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# Prevalence of Cannabis Lifetime Use in Iranian High School and College Students: A Systematic Review, Meta-Analyses, and Meta-Regression

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Milad Nazarzadeh (MSc)<sup>1,2,3</sup>, Zeinab Bidel (MSc)<sup>1</sup>,  
Alireza Mosavi Jarahi (PhD)<sup>4,5</sup>, Keihan Esmaelpour (MD)<sup>2</sup>,  
Walieh Menati (MSc)<sup>1</sup>, Ali Asghar Shakeri (MSc)<sup>3</sup>, Rostam Menati (MSc)<sup>1</sup>,  
Sattar Kikhavani (PhD)<sup>1</sup>, and Kourosh Saki, (PhD)<sup>6</sup>

## Abstract

Cannabis is the most widely used substance in the world. This study aimed to estimate the prevalence of cannabis lifetime use (CLU) in high school and college students of Iran and also to determine factors related to changes in prevalence. A systematic review of literature on cannabis use in Iran was conducted according to MOOSE guideline. Domestic scientific databases, PubMed/Medline, ISI Web of Knowledge, and Google Scholar, relevant reference lists, and relevant journals were searched up to April, 2014. Prevalences were calculated using the variance stabilizing double arcsine transformation and confidence intervals (CIs) estimated using the Wilson method. Heterogeneity was assessed by Cochran's Q statistic and I<sup>2</sup> index and causes of heterogeneity were evaluated using meta-regression model. In electronic database search, 4,000 citations were retrieved, producing a total of 33 studies. CLU was reported with a random effects pooled prevalence of 4.0% (95% CI = 3.0% to 5.0%). In subgroups of high school and college students, prevalences were 5.0% (95% CI = 3.0% to 7.0%) and 2.0% (95% CI = 2.0% to -3.0%), respectively. Meta-regression model indicated that prevalence is higher in college students ( $\beta = 0.089$ ,  $p < .001$ ), male gender ( $\beta = 0.017$ ,  $p < .001$ ), and is lower in studies with sampling versus census studies ( $\beta = -0.096$ ,  $p < .001$ ). This study reported that prevalence of CLU in Iranian students are lower than industrialized countries. In addition, gender, level of education, and methods of sampling are highly associated with changes in the prevalence of CLU across provinces.

## Keywords

cannabis, students, meta-analyses, meta-regression, prevalence

## Introduction

Cannabis (marijuana) is the most widely used substance in the world (Asbridge, Hayden, & Cartwright, 2012). Cannabis has been known to *Homo sapiens* in history and concern has been raised during the past centuries regarding its side effects (Anthony, 2012). Several serious side effects are enumerated for cannabis use such as suppression of rapid eye movement and diffuse slowing of background electroencephalographic activity (Greydanus, Hawver, Greydanus, & Merrick, 2013), chronic cough, sinusitis, conjunctivitis, pharyngitis, and bronchitis (Mallaret, Dal'Bo-Rohrer, & Dematteis, 2005). Increased mortality related to its side effects is reported in countries where the prevalence of cannabis use is high (Greydanus et al., 2013). Also, cannabis use has been associated with

an increased risk of deadly motor vehicle crashes (Asbridge et al., 2012).

According to United Nations Office on Drugs and Crime, the majority of consumers of cannabis were young

<sup>1</sup>Ilam University of Medical Sciences, Ilam, Iran

<sup>2</sup>Shahid Beheshti University of Medical Science, Tehran, Iran

<sup>3</sup>Tehran University of Medical Sciences, Tehran, Iran

<sup>4</sup>Simon Fraser University, Burnaby, British Columbia, Canada

<sup>5</sup>Sabzevar University of Medical Sciences and Health Services, Sabzevar, Iran

<sup>6</sup>Lorestan University of Medical Science, Khorramabad, Iran

## Corresponding Author:

Walieh Menati, Prevention of Psychosocial Injuries Research Center, Ilam University of Medical Sciences, Ilam, Iran.  
Email: waliehmenati@yahoo.com

and the prevalence has been increasing in many countries (Meimandi, Nakhaee, Divsalar, & Dabiri, 2005). Meanwhile, the geographic distribution is very diverse. In Armenia, it is estimated that the prevalence is about 3.0% and in Czech Republic, 45.0% (Greydanus et al., 2013). The distribution in countries of Middle East and western part of Asia is not well studied.

It is established that two of the major cannabis production and distribution routes are in Pakistan and Afghanistan, implicating major problems for the countries around, especially for Iran (United Nations Office on Drugs and Crime, 2003). Studies in Iran have reported different prevalences across the country. In the north and northwest of the country, a lifetime prevalence of 22.2% (Mohammad Poorasl, Vahidi, Fakhari, Rostami, & Dastghiri, 2007) and a point prevalence of 3.6% (Najafi et al., 2007) have been reported.

No systematic review or meta-analyses have been conducted in Iran to estimate a combined prevalence of cannabis use according to different administrative divisions. In addition, the causes of changes in the prevalence across provinces in a country have not been studied. The aim of this study is to systematically review all cross-sectional studies conducted during the past 30 years in order to estimate cannabis lifetime use (CLU) pooled prevalence in high school and college students of Iran as well as determining factors related to changes in prevalence across provinces using meta-regression model.

## Materials and Method

### Search Strategy

The search was conducted for cross-sectional studies or surveys that estimated the prevalence of CLU in each province of Iran that was published since 1979. All domestic scientific databases including Iranmedex, Scientific Information Database, Magiran, Irandoc, Medlib, and IranPsych, as well as international databases, including PubMed/Medline, ISI Web of Knowledge, and Google Scholar, relevant reference lists, and relevant journals were searched up to April 2014. Communication with authors and Iranian experts was done for any additional information or unpublished studies.

Two researchers independently scanned the titles of all retrieved citations, removed duplicates, and identified potentially relevant articles for inclusion. Abstracts from selected articles were then independently reviewed by two researchers for further relevance, and full text manuscripts retrieved when appropriate. In the case of disagreement, a third assessor acted as a mediator.

The search strategy was limited to the Persian and/or English. For the databases search, the combinations of keywords relating to CLU were used. These include the following: "Marijuana," "Marijuana Smoking," "Marijuana abuse," "Hashish," "Cannabis," "Substance," "Drug," "Illicit drug," "Adolescent," "Youth," "School students," "high school students," "student," and "Iran." The search strategy in PubMed was (Marijuana OR "Marijuana Smoking" OR "Marijuana abuse" OR Hashish OR Cannabis OR Substance OR Drug OR "Illicit drug") AND (Adolescent OR Youth OR "School students") AND (Students) AND (Iran). Also, this strategy was modified for each database. EndNote X4 software was employed to manage and scan citations.

### Inclusion and Exclusion Criteria and Quality Assessment

The following exclusion criteria were applied: (a) irrelevant study design such as case-control or clinical trials; (b) inadequate reporting of results, that is, studies not reporting prevalence for CLU; (c) poor quality score (scores below five stars) based on the Newcastle–Ottawa scale (Wells et al., 2014; This scale assigns a maximum of ten stars to each study—five stars for representativeness of the sample, justification of sample size, nonrespondents rate, and ascertainment of the exposure; two stars for comparability [control for confounder and additional factors]; and three stars for ascertainment of the outcomes); (d) articles that were conducted before 1979, and (e) review articles or meta-analyses.

For inclusion into the systematic review, the studies had to meet the following criteria: (a) having clear definition of CLU; (b) having standardized diagnostic criteria for drug abuse/use using the International Classification of Diseases, Classification of Mental and Behavioral Disorders, or Diagnostic and Statistical Manual of Mental Disorders, or direct question in questionnaire and interview; (c) having prevalence proportion for CLU; and (d) place of study should be in Iran.

### Data Extraction and Measures

Information on first author, year of study, method of sampling, sample size, average age, diagnostic instrument, diagnostic criteria, participation rate, geographical location, level of education, and prevalence during lifetime, 1 month later, 1 week later, and current use were extracted independently from every eligible study.

Average age categorized as  $\geq 18$  versus  $\leq 18$  years; level of education: college students and high school

students; gender: male, female, and mixed; sampling methods: census, multistage, stratified, random, and hap-hazard sampling; geographical location: name of provinces. Other variables were considered as continuous in meta-regression analysis.

### Statistical Analysis

Prevalence estimates were calculated using the variance stabilizing double arcsine transformation (Freeman & Tukey, 1950) because the use of the inverse variance weight is inappropriate when dealing with binary data with low prevalence. Also, with this method, studies with zero prevalence can be included in the meta-analyses and their weight considered in combined estimation. In addition, due to zero to very low prevalence of CLU in some studies, confidence intervals (CIs) were calculated using the Wilson method (Newcombe, 1998; Wilson, 1927). The presence of heterogeneity was assessed by Cochran's Q statistic ( $p < .1$ ), combined with  $I^2$  statistic for estimates of inconsistency within the studies. A value of 0% indicates no observed heterogeneity while 100% indicates significant heterogeneity. The  $I^2$  values above 75% were determined as significant heterogeneity warranting analysis with a random effect model to adjust for the observed variability (Higgins, Thompson, Deeks, & Altman, 2003). Potential source of heterogeneity was further explored through subgroup analyses and meta-regression model using likelihood ratio method. In the meta-regression model, variables were examined both in univariable and in a multiple variable models at a significance level of  $<.05$ . All variables were entered in the model (Model 2), because all factors in univariable model (Model 1) were significant. To avoid model instability, only those variables that were significant in Model 2 were entered in speread multiple regression model (Model 3). Egger's test was employed to examine potential publication bias. All analyses were conducted using Stata version 11.2 (Stata Corp LP, College Station, TX) with "metan," "metareg," "metabias," and "propcii" commands.

## Results

### Descriptive Statistics

In an electronic database search, 4,000 citations were retrieved, producing a total of 33 studies from 12 provinces of Iran (Ahmadi, Alishahi, & Alavi, 2004; Ahmadi & Hasani, 2003; Ahmadi & Javadpour, 2001; Ahmadi, Javadpour, & Pridmore, 2009; Ahmadi, Maharlooy, & Alishahi, 2004; Ahmadi & Yazdanfar, 2002; Attari, Asgary, Shahrokhi, Naderi, & Shariatirad, 2012; Dehghani, Zare, Dehghani, Sedghi, & Pormovahed,

2009; Farhadinasab, Allahverdipour, Bashirian, & Mahjoub, 2008; Ghavidel et al., 2012; Jodati, Shakurie, Nazari, & Raufie, 2007; Meimandi et al., 2005; Mohamadi, Shobeiri, & Mahgoob, 2012; Mohammad Poorasl et al., 2007; Mohammadkhani, 2012; Mohammadpoorasl et al., 2012; Mohtasham-Amiri, Jafari-Shakib, & Khalili-Moosavi, 2011; Momtazi & Rawson, 2010; Mortazavi Moghadam, Madarshahian, Tabiei, Pejmankhah, & Sadeghi, 2009; Mustafa et al., 2010; Najafi et al., 2007; Najafi, Zarrabi, Shirazi, Fekri, & Mohseni, 2009; Nakhaee, Ziaaddini, & Karimzadeh, 2009; Nazarzadeh, Bidel, & Carson, 2014; Sajjadi & Sajjadi, 2012; Sarajzadeh & Feizi, 2003; Shams Alizadeh, Moghadam, Mohsenpour, & Rostami Gooran, 2008; Talaie, Mokhber, Fayyazi Bordbar, Javanbakht, & Samari, 2008; Taremiyan, Bolhari, Peirovi, & Tabatabaei, 2005; Zardkhaneh et al., 2011; Zarrabi et al., 2009; Ziaaddini, Zare-zadeh, & Heshmati, 2006; Ziaaddini, Ziaaddini, & Nakhaee, 2013). The characteristics of each included study are reported in Tables 1 to 3 and Figure 1 outlining the details related to the selection process of studies. The studies included a total of 30,972 adolescents and youth (12,931 high school students and 18,041 college students). Fourteen articles reported prevalence in men ( $n = 12,788$ ), nine included mixed gender samples ( $n = 9,177$ ), and nine investigated women ( $n = 9,007$ ). The average age of men (reported in 13 reports) and women (from 7 reports) were 19.6 and 20.8 years, respectively. Average age of the mixed samples was 20.3 years (from 27 studies). Overall, quality assessment of all studies produces medium quality.

### Pooled Prevalence and Subgroup Analysis

A potential publication bias was detected for CLU (Egger's test  $\beta_0 = -1.4$ ;  $p < .001$ ). CLU was reported in 33 surveys with a random effects pooled prevalence of 4.0% (95% CI = 3.0% to 5.0%; Figure 2). Estimates ranged from 0.0% to 23.0% with substantial heterogeneity ( $\chi^2 = 1,424.5$ ,  $p < .001$ ,  $I^2 = 97.8\%$ ). Higher prevalences were identified in smaller studies with smaller weight (Figure 3). Moreover, subgroup analyses based on gender produce evidence of significant difference between three subgroups (Figure 4). In mixed, male, and female subgroups, prevalence were 2.0% (95% CI = 1.0% to 3.0%), 6.0% (95% CI = 4.0% to 9.0%), and 3.0% (95% CI = 2.0% to 6.0%), respectively. Further exploration according to level of education and method of sampling were conducted. For high school and college students subgroups prevalences were 5.0% (95% CI = 3.0% to 7.0%), and 2.0% (95% CI = 2.0% to 3.0%), respectively (Figure 2) and in multistage, random, stratified sampling and

**Table 1.** Description and Characteristics of Included Studies (Only Male).

First author	Year of study	Province	Age in years (M)	Students grade	Sampling methods	Sample size	Measurement tool	Questionnaire			Prevalence (%)			
								Validity (%) or DSM use	Reliability (%)	Response rate (%)	Current	1 week	1 month	Lifetime
Ahmadi, J.	2000	Fars	17.2	High school	Multistage	197	Q	DSM-IV	NM	95.0	3.0	—	—	7.6
Ahmadi, J.	2000	Fars	22.8	College	Multistage	59	Q	DSM-IV	NM	93.0	0.0	—	1.7	10.2
Ahmadi, J.	2000	Fars	24.3	College	Multistage	329	Q	DSM-IV	NM	90.0	4.5	—	—	20.9
Ziaaddini, H.	2001	Kerman	NM	High school	C-A	1,945	Q	NM	NM	94.8	37	11.1	9.3	11.1
Jodati, A. R.	2001	Tabriz	21.3	College	C-D	173	Q	NM	NM	79.0	—	—	—	6.0
Ahmadi, J.	2001	Fars	13.5	High school	Multistage	470	Q	DSM-IV	NM	NM	0.0	—	—	0.2
Mortazavi, G.	2003	Khorasan	Range = 20-24	College	Random	361	Q	NM	NM	87.0	—	—	—	1.9
Najafi, K.	2005	Guilan	Range = 15-20	High school	Random	1,041	Q	NM	66.0	99.0	—	—	—	3.6
Nakhaee, N.	2005	Kerman	NM	High school	Stratified	256	Q	NM	NM	NM	—	—	—	1.6
Poorasi, A.	2005	Tabriz	16.3	High school	Multistage	1,785	Q	90.0	85.0	NM	—	—	—	22.2
Mohamadi, N.	2008	Hamedan	20	College	C-D	430	Q	NM	95.0	86.0	—	—	—	4.1
Ahmadi, J.	2008	Fars	23.03	College	Multistage	150	Q	DSM-IV	NM	78.8	—	—	—	2.3
Zardkhaneh, S.	2011	Survey <sup>a</sup>	Range = 18-35	College	Multistage	3,372	Q	74-90	NM	NM	—	—	—	3.0
Mohammadkhani, S.	2012	Survey <sup>a</sup>	15.5	High school	Multistage	1,283	Q	90.0	NM	95.0	—	—	0.9	2.1
Nazarzadeh, M.	2012	Ilam	17.2	High school	Multistage	937	Q	90.0	85.0	93.7	—	—	—	3.3

Note. NM = not mentioned; DSM-IV = *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition; C-D = census of dormitory; C-A = census of all student in the city; Q = questionnaire; dash (—) in prevalence column indicates not mentioned.

a. Survey includes five universities from whole of Iran: Tehran University, Razi University of Kermanshah, Ferdowsi University of Mashhad, Isfahan University of Technology, and Shahid Bahonar University of Kerman.

**Table 2.** Description and Characteristics of Included Studies (Only Female).

First author	Year of study	Province	Age in years (M)	Students grade	Sampling methods	Sample size	Measurement tool	Questionnaire			Prevalence (%)			
								Validity (%) or DSM	Reliability (%)	Response rate (%)	Current	1 week	1 month	Lifetime
Ahmadi, J.	2000	Fars	15	High school	Multistage	200	Q	DSM-IV	NM	94.0	0.0	—	—	0.0
Ahmadi, J.	2000	Fars	20	College	Multistage	341	Q	DSM-IV	NM	93.0	0.3	—	—	0.9
Ahmadi, J.	2000	Fars	22	College	Multistage	172	Q	DSM-IV	NM	90.0	—	—	—	2.3
Ziaaddini, H.	2001	Kerman	NM	High school	C-A	1373	Q	NM	NM	95.0	15.4	23.1	7.7	23.1
Mortazavi, G.	2003	Khorasan	22	College	Random	509	Q	NM	NM	87.0	—	—	—	0.4
Najafi, K.	2005	Guilan	18	High school	Random	886	Q	NM	66.0	99.0	—	—	—	0.2
Nakhaee, N.	2005	Kerman	NM	High school	Stratified	396	Q	NM	NM	NM	—	—	—	2.6
Ahmadi, J.	2008	Fars	23	College	Multistage	150	Q	DSM-IV	NM	79.0	1.2	—	—	4.7
Zardkhaneh, S.	2011	Survey <sup>a</sup>	27	College	Multistage	4,980	Q	74.0-90.0	NM	NM	—	—	—	0.4

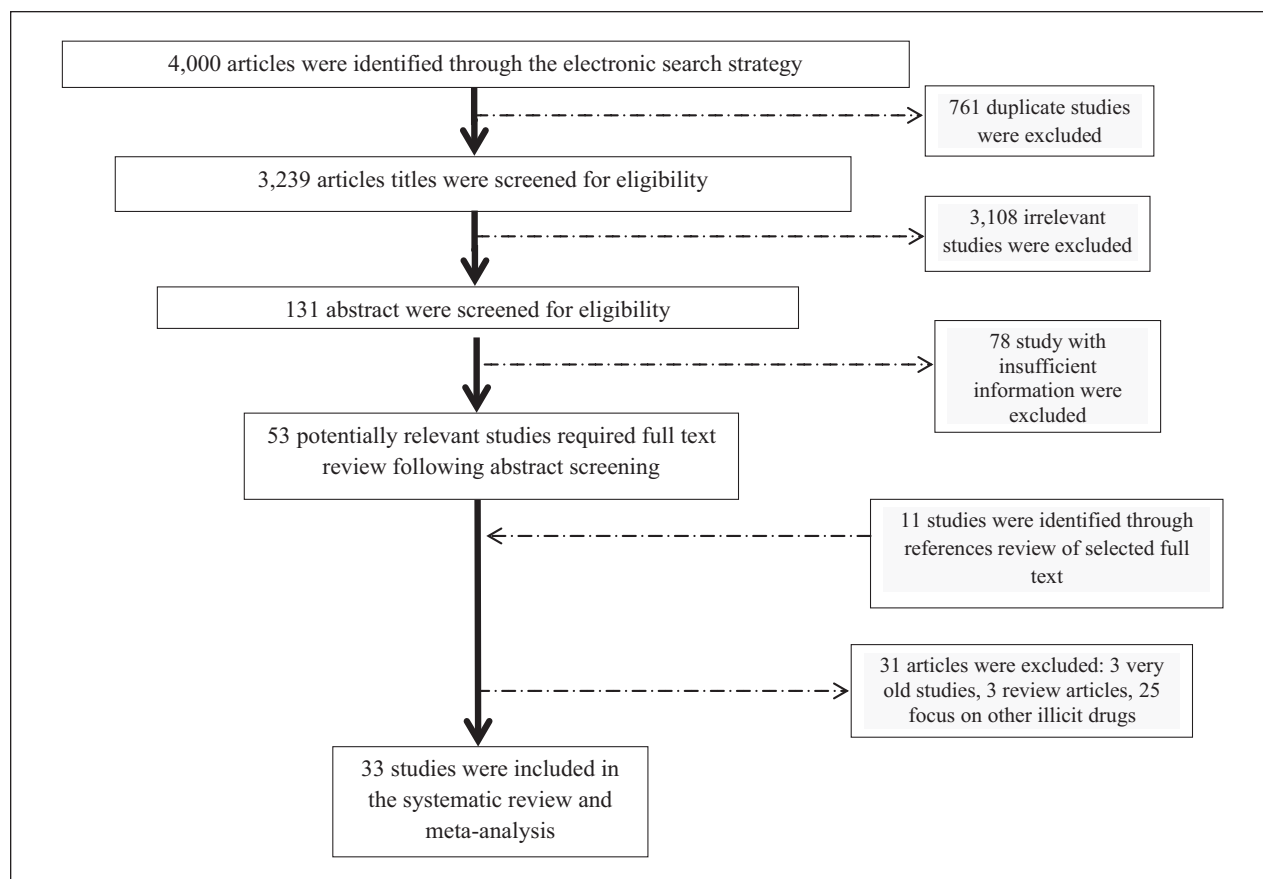
Note. NM = not mentioned; DSM = *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition; C-A = census of all student in the city; Q = questionnaire; dash (—) in prevalence column indicates not mentioned.

a. Survey include five universities from whole of Iran: Tehran University, Razi University of Kermanshah, Ferdosi University of Mashhad, Isfahan University of Technology, and Shahid Bahonar University of Kerman.

**Table 3.** Description and Characteristics of Included Studies (Studies in Which Men and Women Were Not Separated).

First author	Year of study	Province	Age in year (M)	Students Grade	Sampling methods	Sample size	Measurement tool	Questionnaire			Prevalence (%)			
								Validity (%) or DSM use	Reliability (%)	Response rate (%)	Current	1 week	1 month	Lifetime
Ahmadi, J.	2000	Fars	24	College	Multistage	346	Q	DSM-IV	NM	73.0	—	—	—	4.6
Mortazavi, G.	2003	Khorasan	22	College	Multistage	509	Q	NM	NM	87.0	—	—	—	0.4
Mohtasham-Amiri, Z.	2005	Guilan	22	College	Multistage	1,800	Q	NM	NM	94.0	—	—	—	2.4
Attari, M. A.	2006	Esfahan	17	High school	Multistage	537	ELISA	NM	NM	NM	—	—	—	3.2
Zarrabi, H.	2006	Guilan	22	College	Haphazard	827	Q	NM	NM	98.0	—	—	0.4	2.8
Tareman, F.	2006	Tehran	NM	College	Multistage	2,999	Q	NM	NM	99.0	—	—	—	2.2
Sajjadi, S. S.	2008	Fars	NM	High school	Multistage	1,225	Q	NM	74.0-83.0	NM	—	—	—	1.4
Ghavidel, N.	2008	Alborz	17	High school	Multistage	400	Q	NM	72.0	93.0	—	—	0.3	0.3
Dehghani, K.	2009	Yazd	22	College	Multistage	534	Q	NM	86.0	99.0	—	—	—	0.2

Note. NM = not mentioned; Q = questionnaire; DSM = Diagnostic and Statistical Manual of Mental Disorders; ELISA = Enzyme-Linked Immunosorbent Assay; em dash (—) in prevalence column indicates not mentioned.



**Figure 1.** Flowchart of the reviewing process for prevalence of cannabis lifetime use in Iran.

census, pooled prevalences were 4.0% (95% CI = 3.0% to 5.0%), 1.0% (95% CI = 0.0% to 3.0%), 2.0% (95% CI = 0.0% to 4.0%), and 11.0% (95% CI = 3.0% to 19.0%), respectively (Figure 5).

Current, last week, and last month prevalences reported only in few surveys, consequently pooled prevalences were not calculated for them. (Tables 1-3).

### Meta-Regression Model

In univariable meta-regression analyses, newer studies had higher prevalences of CLU ( $\beta$  for study date [year] = 0.0008,  $p < .001$ ), and where the average age was  $\geq 18$  years (vs.  $\leq 18$ ), the prevalence was higher ( $\beta = 0.007$ ,  $p < .001$ ). The college versus high school students had higher prevalence ( $\beta = 0.008$ ,  $p < .001$ ). Also in category of  $\geq 1,000$  sample size versus  $< 1,000$ , prevalence was higher ( $\beta = 0.009$ ,  $p < .001$ ), but where gender was male versus female and mixed, and in multistage, stratified, and random sampling versus census, prevalences were lower ( $\beta = -0.003$ ,  $p < .001$ ;  $\beta = -0.111$ ,  $p < .001$ ), respectively (Table 4, Model 1). In a multiple variable meta-regression model, all of the

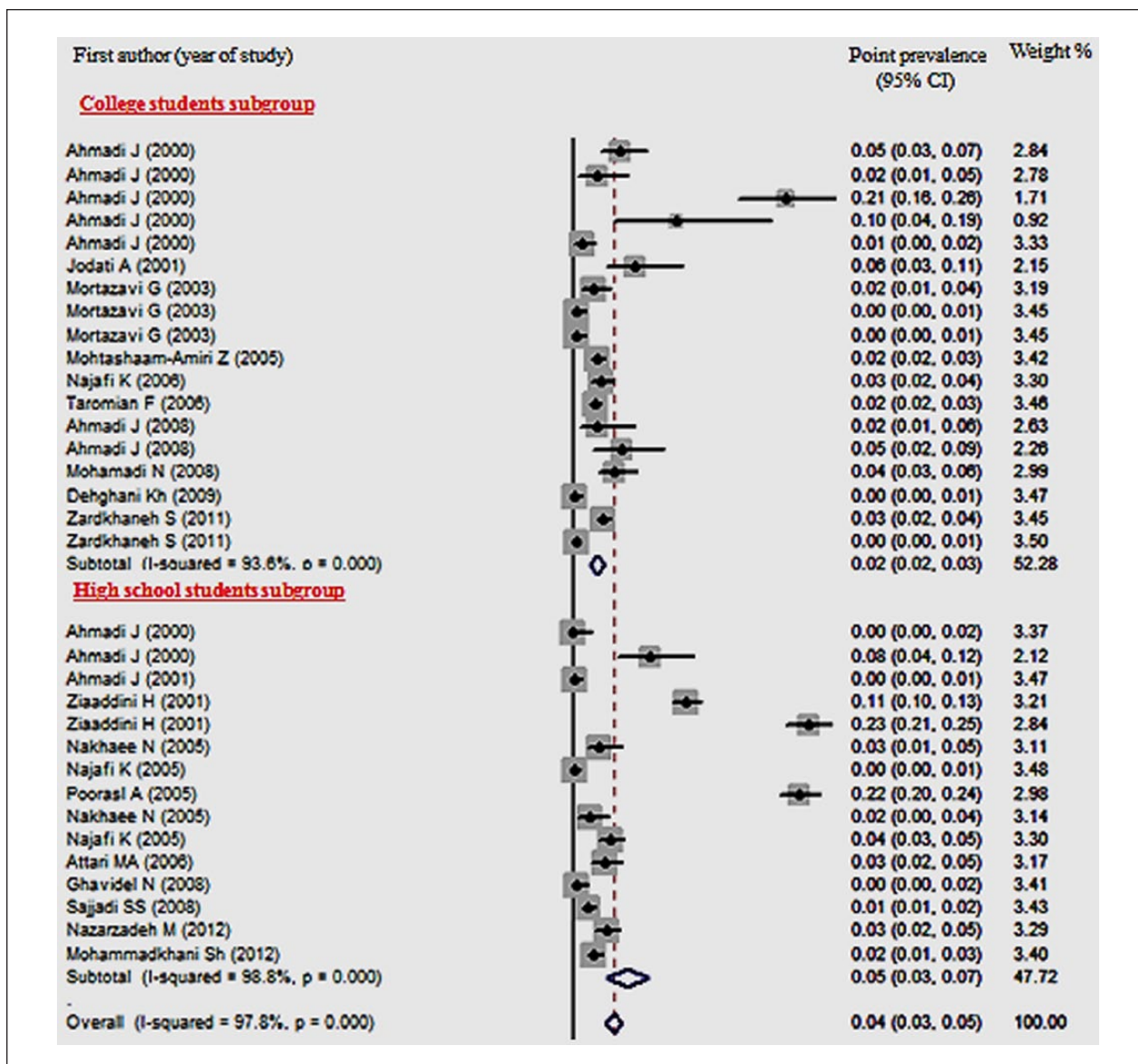
variables were significant except average age (Table 4, Model 2). Consequently, average age was excluded from the Model 3. Model 3 has identified that the prevalence is significantly higher in college students ( $\beta = 0.089$ ,  $p < .001$ ), and in male gender ( $\beta = 0.017$ ,  $p < .001$ ), and is lower in studies with sampling versus census studies ( $\beta = -0.096$ ,  $p < .001$ ).

### Discussion

This systematic review of CLU prevalence in Iranian youth identified 33 surveys including 30,972 subjects. There are four main findings: (a) prevalence of CLU in young Iranian people was 4.0%, (b) higher prevalence in male compared with female and in college students versus high school students, (c) higher prevalence in census based studies versus sampling based studies, (d) little changes to prevalence during past 30 years.

Much research has been conducted to confirm high use of cannabis among adolescents and young adults across communities. The 2007 European School Survey



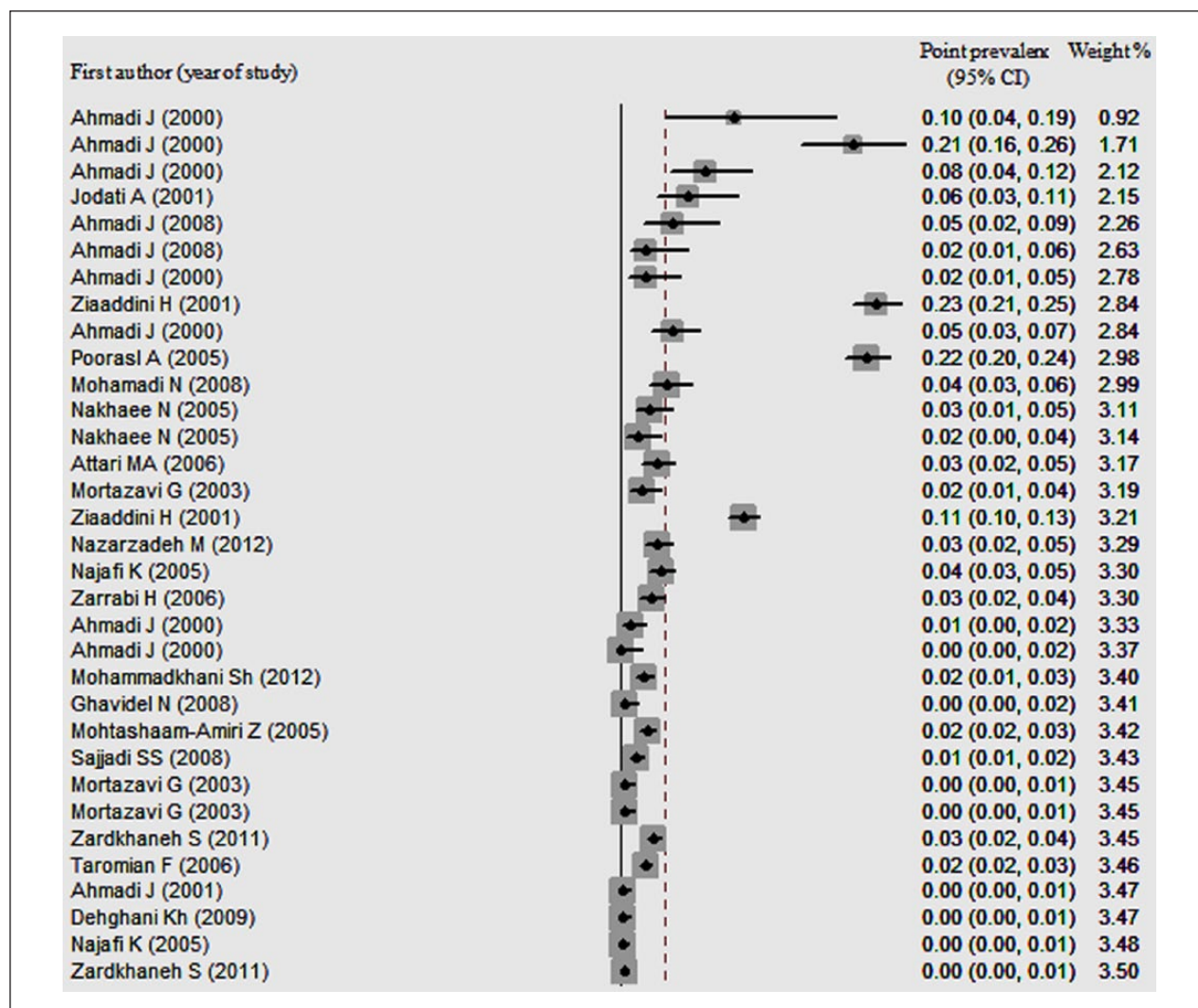


**Figure 2.** Forest plot of studies related to prevalence of cannabis lifetime use in young Iranian population. Data are presented separately for college students and high school students.

Note. Rectangles indicate point prevalence and size of the rectangles represent the weight given to each study in analysis; diamonds and the vertical dashed line indicate the combined point prevalence and horizontal lines indicate 95% confidence intervals.

Project on Alcohol and other Drugs had reported that CLU among students aged 15 to 16 years in Europe is 19.0% in average (among 35 countries) and ranged from 3.0% in Armenia to 45.0% in the Czech Republic (Greydanus et al., 2013). In addition, in Canadian college students, the reported prevalence of cannabis abuse was approximately 30.0% (Fischer et al., 2013). According to the United States Centers for Disease and Prevention's Youth Risk Behavioral Surveillance reports, CLU

prevalence among high school students was 31.3% in 1991, 47.2% in 1999, and 36.8% in 2009 (Eaton et al., 2010). Compared with these international reports, the prevalence of CLU was considerably less in Iran. A primary explanation for this small prevalence might be legal limitations of cannabis and other substances in Iran. In addition, because of the historical background of opium and derivatives use, the prevalence of opium use is higher than other substances such as cannabis in Iran (Siassi &



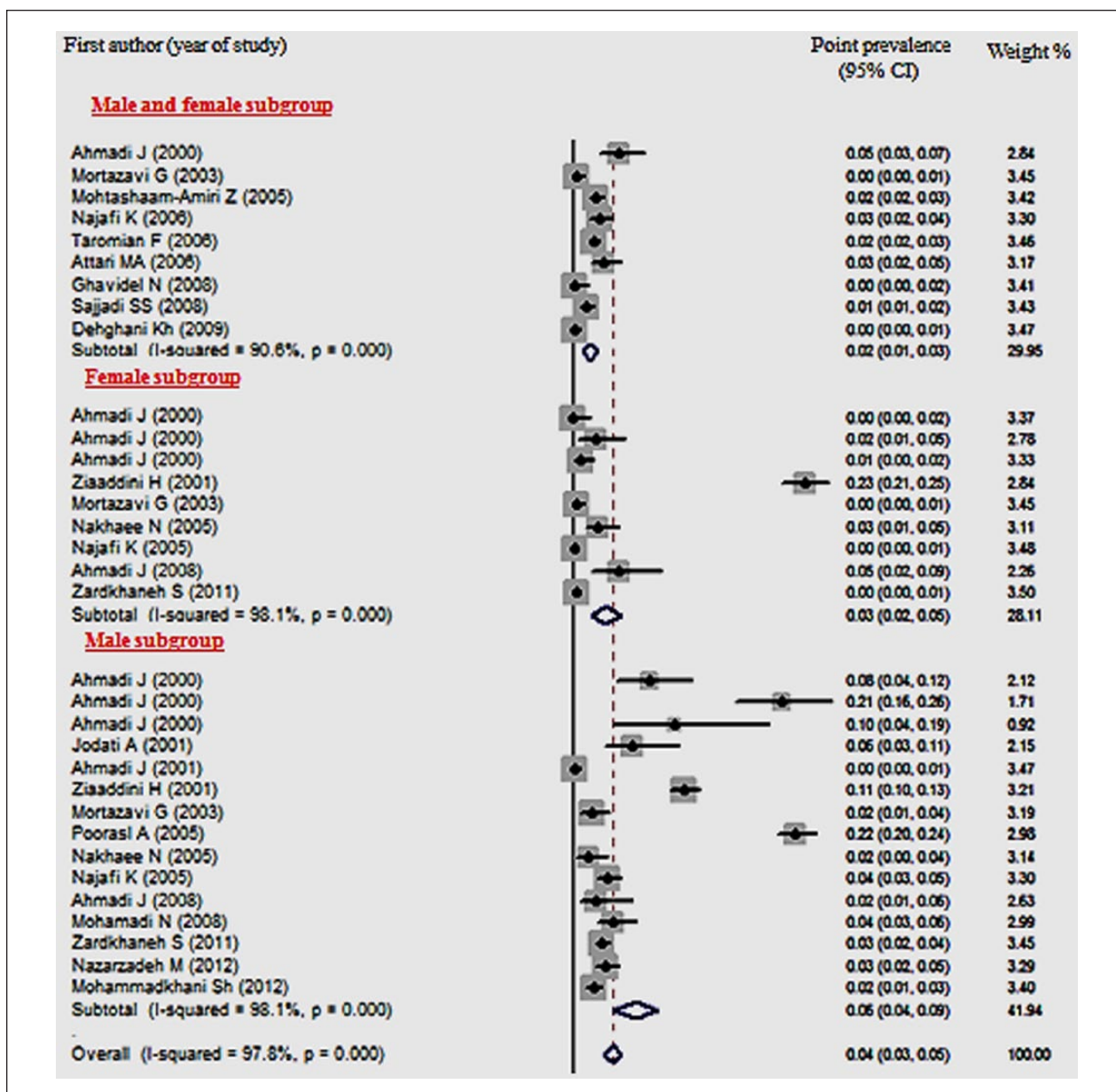
**Figure 3.** Forest plot of studies related to prevalence of cannabis lifetime use in young Iranian population. Studies are sorted by increasing weight in a random effects model.

Note. Rectangles indicate point prevalence and size of the rectangles represent the weight given to each study in analysis; diamonds and the vertical dashed line indicate the combined point prevalence and horizontal lines indicate 95% confidence intervals.

Fozouni, 1980). On the other hand, most of the included studies in these meta-analyses assessed CLU using questionnaires or direct questions. Consequently, false negative answers can be considered as potential low value for pooled prevalence.

This study's finding that the sampling method of studies was significantly associated with prevalences suggests that researchers need to interpret their cross-sectional findings with regard to their methodology specifically with regard to sampling method for which we reported some underestimation. One of the interesting results of this study were the differences in subgroup analyses and

meta-regression results on prevalence between high school and college students. Subgroup analysis indicated that prevalence in high school students is higher than for college students but the meta-regression model had indicated contrast result. It seems possible that these contrasts are due to the confounding role of other variables that were not considered in subgroup analysis. After adjustment for all possible confounders in meta-regression, it was revealed that the prevalence is significantly higher in college students versus high school students. Consequently, the results for subgroup analysis in meta-analyses studies should be interpreted with consideration of other possible



**Figure 4.** Forest plot of studies related to prevalence of cannabis lifetime use in young Iranian population. Data are presented separately for male, female, and mixed.

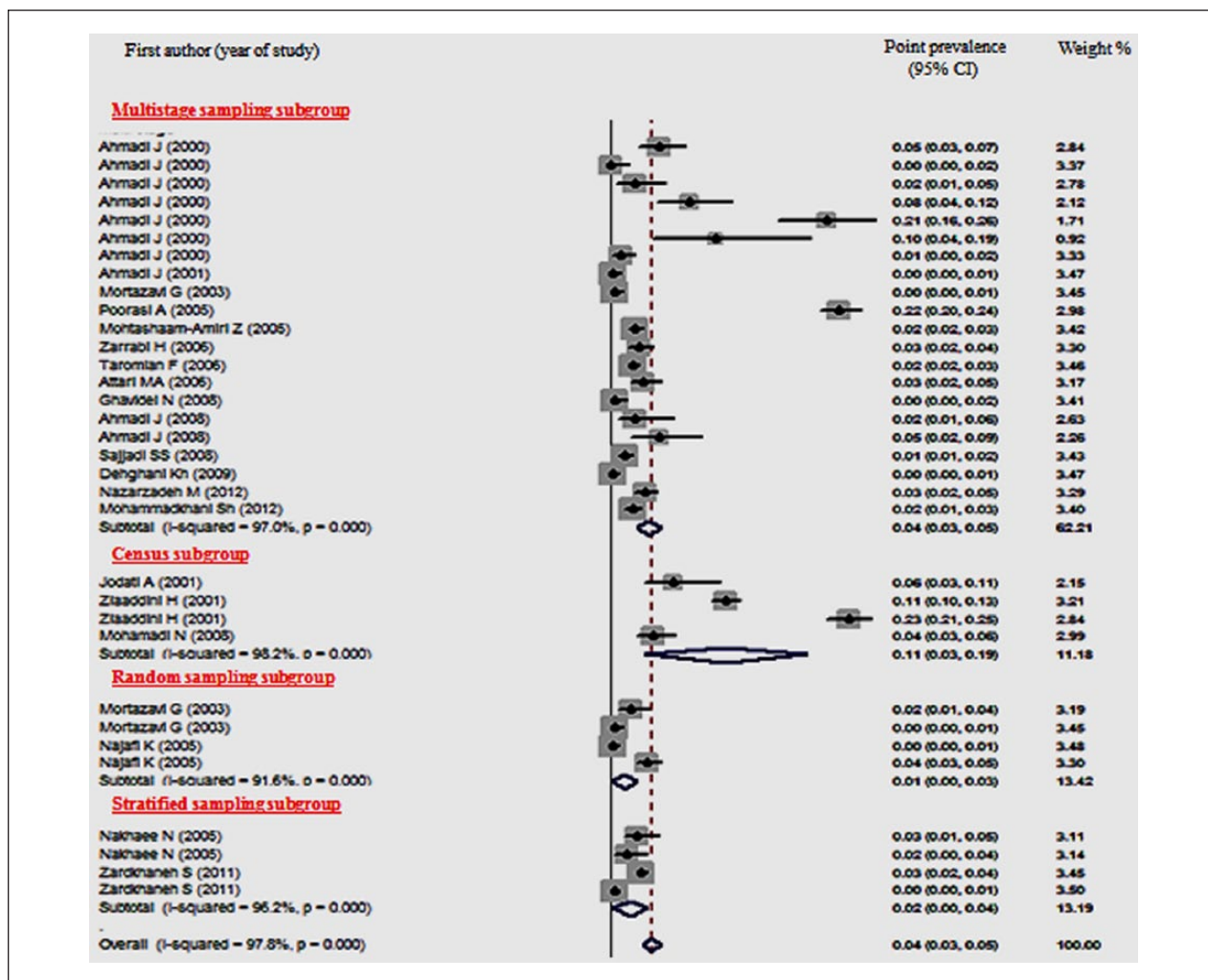
Note. Rectangles indicate point prevalence and size of the rectangles represent the weight given to each study in analysis; diamonds and the vertical dashed line indicate the combined point prevalence and horizontal lines indicate 95% confidence intervals.

confounders. One finding of this review is that future research in prevalence of any drug should provide clear information about study questionnaires and their validity and reliability.

This review is important for enhancing our methodological knowledge of the epidemiology of CLU in adolescents and young adults and provides a more definitive statement on the direction of prevalence changes. Also, it

provides better estimation for prevalences in national studies such as the burden of diseases.

This study does have several limitations, as all pooled analyses contained significant heterogeneity and subsequently should be interpreted with caution. Most studies failed to report questionnaire validity, reliability, and response rate. These characteristics may be a significant source of heterogeneity (Fazel,



**Figure 5.** Forest plot of studies related to prevalence of cannabis lifetime use in young Iranian population. Data are presented separately for sampling methods.

Note. Rectangles indicate point prevalence and size of the rectangles represent the weight given to each study in analysis; diamonds and the vertical dashed line indicate the combined point prevalence and horizontal lines indicate 95% confidence intervals.

**Table 4.** Meta-Regression Analysis<sup>a</sup> of Cannabis Prevalence Heterogeneity Suspected Variables.

Variables	Model 1 <sup>b</sup>			Model 2 <sup>c</sup>			Model 3 <sup>d</sup>		
	$\beta$	SE	p	$\beta$	SE	P	$\beta$	SE	p
Study date (year)	<b>0.0008</b>	<b>0.00006</b>	<b>&lt;.001</b>	<b>-0.0003</b>	<b>0.0001</b>	<b>.04</b>	-0.0002	0.0001	.17
Average age ( $\geq 18$ vs. $\leq 18$ years Ref)	<b>0.007</b>	<b>0.0006</b>	<b>&lt;.001</b>	<b>-0.008</b>	<b>0.006</b>	<b>.14</b>	—	—	—
Level of education (College students vs. high school students Ref)	<b>0.008</b>	<b>0.0006</b>	<b>&lt;.001</b>	<b>0.017</b>	<b>0.006</b>	<b>.005</b>	<b>0.008</b>	<b>0.001</b>	<b>&lt;.001</b>
Gender (Male vs. female and mixed Ref)	<b>-0.003</b>	<b>0.0008</b>	<b>&lt;.001</b>	<b>0.019</b>	<b>0.001</b>	<b>&lt;.001</b>	<b>0.017</b>	<b>0.001</b>	<b>&lt;.001</b>
Sampling methods (Multistage, stratified, and random sampling vs. census Ref)	<b>-0.111</b>	<b>0.004</b>	<b>&lt;.001</b>	<b>-0.019</b>	<b>0.008</b>	<b>.02</b>	<b>-0.096</b>	<b>0.005</b>	<b>&lt;.001</b>
Sample size	<b>0.009</b>	<b>0.001</b>	<b>&lt;.001</b>	<b>0.009</b>	<b>0.001</b>	<b>&lt;.001</b>	0.009	0.001	.09

Note. Significant associations ( $p \leq 0.05$ ) are indicated in bold typeface; Ref = reference group. SE = standard error

a. Likelihood ratio method.

b. Univariable model.

c. Multiple variable model.

d. Variables entered into the model if  $p \leq 0.05$ .

Khosla, Doll, & Geddes, 2008). Moreover, a lack of comprehensive coverage for gray literature containing university databases and research projects, further limit the search.

In conclusion, the results of these meta-analyses indicate that prevalence of CLU in Iranian high school and college students are lower than for industrialized countries. In addition, gender, level of education, and methods of sampling are highly associated with variation in estimation of CLU prevalence.

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