

A systematic review and meta-analysis of substance use among medical students in India

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ABSTRACT

Background and Aims: Substance use among medical students may have consequences like poor academic performance and impaired patient care. There is a growing literature on substance use among medical students in India. This systematic review and meta-analysis were done to synthesize the literature on substance use among medical students in India.

Methods: Medline and Google Scholar were used as search engines to ascertain the literature that reported substance use among Indian medical students from January 2000 to January 2022. The pooled prevalence of tobacco, alcohol, other substance, and overall substance use was computed.

Results: A total of 65 studies were included. The pooled prevalence of tobacco use was 21.9% (95% confidence intervals [CI] 18.5% to 25.3%, $n = 20,165$, $k = 51$), while the pooled prevalence of alcohol use was 27.1% (95% CI of 23.0% to 31.1%, $n = 11,823$, $k = 31$). The overall pooled prevalence of substance use was 40.3% (95% CI of 25.5% to 55.2%, $n = 4960$, $k = 10$), while pooled prevalence of cannabis was 8.2% (95% CI of 4.9% to 11.5%, $n = 2418$, $k = 7$). The use of tobacco was about 10 times higher in males than females, while the odds of alcohol use were about five times higher in males.

Conclusion: Substance use is common among medical students, with rates of substance use being generally higher in males as compared to females. Targeted interventions may help to reduce substance use and prevent the development of substance use disorders in this population.

Key words: Alcohol, cannabis, medical students, prevalence, tobacco

INTRODUCTION

Substance use among medical students has been an important consideration worldwide.^[1-3] Such substance use can lead to the development of substance use disorders later. Excessive substance use among medical students can

lead to professional detriment,^[4] and also may translate into inadequate care for the patients. Knowing the substance use profile among medical students can help to address them appropriately. The prevalence of substances use varies across different parts of the world,^[5] and this also reflects in the extent to which different substances are used by medical students.

There has been a gradual expansion of the literature on substance use among medical students.^[6-9] Previous

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literature reviews have largely comprised of studies from the America and Europe.^[1,2,10] The literature on substance use among medical students from India has expanded considerably in the last two decades. Hence, a synthesis of the literature on substance use among medical students is of relevance. This can help in understanding the patterns of substances being used, so that targeted interventions can be planned for specific population groups of medical students. While substance use has been reported to be quite common in medical students, substance use disorders have been rare in this population.^[11] This is probably because while the initiation of substance use generally occurs in the younger population, it may take some time for the development of substance use disorders. Nonetheless, understanding the extent of substance use can clarify the quantum of vulnerable medical students who might need help.

As of now, there is a recent narrative review on substance use among medical students in India, highlighting the need for reviews on the topic.^[12] A systematic review and meta-analysis provides much more robust quantitative data and is able to pool data from various sources. Also, gender differences in substance use in medical students can help to know about one of the important vulnerability factors for substance use in this population. Gender differences in substance use among medical students have not been studied in a systematic review manner yet in the Indian medical student population. Hence, the present systematic review aimed to provide a meta-analysis of substance use among medical students in India.

METHODS

The primary objective of the study was to find the rates of substance use among medical students in India. The secondary objective was to find gender differences in substance use in medical students.

Search strategies

For the present review, electronic searches were made based on a predefined search strategy. The databases used for searching literature were PubMed and Google Scholar. The following keywords were used individually and in combination for the search: (Use OR "Harmful use" OR Abuse OR dependence) AND ("Tobacco use" OR "smoking" OR "cigarette smoking" OR "smokeless tobacco" OR alcohol OR cannabis OR drugs OR substances) AND ("Medical students" OR Undergraduates OR Interns OR "Young doctors" OR "Medical professionals" OR "Medical college") AND (Prevalence OR Incidence) AND (India OR Indian). Additional articles were identified from the cross-references of the relevant articles identified during the search. Searches were carried out in January 2022 by AS and SS, who independently screened study titles and abstracts.

Study inclusion

Peer-reviewed studies published in English language journals were included in the present review if they mentioned the prevalence or incidence of any substance use in medical students in India. We did not impose any restrictions on the study design, though we assumed most of the studies would have been cross-sectional observational studies. Those studies which did not report prevalence or incidence of substance use separately for medical students or those published as conference abstracts, letters to editor, or book chapters were excluded. Studies were excluded if they reported prevalence data prior to the year 2000 (this was done as we thought that many articles prior to year 2000 would not be available through electronic searches, as they might not have been digitized). Among studies published repeated data of the same cohort, only one study data was selected based on sample size and its overall study quality.

Data extraction

The studies which fulfilled the inclusion and exclusion criteria were assessed in detail. Information that was extracted from the records included author and year of the study, place of conduct, sample size and sampling method, ascertainment method of substance use, prevalence rate (ever use), and prevalence rate in males and females (ever user). We considered "ever use" in the definition of substance use where available. In other words, if the study reported several variables of interest, then the prevalence rate of ever use (someone used substance even once in their lifetime) was recorded. When "ever use" was not reported, we used the highest prevalence rate from the data available for the substance. Overall, substance use rates were inferred for studies that explicitly reported the rate of substance use in the medical student population. In cases where resident doctors were included in the figures presented, without separate data for the medical students, the study was excluded. Data extraction was done by AS and SS. Clarifications and doubts, if any, were sorted out by mutual discussion.

Quantitative analysis

The prevalence rate of each of the substances of use and the overall rate of substance use were extracted from the published reports. The pooled prevalence rate was computed for individual substances (tobacco, alcohol, illicit substances, etc.) and overall substance use using the random-effects model. Computation of pooled prevalence rates and 95% confidence intervals (CIs) was done using Open Meta Analyst software.^[13] The random-effects model was used due to the heterogeneity in the methods of assessment and the prevalence rates reported. For comparison of prevalence in males and females, odds ratios (OR) were computed with 95% CIs.

The I^2 test of heterogeneity was used to assess the heterogeneity of reported prevalence rates, with higher values reflecting a greater degree of heterogeneity.

A meta-regression analysis was conducted as a part of this review to assess the influence of year of publication on the prevalence rate. Sensitivity analysis was not done as a part of the review.

Quality analysis

The included studies were assessed using the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) criteria.^[14] This is a widely acknowledged reporting criteria for observational studies. There are two criteria, and each of the items is scored either reported or not reported. Since we included primarily observational studies, this checklist was deemed suitable for reporting on the studies.

RESULTS

A total of 65 studies were included, which provided prevalence rates of substance use among medical students from different parts of the country [Figure 1]. The sample sizes ranged from 100 to 1188, with a median sample size of 300. Generally, the sample comprised of both male and female students, except studies by Aggarwal *et al.*,^[15] Gupta *et al.*,^[16] Hameedkunj *et al.*,^[17] Inderjit *et al.*,^[18] Khan *et al.*,^[19]

Kumar *et al.*,^[20] Kumari and Nath,^[21] and Vankhuma *et al.*^[22] which comprised exclusively of male students. The response rate of these studies varied from 52.44% to 100%, with a median response rate of 89.8%. While the majority of the studies were based in a single-center, some of the studies had participants from multiple medical colleges.^[23,24] While many of the studies used their self-designed questionnaires, some of the studies used previously validated questionnaires like Alcohol Use Disorder Identification Test, Global Health Professional Students Survey (GHPSS), Global Adult Tobacco Survey (GATS), Global Youth Tobacco Survey (GYTS), and Global Information System on Alcohol and Health (GISAH).

There were 51 studies that provided prevalence for tobacco use, 31 studies provided prevalence figures for alcohol use, and 11 studies each which provided prevalence of use of other substances and 10 for overall substances, respectively [Tables 1-4].

The pooled prevalence of tobacco use was 21.9% (95% CI 18.5% to 25.3%) in a sample of 20,165 medical students from 51 studies using random-effects model ($I^2 = 98.40$) that is shown in Figure 2. Similarly, the pooled prevalence of alcohol use was 27.1% (95% CI of 23.0% to 31.1%) from

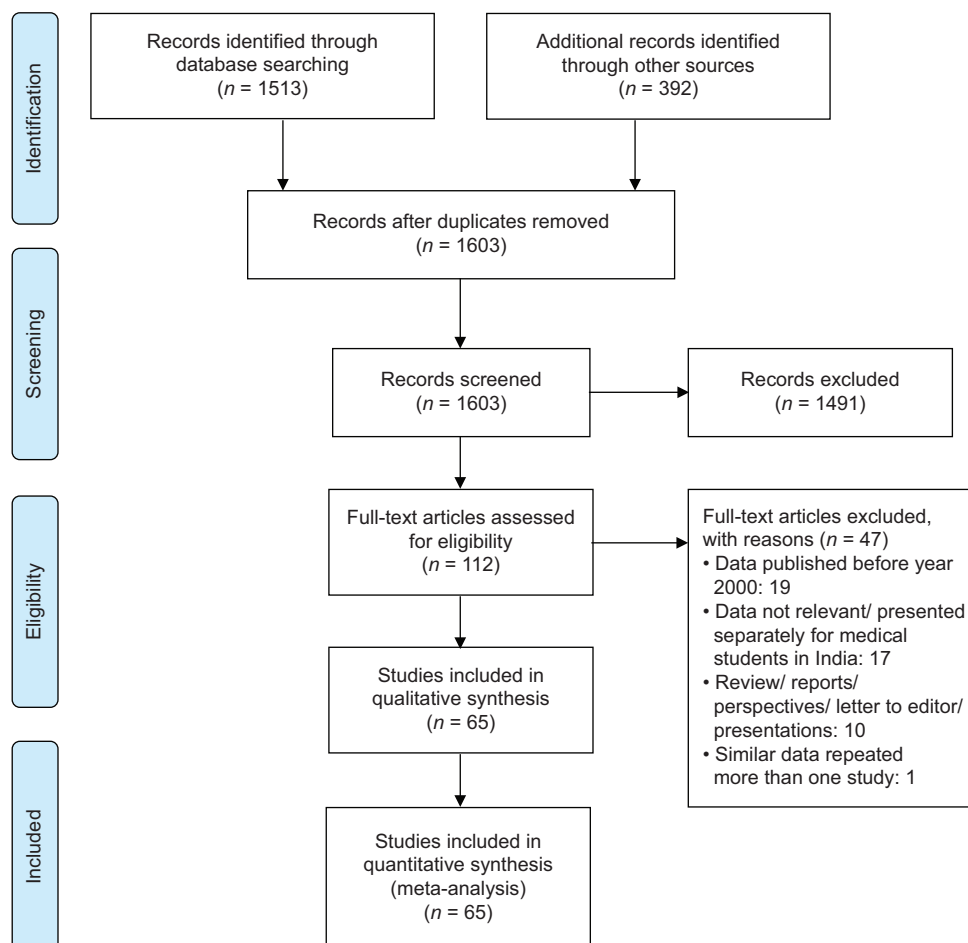


Figure 1: Identification of studies

Table 1: Studies that have assessed tobacco use among medical students

Author, year	Location	Sample size and characteristics	Assessment method	Prevalence of use (percentage)	Prevalence in males and females
Aggarwal <i>et al.</i> , 2012 ^[25]	Dehradun, Uttarakhand	<i>n</i> =386 (1 st to 9 th semester), 97% response rate, 47.7% males, Mean age 21.5 years.	Global Health Professional Students Survey	21.8	38.6, 6.4
Aggarwal <i>et al.</i> , 2012 ^[15]	New Delhi	<i>n</i> =118, (MBBS students), 52.44% response rate, 100% males, Mean age 22.4 years.	Self-administered questionnaire	27.1 (smoked and smokeless)	-
Anuradha <i>et al.</i> , 2021 ^[26]	Chennai, Tamil Nadu	<i>n</i> =200 34% males, Mean age 20.2 years	Pre-designed questionnaire	3.0	8.8, 0
Bandopadhyay <i>et al.</i> , 2013 ^[27]	Burdwan, West Bengal	<i>n</i> =270 (MBBS students), 96.43% response rate, 63% males, Mean age 19.8 years, Random sampling.	GATS (2nd edition, 2011)	22.2 (smoked)	-
Bartwal <i>et al.</i> , 2014 ^[28]	Haldwani, Uttarakhand	<i>n</i> =303 (1 st -5 th year MBBS students), 60.6% response rate, 49.84% males.	Pre-designed and pretested semi-structured questionnaire	14.5 (smoked)	27.2, 2.0
Behera <i>et al.</i> , 2020 ^[29]	Bhopal, Madhya Pradesh	<i>n</i> =331 (Medical students and interns) Response rate=67.3% 66.8% male, 70.1% aged 20 years or more	Self-administered questionnaire	8.5%	-
Boopathirajan and Muthunaryanan, 2017 ^[30]	Chennai, Tamil Nadu	<i>n</i> =479 (3 rd year medical college students) 41.8% males, Mean age 20.46 years.	GHPSS	10.9 (smoked), 1.9 (smokeless)	23.5, 1.8 (smoked), 4.5, 0.0 (smokeless)
Brar <i>et al.</i> , 2020 ^[6]	Pune, Maharashtra	<i>n</i> =107 (3 rd year MBBS students), 88% response rate, 73.8% males	GHPSS	42.1 (smoked)	51.9, 14.3
Chatterjee <i>et al.</i> , 2011 ^[31]	Kolkata, West Bengal	<i>n</i> =515 (1 st -5 th year MBBS students), 66.02% males.	Pre-designed and pretested self-administered questionnaire	18.3	26.2, 2.9
Das <i>et al.</i> , 2015 ^[32]	Jorhat, Assam	<i>n</i> =264 (2 nd , 3 rd & final year MBBS students), 96.7% response rate, 48.1% males, Mean age 21.81 years.	Pre-designed and pretested questionnaire	41.7	65.4, 19.7
Datta <i>et al.</i> , 2015 ^[33]	Kolkata, West Bengal	<i>n</i> =800 (1 st to 9 th semester MBBS course), 80% response rate, Random sampling.	Modified WHO questionnaire	57.4	-
Desai <i>et al.</i> , 2021 ^[34]	Vadodara, Gujarat	<i>n</i> =507 (MBBS Students), Response rate 72.3% 38% males	Online form	10.5	-
Goel <i>et al.</i> , 2015 ^[23]	Maharashtra New Delhi, West Bengal, Madhya Pradesh, Kerala	<i>n</i> =1144 46.2% males, Mean age 21.5 years, Simple random sampling.	Self-report pretested questionnaire	79.5	-
Gupta <i>et al.</i> , 2012 ^[16]	Shimla, Himachal Pradesh	<i>n</i> =131, (all phases MBBS students), 99.2% response rate, 100% males, Mean age 20.63 years.	Pre-designed and pretested questionnaire	61.8	-
Halder <i>et al.</i> , 2018 ^[35]	Kolkata, West Bengal	<i>n</i> =452 (1 st -4 th year MBBS students), 59.29% males, Stratified random sampling.	Pretested questionnaire	34.7 (smoked)	-
Hameed kunju <i>et al.</i> , 2018 ^[17]	Thiruvananthapuram, Kerala	<i>n</i> =243, (1 st -Final years MBBS students), 100% response rate, 100% males, Mean age 20.84 years, Stratified Random sampling.	Modified GHPSS	17.3 (smoked)	-
Inderjit <i>et al.</i> , 2015 ^[18]	Davanagere, Karnataka	<i>n</i> =230 (1 st year, final year MBBS students and house surgeons [interns]), 100% response rate, 100% male.	Self-designed questionnaire	43.9	-
Iyer <i>et al.</i> , 2019 ^[36]	Mangalore, Karnataka	<i>n</i> =249 (interns), 73.4% response rate, 62.7% males, mean age 23 years.	Modified and adapted GHPSS	41.8 (cigarette smoking) 14.9 (other tobacco products-bidi, ghutka, etc)	-
Jagnany <i>et al.</i> , 2008 ^[7]	Mumbai, Maharashtra	<i>n</i> =235 (MBBS students), 88.3% response rate, 69.78% males, Mean age 20.57 years.	Pretested questionnaire	27.2 (smoked), 12.8 (smokeless)	39.0, 0.0 (smoked), 18.3, 0.0 (smokeless)
Jaiswal <i>et al.</i> , 2017 ^[37]	-	<i>n</i> =100 (<i>n</i> =50 first year and 50 Final year MBBS students), 56% males (first year) and 52% males (final year), Mean age 18.64 years (first year), Mean age 22.02 years (final year), Random sampling	Structured epidemiological survey questionnaire based on DSM-IV criteria	21.0 (smoked), 3.0 (smokeless)	-

Contd...

Table 1: Contd...

Author, year	Location	Sample size and characteristics	Assessment method	Prevalence of use (percentage)	Prevalence in males and females
Jambaiah <i>et al.</i> , 2015 ^[38]	Bagalkot, Karnataka	<i>n</i> =114 (1 st year MBBS students), 91.2% response rate, 61.4% males, Mean age 18.25 years	Prestructured questionnaire	24.6 14.0 (smoked) 6.1 (smokeless) 4.4 (both)	-
Khan <i>et al.</i> , 2012 ^[19]	Bareilly, Uttar Pradesh	<i>n</i> =277 (1 st -5 th semester MBBS students), 83.68% response rate, 100% males.	Structured questionnaire	33.2 25.3 (smoked) 10.5 (smokeless), 2.5 (both)	-
Kokiwar <i>et al.</i> , 2019 ^[39]	Hyderabad, Telangana	<i>n</i> =612 (all years MBBS students), 34.16% males	Semi-structured questionnaire	5.6	-
Kulkarni <i>et al.</i> , 2016 ^[40]	Nagpur, Maharashtra	<i>n</i> =120 (Batch II MBBS), 48.3% males	Pre-designed questionnaire	15 (smoked)	-
Kumar <i>et al.</i> , 2011 ^[20]	Mangalore, Karnataka	<i>n</i> =299 (1 st - 4 th year MBBS students), 89.8% response rate, 100% males, Mean age 21.1 years, Probability proportional to sampling technique.	Pretested questionnaire	22.4 (smoked)	-
Kumar <i>et al.</i> , 2016 ^[41]	Rewa, Madhya Pradesh	<i>n</i> =228 (all years MBBS students), 85.4% response rate, 68.42% males.	Semi-structured questionnaire	23.7 (smoked) 3.1 (smokeless)	-
Kumari and Nath, 2008 ^[21]	Lucknow, Uttar Pradesh	<i>n</i> =250 (undergraduate medical students) 59.1% response rate, 100% males, Mean age 23.5 years.	Pre-designed and pretested structured questionnaires	4.0	-
Madhusudan <i>et al.</i> , 2017 ^[42]	Wayanad, Kerala	<i>n</i> =400 (1 st , 2 nd , and Final phase of MBBS students), 32.25% males, Mean age 20.91 years.	Pre-designed and pretested questionnaire	18.9	51.2, 3.3
Mangalesh <i>et al.</i> , 2021 ^[43]	All across India	<i>n</i> =1000 (First to Fifth year medical students)	Online structured questionnaire	3.0	-
Manghani <i>et al.</i> , 2020 ^[44]	Mumbai Maharashtra	<i>n</i> =250 (1 st to final year MBBS students and interns), 44.4% males, Mean age 21.54 years.	Online structured questionnaire	14.4	15.3, 13.7
Mehrotra <i>et al.</i> , 2010 ^[45]	Allahabad, Uttar Pradesh	<i>n</i> =560 (3 rd to 4 th semester MBBS students), 96.2% response rate, 66.8% males.	GHPSS	32.7	32.4, 33.3
Menon <i>et al.</i> , 2015 ^[8]	Puducherry, Tamil Nadu	<i>n</i> =461 (1 st to 9 th semesters MBBS students), 90.6% response rate, 53.8% males	Structured questionnaire	8.0	-
Mohan <i>et al.</i> , 2006 ^[46]	Trivandrum, Kerala	<i>n</i> =518 (MBBS students) 46.5% males, Mean age 20.4 years.	Pretested questionnaires	27.4	-
Mony <i>et al.</i> , 2010 ^[47]	Coimbatore Bangalore Karnataka and Tamil Nadu	<i>n</i> =578 (3 rd year MBBS students), 80% response rate, 47.57% males.	GHPSS	2.1	4.0, 0.0
Padhy <i>et al.</i> , 2014 ^[48]	Bhubaneswar, Odisha	<i>n</i> =1188 (MBBS students), 52.5% males.	Structured close-ended questionnaire	33.4 (smoked) 11.3 (smokeless)	60.9, 3.0 (smoked) 21.5, 0.0 (smokeless)
Pankaj <i>et al.</i> , 2015 ^[49]	Jaipur, Rajasthan	<i>n</i> =370, undergraduate medical students.	Pretested questionnaire	23.2	-
Parmar <i>et al.</i> , 2018 ^[50]	Jamnagar, Gujarat	<i>n</i> =414 (1 st -3 rd year MBBS students), 55.56% males.	Pre-designed and pretested questionnaire	19.6	34.3, 1.1
Patel <i>et al.</i> , 2016 ^[51]	Belagavi, Karnataka	<i>n</i> =372 (1 st -4 th year MBBS students), 65.9% males, Mean age 21.18 years, Simple random sampling method.	Pre-designed, pretested, structured questionnaire	27.2 22.6 (smoked) 7.8 (smokeless)	-
Rajini <i>et al.</i> , 2018 ^[52]	Pondicherry, Tamil Nadu	<i>n</i> =300 (1 st -5 th year MBBS students), 86% males, Random sampling.	Pretested and pre-designed questionnaire	20.0	20.2, 18.6
Ramakrishna <i>et al.</i> , 2005 ^[53]	Orissa	<i>n</i> =1189 (all MBBS students), 73.5% response rate, 68.5% Males.	Pretested questionnaire	24.1 9.8 (smoked) 7.9 (smokeless) 6.3 (both)	32.5, 5.6 13.4, 2.1 (smoked) 10.4, 2.4 (smokeless) 8.7, 1.1 (both)
Seera <i>et al.</i> , 2020 ^[54]	Rohtak, Haryana	<i>n</i> =282 (Year 1 to 4), 40.4% male, Mean age 20.3 years	Pre-designed structured questionnaire	5.3	-
Selokar <i>et al.</i> , 2011 ^[55]	Sawangi, Wardha Maharashtra	<i>n</i> =335 (under graduate and intern medical students), Mean age 21.34 years,	Pre-designed structured questionnaire	5.1	-
Sharma <i>et al.</i> , 2019 ^[56]	Jaipur, Rajasthan	<i>n</i> =614 (502 MBBS students, 112 interns)	Pre-designed structured questionnaire	16.8	-
Singh <i>et al.</i> , 2003 ^[57]	Pune, Maharashtra	<i>n</i> =200 (medical students), 86% males, Random selection.	Pretested questionnaire recommended by WHO	46.0	53.5, 0.0

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Table 1: Contd...

Author, year	Location	Sample size and characteristics	Assessment method	Prevalence of use (percentage)	Prevalence in males and females
Singh <i>et al.</i> , 2014 ^[58]	Delhi	n=112 (medical students), Random sampling.	Questionnaire based on GHPSS	17.9	-
Singh, 2016 ^[59]	Kerala	n=342 (medical students), 34.8% males, Mean age 20.80 years.	Pretested questionnaire	21.1	50.4, 5.4
Singh <i>et al.</i> , 2017 ^[60]	Lucknow, Uttar Pradesh	n=116 (1 st prof. year), 26.7% males	Questionnaire based on GYTS and GISAH	8.6	12.9, 7.1
Taneja <i>et al.</i> , 2020 ^[9]	New Delhi	n=206 (1 st year MBBS students to interns), 83.3% response rate	Adapted GHPSS	40.3	-
Tiwari <i>et al.</i> , 2015 ^[61]	Jabalpur Madhya Pradesh	n=376 (all years), 89.5% participation), 53.2% males.	Self-administered pretested questionnaire	41.0 (smoked) 39.4 (smokeless)	77.0, 0.0 (smoked) 74.0, 0.0 (smokeless)
Vankhuma <i>et al.</i> , 2020 ^[22]	New Delhi	n=302 (1 st -3 rd year medical students), 86.53% response rate, 100% males.	Self-administered questionnaire	9.3	-
Yadiyal <i>et al.</i> , 2015 ^[62]	Mangalore, Karnataka	n=102, undergraduate medical students, 92.73 response rate.	Semi-structured questionnaire	18.6	-

Table 2: Studies that have assessed alcohol use among medical students

Author, year	Location	Sample size and characteristics	Assessment method	Prevalence of use (percentage)	Prevalence in males and females (percentage)
Adhya <i>et al.</i> , 2016 ^[63]	West Bengal	n=244 (1 st -3 rd year MBBS students), 59.42% males, Randomized single blind control study.	Pretested and prevalidated questionnaire	35.7	42.1, 26.3
Anandi <i>et al.</i> , 2018 ^[64]	Kalaburagi, Karnataka	n=224 (1 st year- final year MBBS and interns), 54.9% males, Random sampling.	AUDIT	25.4	35.0, 13.9
Anuradha <i>et al.</i> , 2021 ^[26]	Chennai, Tamil Nadu	n=200 34% males, Mean age 20.2 years	Predesignated questionnaire	7.5	17.6, 2.3
Behera <i>et al.</i> , 2020 ^[29]	Bhopal, Madhya Pradesh	n=331 (Medical students and interns) Response rate=67.3% 66.8% male, 70.1% aged 20 years or more	Self-administered questionnaire	16.3	-
Chaudhary <i>et al.</i> , 2015 ^[65]	Bareilly, Uttar Pradesh	n=220 (MBBS students)	AUDIT	12.7	-
Datta <i>et al.</i> , 2015 ^[33]	Kolkata, West Bengal	n=800 (1 st to 9 th semester MBBS course), 80% response rate, Random sampling.	Modified WHO questionnaire	27.3	-
Desai <i>et al.</i> , 2021 ^[34]	Vadodara, Gujarat	n=507 (MBBS Students) Response rate 72.3%, 38% males	Online form	17.4	-
Goel <i>et al.</i> , 2015 ^[23]	Maharashtra New Delhi, West Bengal, Madhya Pradesh, Kerala	n=1144 final year MBBS students, 46.2% males, Mean age 21.5 years, Simple random sampling.	Self-report pretested questionnaire	16.6	-
Inderjit <i>et al.</i> , 2015 ^[18]	Davanagere, Karnataka	n=230 (1 st year, final year MBBS students and house surgeons), 100% response rate, 100% male.	Self-designed questionnaire	40.9	-
Jagnany <i>et al.</i> , 2008 ^[7]	Mumbai, Maharashtra	n=235 (MBBS students), 88.3% response rate, 69.78% males, Mean age 20.57 years.	Pretested questionnaire	30.2	41.5, 4.2
Jaiswal <i>et al.</i> , 2017 ^[37]	-	n=100 (n=50 first year and 50 Final year MBBS students), 56% males (first year) and 52% males (final year), Mean age 18.64 years (first year), Mean age 22.02 years (final year), Random sampling	Structured epidemiological survey questionnaire based on DSM-IV criteria	19.0	-
Kokiwar <i>et al.</i> , 2019 ^[39]	Hyderabad, Telangana	n=612 (all years MBBS students), 34.16% males,	Semi-structured questionnaire	21.2	-
Kulkarni <i>et al.</i> , 2016 ^[40]	Nagpur, Maharashtra	n=120 (Batch II MBBS), 48.3% males	Predesignated questionnaire	23.3	-
Kumar <i>et al.</i> , 2016 ^[41]	Rewa, Madhya Pradesh	n=228 (all years MBBS students), 85.4% response rate, 68.42% males.	Semi-structured questionnaire	17.5	-
Mangalesh <i>et al.</i> , 2021 ^[43]	All across India	n=1000 (First to Fifth year medical students)	Online structured questionnaire	7.7	-
Manghani <i>et al.</i> , 2020 ^[44]	Mumbai, Maharashtra	n=250 (1 st to final year MBBS students and interns), 44.4% males, Mean age 21.54 years.	Online structured questionnaire	47.6	41.4, 52.5
Mehra <i>et al.</i> , 2018 ^[66]	Etawah, Uttar Pradesh	n=200 (MBBS students), 68.57% males, Random sampling.	Structured questionnaire	20.0	25.5, 7.9
Menon <i>et al.</i> , 2015 ^[8]	Puducherry	n=461 (1 st -9 th semesters MBBS students), 90.6% response rate, 53.8% males.	Structured questionnaire	21.5	-

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Table 2: Contd...

Author, year	Location	Sample size and characteristics	Assessment method	Prevalence of use (percentage)	Prevalence in males and females (percentage)
Padhy <i>et al.</i> , 2014 ^[48]	Bhubaneswar, Odisha	$n=1188$ (MBBS students), 52.5% males,	Structured close ended questionnaire	31.3	58.0, 1.8
Rajini <i>et al.</i> , 2018 ^[52]	Pondicherry	$n=300$ (1 st -5 th year MBBS students), 86% males, Random sampling.	Pretested and predesigned questionnaire	31.7	32.3, 27.9
Rathore <i>et al.</i> , 2015 ^[67]	Jaipur, Rajasthan	$n=370$ (MBBS students), 48.11% males.	Prestructured and pretested questionnaire	20.8	33.1, 9.4
Sathish and Brogen, 2013 ^[68]	Imphal, Manipur	$n=300$ (MBBS students), 93.46% response rate	Self-administered questionnaire	48.3	63.0, 31.1
Sathish and Kumar, 2019 ^[69]	Kancheepuram, Tamil Nadu	$n=100$ (MBBS Students), 72% males.	Self-managed survey questions	27.0	-
Seera <i>et al.</i> , 2020 ^[54]	Rohtak, Haryana	$n=282$ (Year 1 to 4), 40.4% male, Mean age 20.3 years	Predesigned structured questionnaire	26.6	-
Sharma <i>et al.</i> , 2019 ^[56]	Jaipur, Rajasthan	$n=809$ (502 MBBS students, 112 interns and 195 residents), 94.38% response rate, 49.6% males	Predesigned structured questionnaire	22.5	-
Sharma and Bhattacharjee, 2021 ^[70]	Pune, Maharashtra	$n=300$ (Medical students), 69.3% male	Questionnaire designed for the study	38.3	-
Singh <i>et al.</i> , 2017 ^[60]	Lucknow, Uttar Pradesh	$n=116$ (1 st prof. year), 26.7% males	Questionnaire based on GYTS and GISAH	25.0	19.4, 27.1
Singh <i>et al.</i> , 2020 ^[71]	Etawah, Uttar Pradesh	$n=250$ (2 nd and 3 rd Year MBBS Students), 58.4% male	Questionnaire designed for the study	31.2	48.6, 6.7
Taneja <i>et al.</i> , 2020 ^[9]	New Delhi	$n=206$ (1 st year MBBS students to interns), 83.3% response rate	Adapted GHPSS	47.6	-
Tiwari <i>et al.</i> , 2015 ^[61]	Jabalpur	$n=376$ (all years MBBS students) 89.5% participation, 53.2% males	Self-administered pretested questionnaire	45.7	85.0, 1.1
Verenkar and Vaz, 2018 ^[72]	Goa	$n=315$ (all semesters MBBS Students), 90% response rate, 47.61% males, Random sampling	AUDIT	39.4	38.0, 40.6

a sample of 11,823 students from 31 studies ($I^2 = 96.74$) that is presented in Figure 3. The other substances of use are graphically depicted in Figure 4. Among them, cannabis use was the most frequently used substance ($k = 7$ studies, $n = 2418$). The pooled prevalence of cannabis use was 8.2% (95% CIs of 4.9% to 11.5%). Other commonly reported substances were stimulants ($k = 4$, $n = 1629$), hallucinogens ($k = 3$, $n = 1379$), opioids ($k = 3$, $n = 1285$), and sedatives ($k = 3$, $n = 1244$). The overall prevalence of substance use was 40.3% (95% CI of 25.5% to 55.2%) from a pooled sample of 4960 participants from 10 studies ($I^2 = 99.33$). This has been depicted in Figure 5.

The prevalence of substance use generally seemed to be higher in males as compared to females for all of the substances for which such data were available. For a few of the studies, the prevalence rate of use was higher among female students than males (e.g., Mehrotra *et al.*^[45] for tobacco; Manghani *et al.*,^[44] Singh *et al.*,^[60] and Verenkar and Vaz^[72] for alcohol, and Manghani *et al.*^[44] for amphetamines), but the differences were not statistically significant. In pooled analysis, the prevalence of tobacco use was about

10 times higher in males (OR 10.706, 95% CI 5.180 to 22.127, $P < 0.001$, $n = 8002$, $k = 19$, $I^2 = 92.89$). The odds of alcohol use were about five times higher in males than females (OR 5.039, 95% CI 2.236 to 11.354, $P < 0.001$, $n = 4565$, $k = 14$, $I^2 = 94.82$). Overall, substance use rates were also higher among males (OR 4.032, 95% CI 1.169 to 13.910, $P < 0.001$, $n = 2318$, $k = 5$, $I^2 = 96.88$). The rates of cannabis use, opioid, and amphetamine use were numerically higher in males than females though the differences were not statistically significant. Using meta-regression, there was no significant change in prevalence of tobacco use (coefficient -0.006 , $P = 0.163$) or alcohol use (coefficient -0.008 , $P = 0.264$) across the years.

The quality of the studies was assessed using the STROBE criteria. It was seen that the main issues in the included papers related to reporting other analyses done (like subgroups, interactions, and sensitivity analyses) and discussing the generalizability (external validity) of the study results. We divided the studies which scored at least 75% of STROBE items, and we found that 53 studies had scored above this threshold, while 12 studies scored below this threshold.

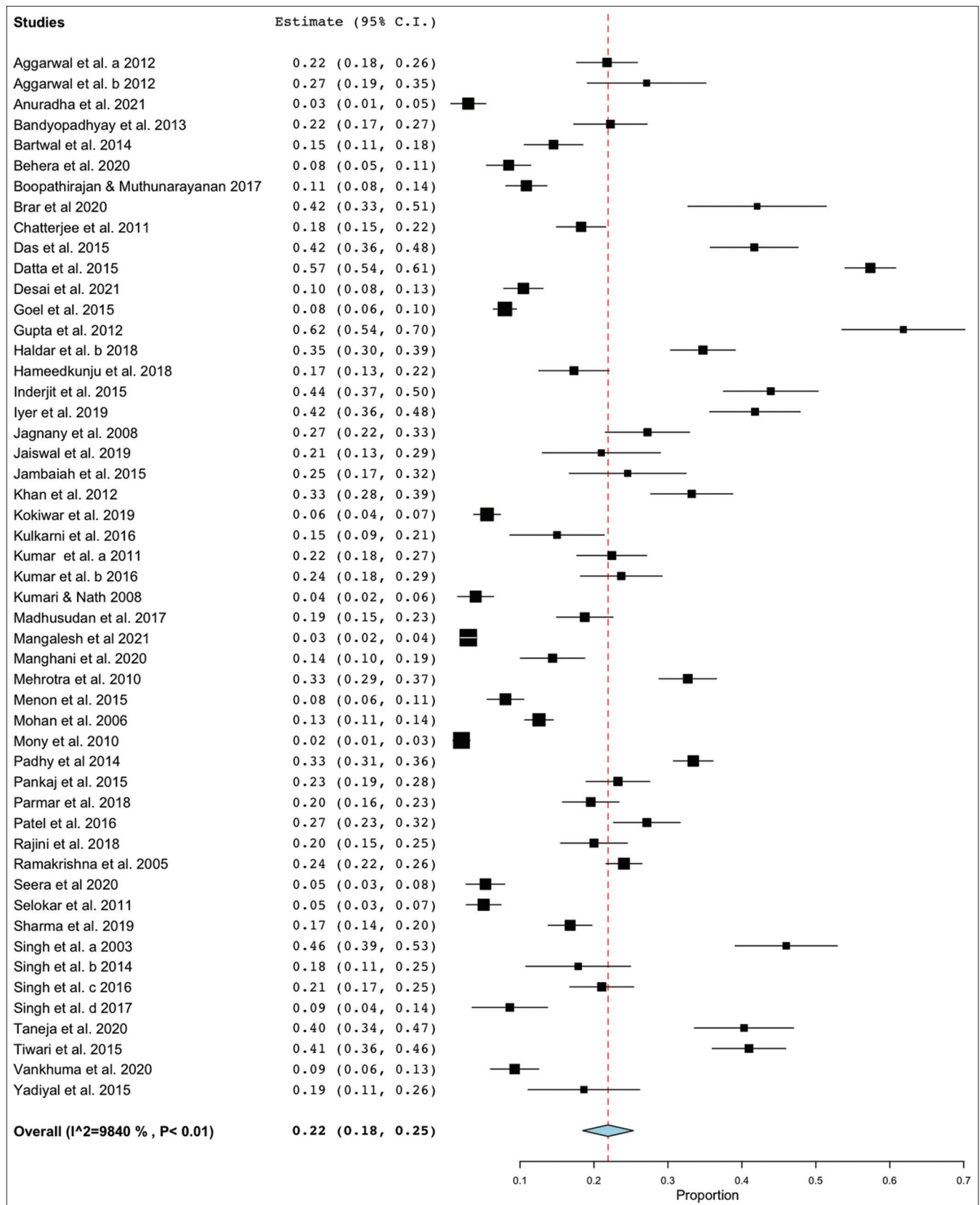


Figure 2: Rates of tobacco use among medical students. Estimates represent the prevalence figures as proportion with 95% CIs. The squares represent the individual studies while the diamond represents the pooled prevalence (center of the diamond) with CIs (ends of the diamond). The X axis represents the prevalence measured as proportion

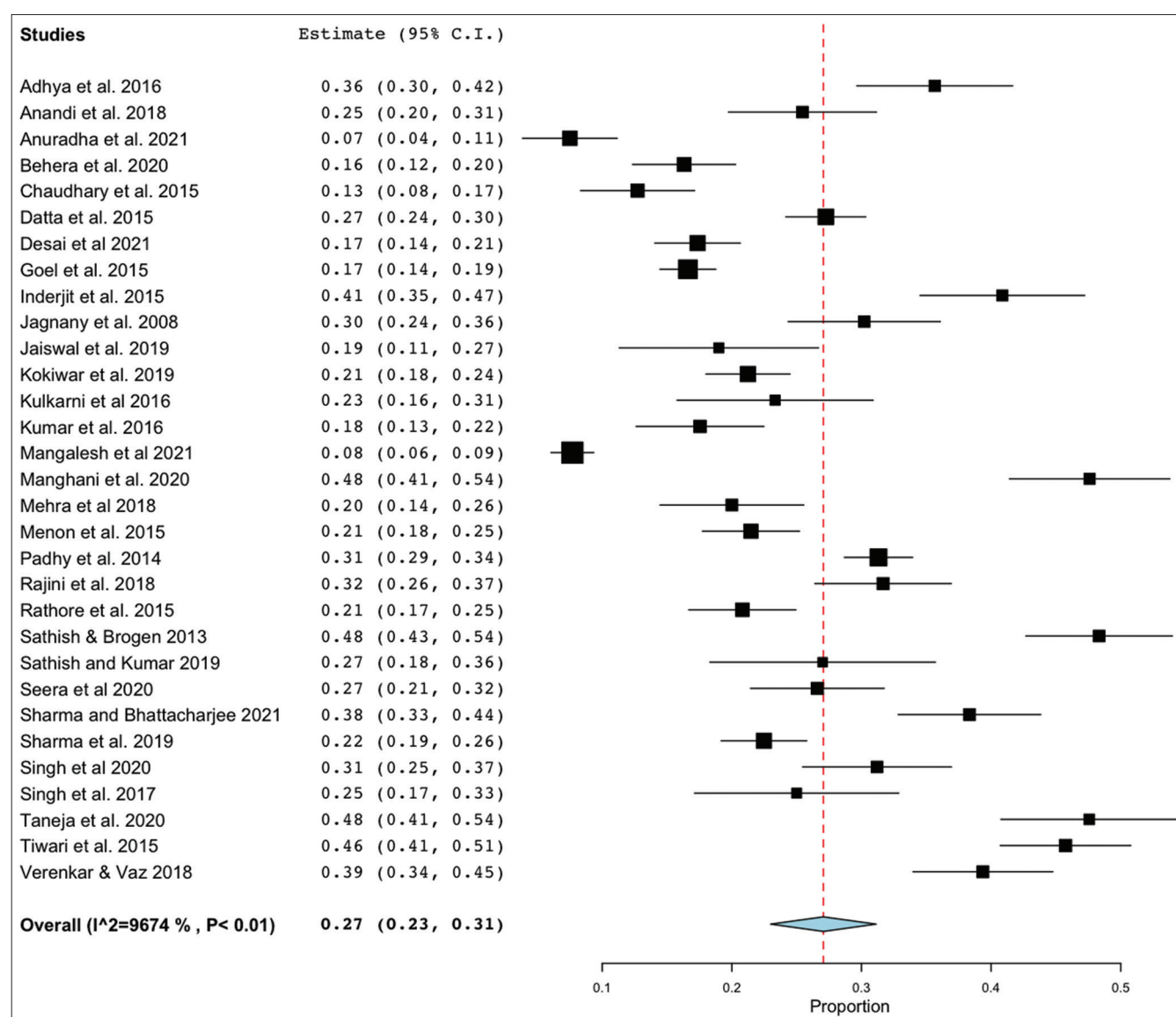


Figure 3: Rates of alcohol use among medical students. Estimates represent the prevalence figures as proportion with 95% CIs. The squares represent the individual studies while the diamond represents the pooled prevalence (center of the diamond) with CIs (ends of the diamond). The X axis represents the prevalence measured as proportion

DISCUSSION

The present systematic review and meta-analysis found that overall substance use prevalence among medical students in India is about 40%. Alcohol use seemed to be the most common substance use, followed by tobacco, primarily in smoked form. Cannabis use was present in about 8% of the sample, and sedative-hypnotics were used by about 4% of the sample of medical students. Substance use was generally more common in male students than females.

Alcohol and tobacco being the common substances of abuse among medical students were in line with the findings from other parts of the world. The prevalence rates of alcohol and tobacco use reported in the present meta-analysis were higher than a previous one which covered 106 studies

from various parts of the world.^[1] On the other hand, the rates of alcohol use among Indian medical students were much lower than reported in a review of substances among medical students in Brazil.^[2]

The use of cannabis was reported in about 8% of the medical students. The rates of use were lower than the worldwide average, where lifetime use was reported in about a third of the medical students.^[76] However, the same systematic review reported that the rates of cannabis use among medical students in the Asian countries were around 6%, much closer to the rates reported in the present study. While cannabis is the most common illicit substance of use in India and the world, most users do not become dependent users. Nonetheless, it may become a gateway drug for the use of

Table 3: Studies that have assessed other substance use among medical students

Author, year	Location	Sample size and characteristics	Assessment method	Substance	Prevalence of use (percentages)	Prevalence in males and females
Datta <i>et al.</i> , 2015 ^[33]	Kolkata, West Bengal	n=800 (1 st to 9 th semester MBBS course), 80% response rate, Random sampling	Modified WHO questionnaire	Cannabis Cocaine Amphetamine Sedatives Hallucinogen Inhalant Tranquilizers Opium	10.4 0.0 1.1 3.8 0.4 0.8 1.0 1.5	-
Jagnany <i>et al.</i> , 2008 ^[7]	Mumbai, Maharashtra	n=235 (MBBS students), 88.3% response rate, 69.78% males, Mean age 20.57 years.	Pretested questionnaire	Cannabis (Ganja or bhang) Heroin Amphetamine LSD	19.6 1.3 0.4 0.4	28.0, 0.0 1.8, 0.0 0.6, 0.0 0.6, 0.0
Jaiswal <i>et al.</i> , 2017 ^[37]	-	n=100 (n=50 first year and 50 Final year MBBS students), 56% males (first year) and 52% males (final year), Mean age 18.64 years (first year), Mean age 22.02 years (final year), Random sampling	Structured epidemiological survey questionnaire based on DSM-IV criteria	Cannabis Benzodiazepine	2.0 3.0	-
Kumar <i>et al.</i> , 2016 ^[41]	Rewa, Madhya Pradesh	n=228 (all years MBBS students), 85.4% response rate, 68.42% males.	Semi-structured questionnaire	Cannabis	3.9	-
Manghani <i>et al.</i> , 2020 ^[44]	Mumbai, Maharashtra	n=250 (1 st to final year MBBS students and interns), 44.4% males, Mean age 21.54 years	Online structured questionnaire	Amphetamines Cannabis Heroin	0.4 6.0 0.4	0.0, 0.7 7.2, 5.0 0.9, 0.0
Menon <i>et al.</i> , 2015 ^[8]	Puducherry	n=461 (1 st -9 th semesters MBBS students), 90.6% response rate, 53.8% males	Structured questionnaire	Cannabis	6.3	-
Padhy <i>et al.</i> , 2014 ^[48]	Bhubaneswar, Odisha	n=1188 (MBBS students), 52.5% males,	Structured close ended questionnaire	"Medications"	10.8	11.5, 9.9
Philip <i>et al.</i> , 2021 ^[24]	Multiple places	n=344 (MBBS Students), 39% males	CAGE questionnaire	Cannabis Sedatives Stimulants Hallucinogens	11.6 3.8 1.7 1.5	-
Rajini <i>et al.</i> , 2018 ^[52]	Pondicherry	n=300 (1 st -5 th year MBBS students), 86% males, Random sampling	Pretested and predesigned questionnaire	Drug (self-prescription of drugs and illicit drugs)	2.0	2.3, 0.0
Seera <i>et al.</i> , 2020 ^[54]	Rohtak, Haryana	n=282 (Year 1 to 4), 40.4% male, Mean age 20.3 years	Predesigned structured questionnaire	Illicit drugs	4.6	-
Taneja <i>et al.</i> , 2020 ^[9]	New Delhi	n=206 (1 st year MBBS students to interns), 83.3% response rate	Adapted GHPSS	Nonmedicinal drug	18.4	-

other substances. The use of sedatives was also reported by some of the participants, probably reflecting easy availability to the medical students, and possible use to improve sleep before the examinations. However, it must be noted that the use of sedatives and tranquilizers may affect cognitive abilities if taken in the longer run. Fortunately, the use of stimulants and hallucinogens was rare, probably reflecting the low overall use of these substances in India.

The use of substances, as mentioned above, has multiple consequences for medical students and the medical fraternity. For medical students, the use of these substances may lead to regular and subsequently problematic use. One should be cautious in interpretation as not every substance user would develop a substance use disorder, or suffer from harmful consequences. However, the use of substances raises the chances of developing a substance use disorder subsequently. Also, the use of substances recreationally

may divert away attention from coursework and lead to deficient or falling academic performance. Moreover, substance use by the medical students may lead to an image of the profession being blemished, though it could be argued that the medical students are also humans who are equally vulnerable to human iniquities. The impact of substance use among medical students can impact patient care adversely in some circumstances, especially when students are given tasks and responsibilities in patient care.

The literature over the last about 20 years of substance use among medical students has expanded considerably. Studies have emerged from different regions of the country, including north, south, east, west, and central India. The studies have been generally conducted in single institutions, though some of the studies have enrolled students from many places. Studies by Goel *et al.*^[23] and Philip *et al.*^[24] could

Table 4: Studies that have reported overall substance use rates among medical students

Author, year	Location	Sample size and characteristics	Assessment method	Prevalence of use	Prevalence in males and females
Datta <i>et al.</i> , 2015 ^[33]	Kolkata, West Bengal	<i>n</i> =800 (1 st to 9 th semester MBBS course), 80% response rate, Random sampling	Modified WHO questionnaire	57.4	-
Dhodi <i>et al.</i> 2014 ^[73]	Mumbai, Maharashtra	<i>n</i> =200 64% males	Well-structured questionnaire	60.5	64.1, 54.2
Halder <i>et al.</i> , 2018 ^[35]	Kolkata, West Bengal	<i>n</i> =452 (1 st -4 th year MBBS students), 59.29% males, Stratified random sampling	Pretested questionnaire	60.2	76.2, 37.0
Jaiswal <i>et al.</i> , 2017 ^[37]	-	<i>n</i> =100 (<i>n</i> =50 first year and 50 Final year MBBS students), 56% males (first year) and 52% males (final year), Mean age 18.64 years (first year), Mean age 22.02 years (final year), Random sampling	Structured epidemiological survey questionnaire based on DSM-IV criteria	25.0	-
Kumar <i>et al.</i> , 2016 ^[41]	Rewa, Madhya Pradesh	<i>n</i> =228 (all years MBBS students), 85.4% response rate, 68.42% males.	Semi-structured questionnaire	29.4	40.4, 5.6
Manghani <i>et al.</i> , 2020 ^[44]	Mumbai, Maharashtra	<i>n</i> =250 (1 st to final year MBBS students and interns), 44.4% males, Mean age 21.54 years.	Online structured questionnaire	68.8	64.9, 71.8
Menon <i>et al.</i> , 2015 ^[8]	Puducherry	<i>n</i> =461 (1 st -9 th semesters MBBS students), 90.6% response rate, 53.8% males	Structured questionnaire	21.7	-
Mir <i>et al.</i> , 2017 ^[74]	Tumkur, Karnataka	<i>n</i> =379 (MBBS students), 49.6% males	Semi-structured questionnaire	26.1	-
Padhy <i>et al.</i> , 2014 ^[48]	Bhubaneswar, Odisha	<i>n</i> =1188 (MBBS students) 52.5% males	Structured close ended questionnaire	45.9	74.0, 14.7
Pattnaik <i>et al.</i> , 2020 ^[75]	Odisha	<i>n</i> =902 (MBBS students)	Daily use of tobacco, alcohol, or other drugs	8.5	

be considered truly pan-national recruiting students from all parts of the country. Most commonly, the assessment was done using a self-developed questionnaires to assess the use of substances. While this has the advantage of the simplicity of assessment, it makes comparisons difficult, especially when the questions are worded substantially differently.

The available literature points toward the need to address substance use among medical students. There are several things that can be done for the prevention of substance use/substance use disorder on individual and systemic levels. From a general population level, outlet density control for alcohol and tobacco sales, increasing the legal age of buying, increased taxation, awareness campaigns, and enforcement of drunk driving policies are likely to be effective in reducing the prevalence of substance use. From a systemic level, curricular emphasis on substance use and consequent harms might be useful. The literature is most prominent on tobacco and alcohol use among students. Medical students are likely to be cognitively aware of the adverse consequences of tobacco or alcohol use on the body and the role of the use of tobacco or alcohol in the genesis of a host of medical illnesses. Information may be given early about the course of the evolution of tobacco and alcohol use disorder, and the treatment approaches can be emphasized. Clinical exposure to diseases where tobacco or alcohol has played a major role and where tobacco and/or alcohol use is addressed in the management plan can help medical students to internalize that these issues can be handled professionally. At the same time, campus proctors, in-charges, or wardens need to enforce institute/university regulations to deter substance use. Rules like

the establishment of shops selling alcohol or tobacco away from educational institutions can be enforced more strictly. Tobacco and alcohol-free campus campaigns can be beneficial, along with encouraging students to make Information Education and Communication material for patients pertaining to the harms of tobacco and alcohol. Peer-led interventions can also be considered.

From an individual student perspective, who have been using substances, student wellness services may help to address these when they become problematic. Addressing the physical and mental health issues of students in a confidential and responsive manner would probably address their concerns and prevent the self-prescription/unregulated use of medications. In case the students are not willing to seek care in their own medical setting (attributable to logistic and confidentiality-related issues), telepsychiatry can be used as a modality for providing help for cessation of use of substances. In addition, seeking help for substance use should be de-linked from academic or hostel allocation strictures, which may enable students to seek services more freely when they need them. Focusing on students showing recent academic deterioration or absenteeism from clinical rotations may be another approach to help the students in need. Involving families with due consent and linking up with consultants in the psychiatry department may help to liaison for better care for such students.

There was a high degree of heterogeneity across the studies in the present review (as reflected by the I^2 tests in the pooled prevalence). Several issues may be contributory to this high heterogeneity. The major reason of statistical heterogeneity is the differences in prevalence rates across

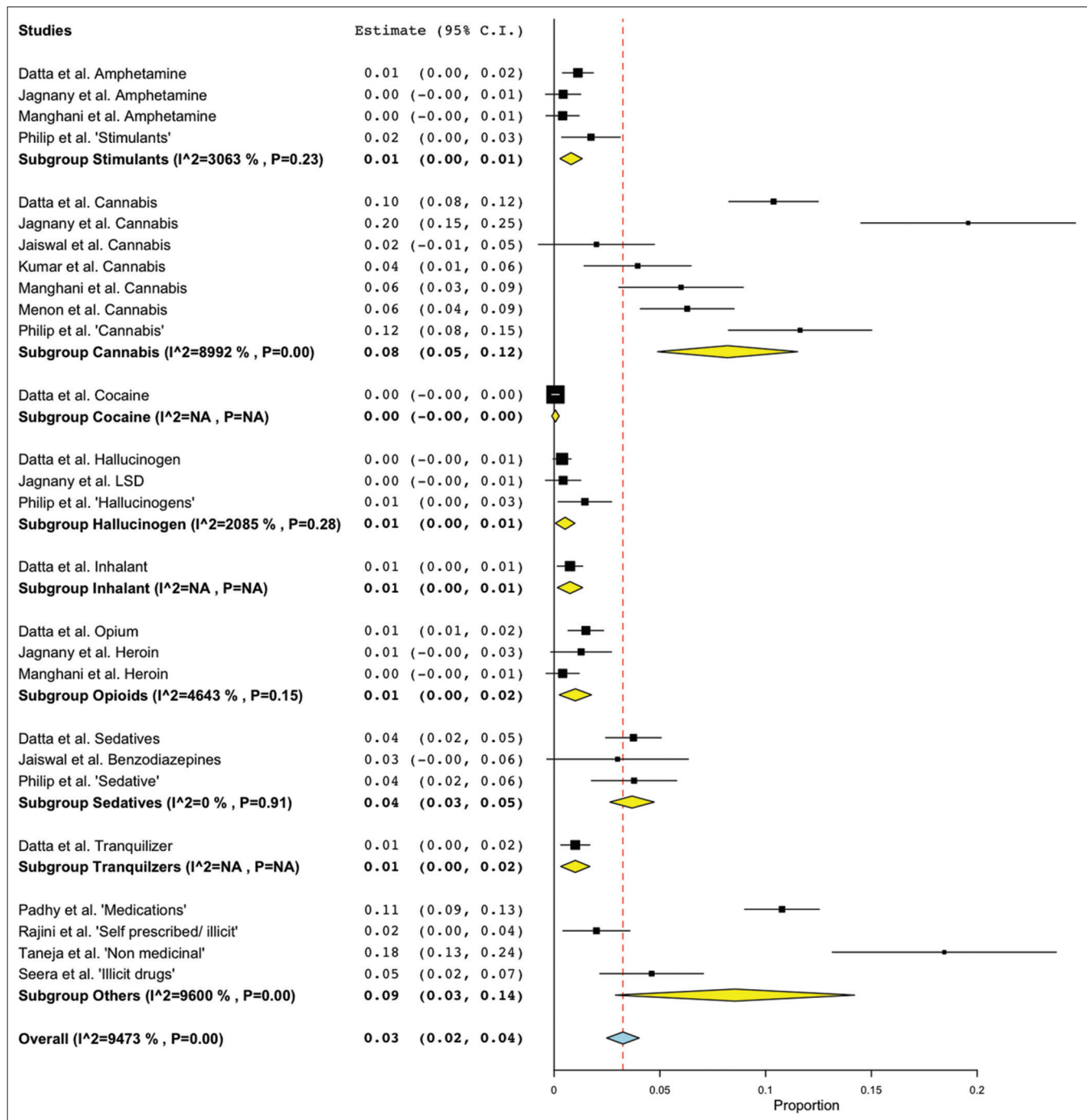


Figure 4: Rates of other substance use among medical students. Estimates represent the prevalence figures as proportion with 95% CIs. The squares represent the individual studies while the diamond represents the pooled prevalence (center of the diamond) with CIs (ends of the diamond). The X axis represents the prevalence measured as proportion

the studies. The prevalence rates have been measured using different methodologies and may also reflect the actual differences in the prevalence of substance use across different regions or differences in samples and settings. The implication of interpretation of heterogeneity lies in the fact that while pooled prevalence provides an idea of overall substance use, each individual study also needs to be paid attention to while drawing inferences. The locally available

prevalence (if available) needs to be used in conjunction with the pooled prevalence while planning intervention for a set of students.

Some of the limitations of this study merit attention. There was considerable heterogeneity in the manner in which the substance use was ascertained and evaluated in the different studies. We took a broad outlook of the definition and took

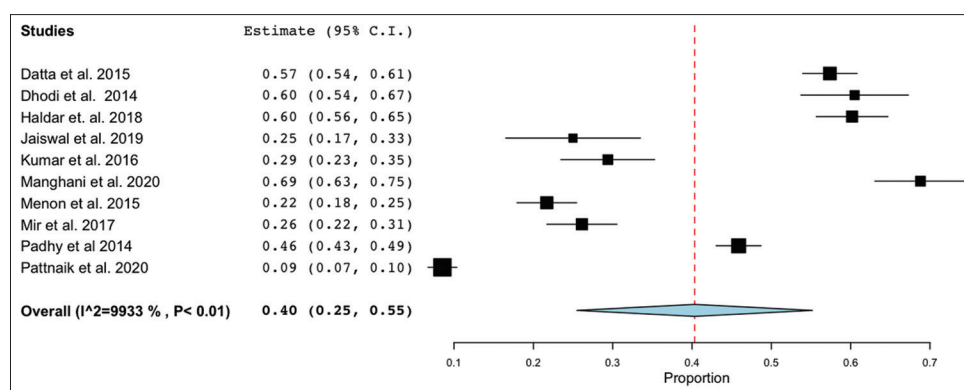


Figure 5: Rates of overall substance use among medical students. Estimates represent the prevalence figures as proportion with 95% CIs. The squares represent the individual studies while the diamond represents the pooled prevalence (center of the diamond) with CIs (ends of the diamond). The X axis represents the prevalence measured as proportion

“ever use” as definition wherever possible to capture lifetime use. This was done as substance dependence is uncommon in the adolescent age groups and has been seldom reported by studies among medical students. We looked at two important databases, that is, PubMed and Google Scholar. These databases do cover most of the published literature, though the Google Scholar database provides results using a different algorithm than PubMed. Also, smoked and smokeless tobacco users could not be grouped in some of the studies, as there was likely to be an unknown overlap between the two groups. Hence, smoked tobacco was used as the reference category for estimating the prevalence of tobacco use, leading to the underestimation of tobacco users. Also, the maximum prevalence from the reported figures of substance use was taken, though there was heterogeneity in reporting of the outcome measures. Furthermore, the systematic review does not report on the etiological or risk factors for substance use in this population. Such a question would be best addressed by a systematic review with a different approach and encompassing studies that do not necessarily report prevalence figures. And finally, the search strategy might have omitted some studies focused on cannabis or other illicit substance use. Despite the limitations, the study provides insights into the extent of substance use among medical students and provides reasonably reliable quantitative estimates. Since the locally relevant literature is often under-referenced,^[77] the meta-analysis included those studies which are published in non-indexed journals to bring the pertinent evidence into consideration, suitably citing the relevant literature, which might be otherwise skipped.

To conclude, this study suggests that alcohol and tobacco use was present among a substantial proportion of medical students and that illicit substance use may occur in some students. Addressing substance use in these students may prevent substance use disorder from occurring. Future studies can look at the longitudinal trajectories of substance use among medical students as they move into residency or practice. Endeavors may also look into the circumstances

and opinions about cannabis intake and when the use of cannabis is considered problematic. Also, the acceptance and efficacy of peer-led or student welfare activities in reducing the use of substances among medical students can be considered.

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Conflicts of interest

There are no conflicts of interest.

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