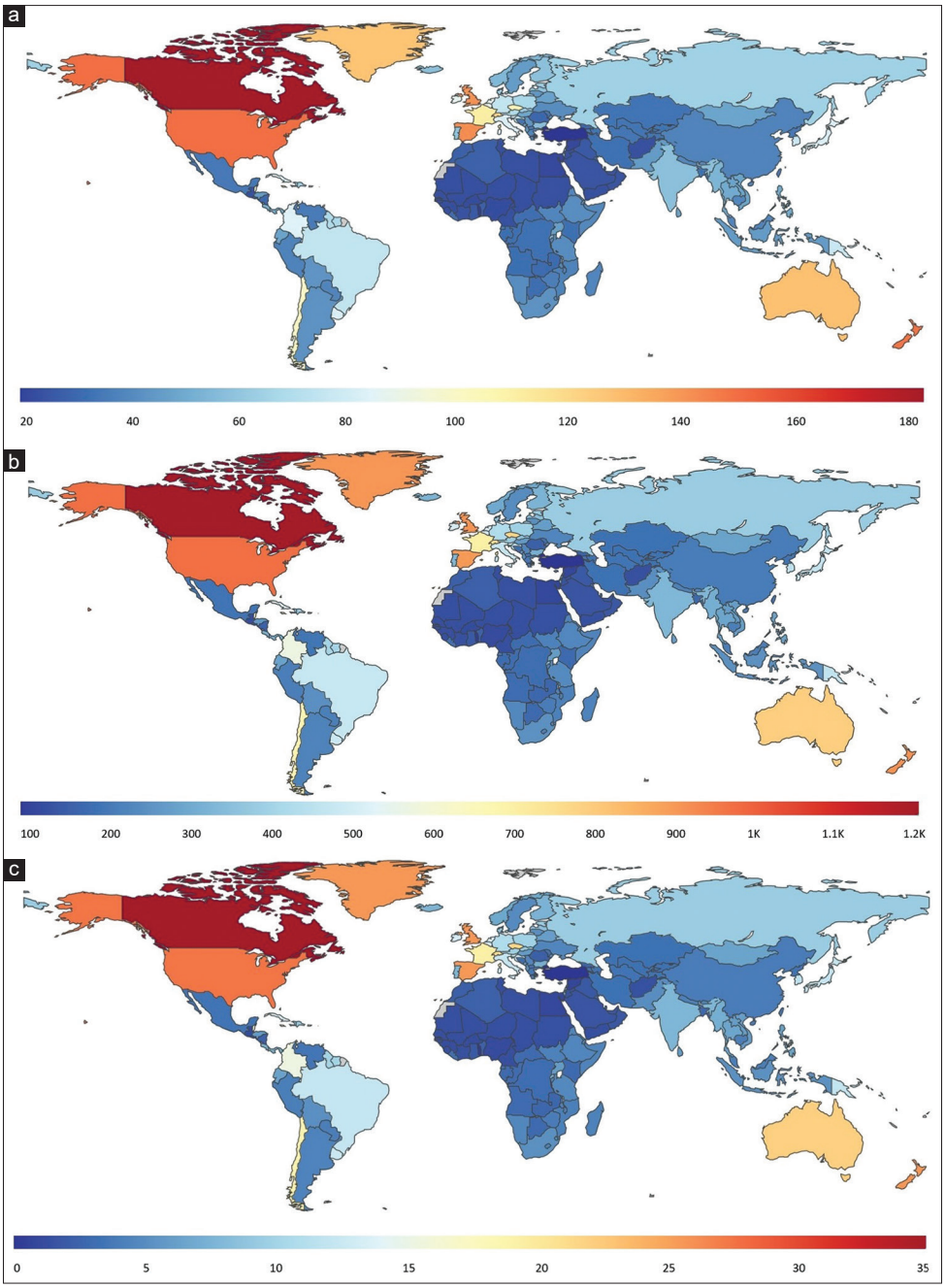

Figure 2: Age-standardized rate (per 100,000 person years) by region; (a) Age-standardized incidence rate, (b) Age-standardized Prevalence rate, (c) Age-standardized DALYs rate. Data source: Global burden of diseases, injuries, and risk factors study 2019

across 21 regions in 2019. The ASIR was the lowest in western sub-Saharan Africa at 21.86 (95%UIs = 16.18–30.73) per 100,000 and in North Africa and Middle East 22.91 (95%UIs = 16.73–32.90) per 100,000. The ASDR was the highest in HINA 28.6 (95%UIs = 17.3–43.9] per 100,000 and lowest in western sub-Saharan Africa 3.73 (95%UIs = 2.15–5.94) per 100,000 in 2019 [Table 1].

The preponderance of CUDs in males in 2019, in terms of both ASIR and ASDR, was more apparent in developed regions such as HINA, Australasia, and Western Europe, and differences between males and females were smaller in south-east Asia, east Asia and high-income Asia pacific [Figures 2-4].

In most regions, ASIR, ASPR, and ASDR remained steady in the last three decades with modest waxing and waning. ASIR, ASPR, and ASDR remained high in HINA, Australasia, and Western Europe in the last three decades compared to other regions of the world. Although, CUDs burden was reported in decreasing trend in all three regions from 1990 to 2019, the burden of CUDs in all regions was relatively stable, with only modest fluctuation. The lowest CUDs burden was reported in western sub-Saharan Africa and North Africa and Middle East in the last three decades [Figure 5].

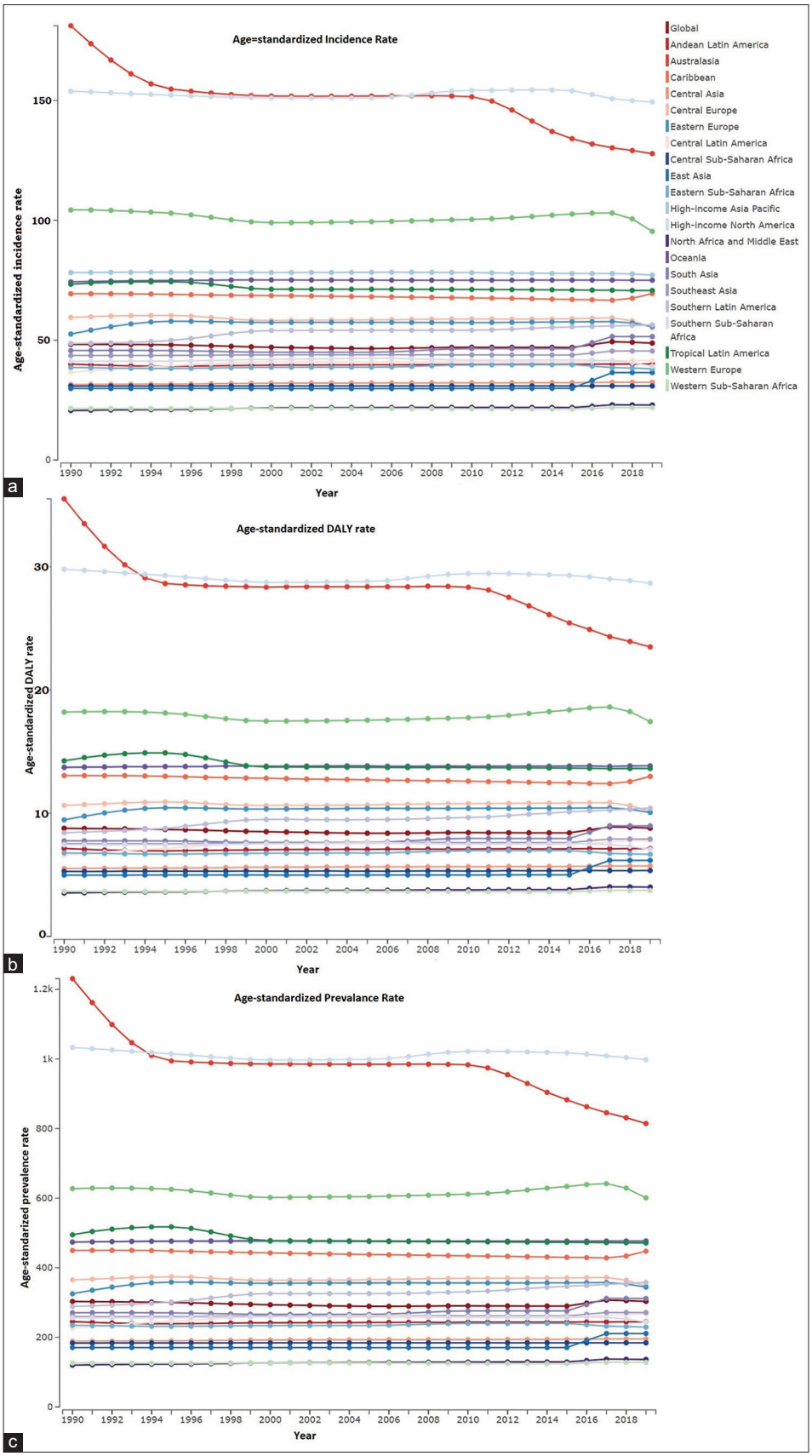

Figure 3: Global trend of CUDs by region from 1990–2019 (a) Age-standardized incidence rate (b) age-standardized DALYs (c) age-standardized prevalence rate

Table 1: Selected countries from each global WHO region having higher CUD Incidence Rate in 2019

Unadjusted Age-specific Incidence Rate			Adjusted Age-standardized Incidence Rate		
Region	**Countries**	**Per 100 000 (95%UI)**	**Region**	**Countries**	**Per 100 000 (95%UI)**
Africa	Ethiopia	50,505 (34,832–74,290)	Africa	Seychelles	94 (67–138)
	Nigeria	49,415 (35,485–70,284)		Mauritius	59 (43–81)
	Democratic Republic of Congo	30,590 (20,896-–46,314)		Rwanda	52 (35–79)
Eastern Mediterranean Region	Pakistan	106,749 (76,620-153, 969)	Eastern Mediterranean Region	Pakistan	43 (32–60)
	Iran	24, 524 (18,064-33,374)		Djibouti	38 (27–59)
	Egypt	21,568 (15,008-31,699)		Somalia	37 (26–58)
Europe	United Kingdom	68,217 (51,608-97,362)	Europe	United Kingdom	138 (101–200)
	Russian Federation	65,498 (49,075-93,977)		Spain	139 (125–159)
	France	54,047 (43,707–68,003)		Switzerland	118 (88–159)
America	United States of America	395,958 (299,091–550,771)	America	Canada	181 (157–209)
	Brazil	152,795 (115,800–206,273)		United States of America	146 (109–205)
	Canada	46,523 (40,483–53,788)		Saint Lucia	137 (94–194)
South-east Asia	India	863,675 (632,600–1,218,930)	South-east Asia	India	55 (41–77)
	Indonesia	120,325 (88,028–167,730)		Myanmar	52 (37–75)
	Bangladesh	55,557 (42,530–76,692)		Thailand	48 (35–70)
Western Pacific Region	China	450,153 (344,176–612,741)	Western Pacific Region	New Zealand	145 (102–209)
	Japan	66,795 (49,151–93,690)		Australia	124 (96–157)
	Philippines	60,538 (43,566–87,333)		Samoa	116 (85–159)

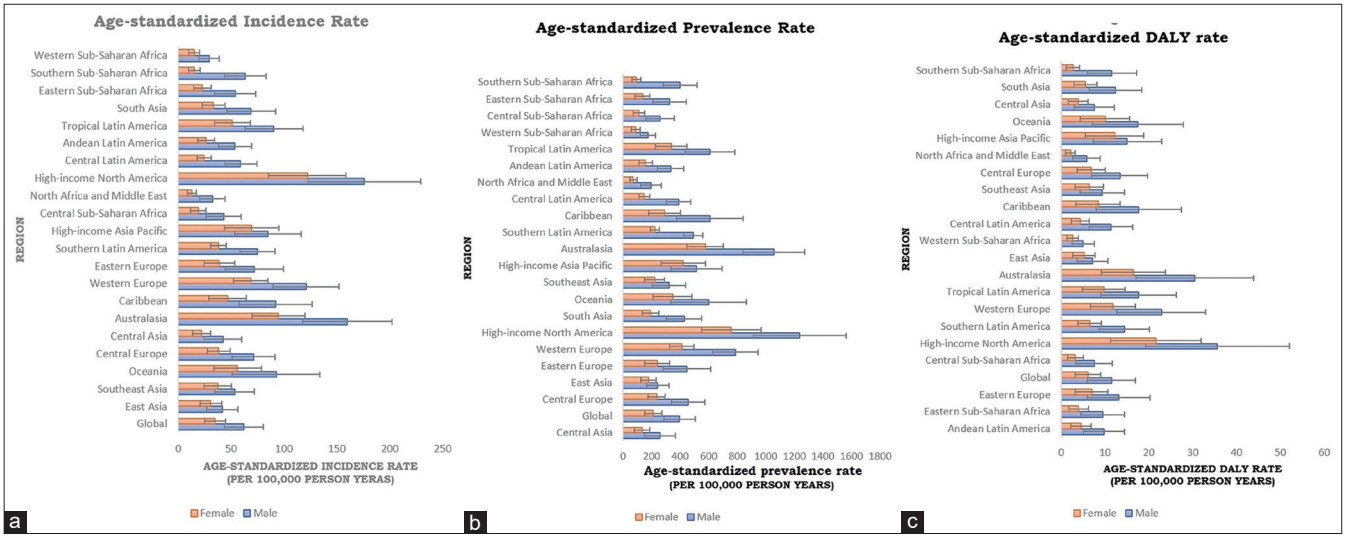

Figure 4: Geographical distribution of age-standardized rates of CUDs in 2019 (a) Age-standardized incidence rate (b) age-standardized prevalence rate (c) age standardized DALYs rate

CUDs burden by country

India, China, and the USA had the highest all-age incident counts for both sexes combined, with 863, 675 (95% = UI632, 600–1,218,930) new cases in India, 450, 153 (95%UIs = 344,176–612,741) new cases in China, and 395,958 (95%UIs = 299,091–550,771) new cases in the USA, in 2019. China 87,749 (95%UIs = 51,884–135,517), India 148,395 (95%UIs = 85,295–230,310), and the USA 82,321 (95%UIs = 50,047–126,648) had the highest DALY counts. Turkey 15.29 (95%UIs = 11.43–20.87) per 100,000, Togo 17.52 (95%UIs = 12.73–24.37) per 100,000, and Egypt 19.91 (95%UIs = 14.07–29.01) per 100,000 had the lowest age-standardized incidence rates, whereas Canada 180.0 (95%UIs = 157.06–208.550) per 100,000), the USA 146.49 (95%UIs = 109.83–204.65) per 100,000, and New Zealand 145.18 (95%UIs = 102.45–209.67) per 100,000 had the highest ASIR [Figure 4a]. Canada 35·0 (95%UIs = 22.7–51.02) per 100,000, the USA 28.06 (95%UIs = 16.7–43.9) per 100,000, and Saint Lucia (Eastern Caribbean Island) 26·6 (95%UIs = 14.48–42.75) per 100,000 had the highest ASDR among 204 countries and territories in 2019.

CUDs burden by age group

Figure 5 illustrates the CUDs incidence count and age-specific rates (per 100,000 person-years) in 2019. The incidence count followed a bell-shaped distribution with a peak in individuals aged 15–19 years for both males and females. Incident cases

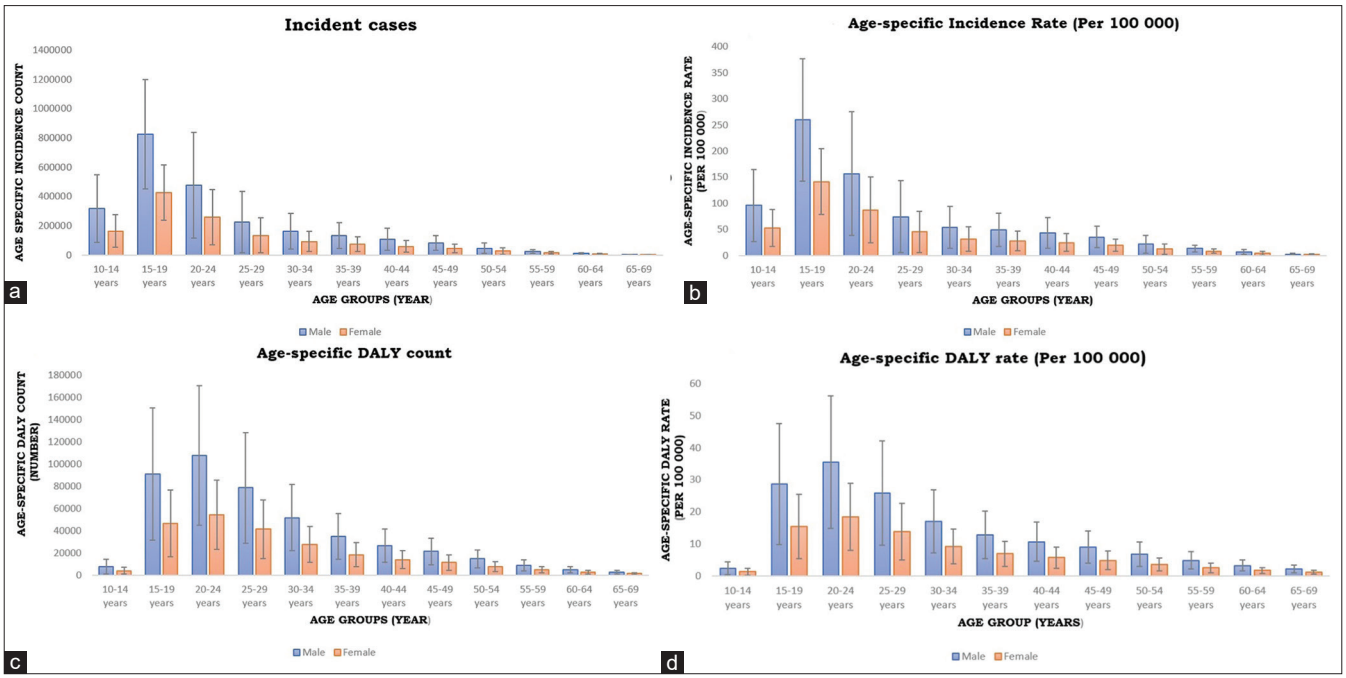

Figure 5: Age and sex specific burden of CUDs in 2019; (a) Incidence cases, (b) Age-specific incident rate (per 100,000 person years), (c) Age and sex specific DALYs, Age-specific DALYs rate (per 100,000 person years)

were higher in males than in females in all age groups up to age 65–69 years, with a greater number of new cases in females aged 15–19 years.

Present findings reveal conspicuous surge in the incidence cases and incidence rates among adolescent aged 15–19 years and young adults, marked by downward trend with each successive age bracket. In 2019, DALY exhibited a discernible at the age cohort of 20–24 years old, with the subsequent highest magnitude manifesting within the age group of 15–19 years old. Over the course of 3 decades, despite noticeably the highest incidence of cases in young adults, our finding reveals that the highest annual percentage change increase in incidence was evident among aged 40–45 years and older across the globe .

Discussion

To the best of our understanding, the present study represents the maiden attempt to gauge the worldwide, territorial, and national burden of CUDs and to appraise its involvement in the global load of infirmity. From 1990 to 2019, the number of new cases of CUDs grew by two times or even more than two times in 53 out of 204 countries and territories. Moreover, low SDI and low-middle SDI countries observed a substantial growth in CUDs cases. The annual rate of change in incidence cases from low-SDI and low-middle SDI countries demonstrated a marked increase of 115% and 70%, respectively. Our research revealed significant rises in age-standardized incidence rates in various regions, such as East Asia with a 22% surge, Southeast Asia with a 14% spike, Andean Latin America with an increase of 16%, central Latin America with a growth of 13%, and North Africa and the Middle East with an 11% hike between the years 1990 and 2019. Due to rapid industrialization, economic growth, the thriving middle class in developing countries, increased cultivation of cannabis, cannabis legalization, shifting cultural norms, and perception of cannabis as a harmless drug are among the risk factors contributing to the growing burden of CUDs in these regions.[1,17,18]

We reported a higher incidence of ASIR among high-income North America, Australasia, and Western Europe in males. The ASIR in females was at its peak in high-income regions such as North America, Australasia, and high-income Asia Pacific. Globally, it is observed that about two-thirds of individuals who consumed cannabis in the past year were males; however, this ratio varies greatly depending on the region. In numerous affluent nations, the disparity between genders in drug use appears to be decreasing, a pattern that is reflected in the prevalence of diverse drugs, including cannabis. The dissimilarity between genders regarding cannabis use can be predominantly attributed to differences in opportunities to partake in drug consumption in various settings, rather than inherent biological and psychological discrepancies between males and females in their approach toward cannabis use and the progression of CUDs. The gender-specific societal and environmental norms and roles assumed by males and females considerably influence the initiation and course of drug use and, subsequently, the development of CUDs.[19-22]

In the year 2019, DALYs reached their zenith among individuals aged between 20 and 24 years, with the subsequent highest magnitude observed in the subpopulation of 15 to 19 years old, thereby indicating an alarming trend that warrants prompt scientific inquiry and targeted public health interventions.

Collectively, within the USA, occurrences of CUDs within the past year, frequent and occasional cannabis use were correlated with an augmented incidence of suicidal ideation, plans, and attempts during the previous year amidst the 18- to 23-year-old demographic of both genders. It is noteworthy that females demonstrated a considerably higher prevalence of such instances as compared to males.[23] A study conducted at a Canadian hospital's emergency unit scrutinized psychiatric consultations of 1,247 patients aged 18 years or above before the legalization of cannabis and 1,368 patients during the post-legalization phase (5 months after the legalization of cannabis). The results of the study revealed that there was a noteworthy surge in the utilization of cannabis (escalating from 28% to 37%) among patients seeking psychiatric consultations in the post-legalization period (2018), predominantly in the 18–24 age group.[24] Nonetheless, there was an absence of statistically noteworthy divergence in relation to diagnoses of psychotic ailments pre- or post-legalization; however, the proportion of individuals diagnosed with a personality disorder exhibited an upsurge in the post-legalization epoch, ascending from 39.6% to 44.9%.[25]

It is of utmost importance for all healthcare providers, regardless of their specialty, to become acquainted with the impacts of using cannabis. An interprofessional team approach is needed to manage CUDs, including nurses, clinicians, social workers, pharmacists, mid-level practitioners, and other mental health professionals. This team should collaborate to address the issue, monitor the use of medical cannabis, and share information about the patient's treatment plan and progress to ensure the best outcomes.

Primary care physicians have an important role in educating their patients about the potential risks associated with cannabis use. They can provide information on responsible use, potential adverse effects, and harm reduction strategies. Patients should be made aware of the legal implications of cannabis use, especially in jurisdictions where it is still illegal. Primary care physicians should stay informed about cannabis use and its potential adverse effects to effectively address the burden of cannabis-induced disorders. By recognizing and addressing these issues, they can contribute to the overall health and well-being of their patients.

Our study on the burden of CUDs revealed significant findings; however, there are several limitations to our analysis. Our results could have been affected by data gaps, variable data quality, and uncertainty inherent in our modeling approach, which might lead to overestimation or underestimation of the actual disease burden. Moreover, changes in health status over time may not have been adequately accounted for due to delayed health data reporting by nations and consequent incorporation lags in the GBD estimate. The wider intervals of uncertainty observed in some specific locations may be attributed to data scarcity. While we incorporated various sources of uncertainty in our estimates, we were unable to integrate them into the covariates used for non-fatal models. Finally, as the GBD relies on the ICD-10 system to categorize illnesses and injuries and the DSM-V prevalence estimates for substance use disorders, the estimated burden of CUDs may be higher than our estimates. Furthermore, we observed inconsistencies and discrepancies between previous research and the GBD database with regard to CUDs incidence, prevalence, and DALYs in the European region. The GBD database suggests a decline in CUD over the past 30 years, while a recent study based on the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) survey indicates an increase in CUDs and related problems over the past decade. The differing trends between these studies raise questions about the validity of CUDs prevalence estimates.[25,26] Finally, the GBD definition of disability limits its scope to a person's health decline. The social and economic repercussions of mental and substance use problems, as well as other implications on non-drug users, including the family, are not included in the definition of impairment. The differing trends between these studies suggest a need to revisit and improve the modeling for estimating CUDs burden estimates. Some studies have questioned the consistency of selected GBD estimates, and the validity of CUDs estimates may vary across countries, further highlighting the need for improvement in CUDs burden estimation.

Conclusions

With over 209 million cannabis users and a prevalence of 23.8 million CUDs cases, CUDs is a notable risk factor for the global burden of disease. Our findings highlight that the burden of CUDs is primarily experienced in young adults, and as more states legalize cannabis and perceptions of its risks decrease, our estimates show that the burden is shifting toward developing nations and is higher in high-income countries. We also noticed a narrowing gender gap in the annual prevalence of CUDs across the world. Prevention efforts should focus on promoting public education and awareness about the risks associated with cannabis use, implementing evidence-based prevention strategies, and providing early intervention and treatment for individuals who may be at risk of developing CUDs. Additionally, regulatory measures such as age limits, taxation, and restrictions on marketing and availability can help reduce the prevalence of CUDs. Further deliberation is required regarding CUDs in relation to its pathophysiological mechanisms, socioeconomic implications as well as legal and policy enhancements.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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