Toward a Global View of Alcohol, Tobacco, Cannabis, and Cocaine Use: Findings from the WHO World Mental Health Surveys

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Abbreviations: AOO, age of onset; OR, odds ratio; WHO, World Health Organization; WMH, World Mental Health; WMHS, World Mental Health Surveys

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ABSTRACT

Background

Alcohol, tobacco, and illegal drug use cause considerable morbidity and mortality, but good cross-national epidemiological data are limited. This paper describes such data from the first 17 countries participating in the World Health Organization's (WHO's) World Mental Health (WMH) Survey Initiative.

Methods and Findings

Household surveys with a combined sample size of 85,052 were carried out in the Americas (Colombia, Mexico, United States), Europe (Belgium, France, Germany, Italy, Netherlands, Spain, Ukraine), Middle East and Africa (Israel, Lebanon, Nigeria, South Africa), Asia (Japan, People's Republic of China), and Oceania (New Zealand). The WHO Composite International Diagnostic Interview (CIDI) was used to assess the prevalence and correlates of a wide variety of mental and substance disorders. This paper focuses on lifetime use and age of initiation of tobacco, alcohol, cannabis, and cocaine. Alcohol had been used by most in the Americas, Europe, Japan, and New Zealand, with smaller proportions in the Middle East, Africa, and China. Cannabis use in the US and New Zealand (both 42%) was far higher than in any other country. The US was also an outlier in cocaine use (16%). Males were more likely than females to have used drugs; and a sex–cohort interaction was observed, whereby not only were younger cohorts more likely to use all drugs, but the male–female gap was closing in more recent cohorts. The period of risk for drug initiation also appears to be lengthening longer into adulthood among more recent cohorts. Associations with sociodemographic variables were consistent across countries, as were the curves of incidence of lifetime use.

Conclusions

Globally, drug use is not distributed evenly and is not simply related to drug policy, since countries with stringent user-level illegal drug policies did not have lower levels of use than countries with liberal ones. Sex differences were consistently documented, but are decreasing in more recent cohorts, who also have higher levels of illegal drug use and extensions in the period of risk for initiation.

The Editors' Summary of this article follows the references.

Introduction

Alcohol, tobacco, and illegal drug use are held responsible for considerable mortality and morbidity [1], but in the most recent World Health Organization (WHO) *Global Burden of Disease* estimates, the authors unanimously asserted that better epidemiological data on use were needed, particularly in less established market economies [2–4]. This paper presents data on lifetime alcohol, tobacco, cannabis, and cocaine use from rigorously conducted field surveys using a common research approach in the first 17 countries to participate in the WHO's *World Mental Health (WMH) Survey* Initiative [5,6]. A number of less established market economies are included in this set of countries.

Cross-national research on diseases and their putative risk factors has long been acknowledged as extremely difficult [7,8]. The creation of an international classification of causes of death advanced this line of inquiry [9], and was followed by the developments of international classifications and measurement approaches for chronic conditions, including mental disorders [10]. Historically, cross-national comparisons for alcohol and tobacco were undertaken using correlation studies of nation-level consumption (e.g., taxation data) plotted in relation to pertinent causes of death (e.g., liver cirrhosis, lung cancer). There is continuing uncertainty, however, about the comparability of death certification practices across countries, and for illegal drugs particularly, official statistics are considered unreliable in many countries [11].

Following refinements in survey research, well-specified and standardised methods were developed for population surveys on alcohol use [12–14], illegal drug use [15], and tobacco use [16]. Cross-national elaboration of these protocols is difficult [14,17], though, and has consequently been limited. More qualitative "rapid assessment" methods, widely adopted in the emerging market economies and valuable for within-country planning purposes, are difficult to use for the purposes of cross-national comparisons [18].

Cross-national comparisons within regions have been conducted in Europe [19–22] and in Panama, Central America, and the Dominican Republic (PACARDO) [23]. Efforts to collate existing survey data on alcohol and tobacco use (and abstention) have been undertaken through the WHO's *Global Status Report on Alcohol* [24] and the *Tobacco or Health: Global Status Report* [25]. Recently, the Global Youth Tobacco Survey (GYTS) [26] and a cross-national survey known as the Gender, Alcohol, and Culture: an International Study (GENACIS) [20], included population surveys of tobacco or alcohol use in selected populations in multiple countries. None of these, though, examined alcohol, tobacco, and illegal drug use concomitantly, in all regions, and across all ages.

The current study presents data on basic epidemiological patterns of alcohol, tobacco, cannabis, and cocaine use in 17 countries participating to date in the WMH surveys [5,6]. The WMH countries include countries in which cannabis use has been strongly prohibited (the US) as well as countries in which a harm reduction policy has long been in place (the Netherlands). The survey also includes cocaine source (Colombia) and consumer (US, Europe) countries.

This paper has the following objectives: (a) document the cumulative (lifetime) use of alcohol, tobacco, cannabis, and cocaine in each country, with some focus on young adults; (b) consider sociodemographic correlates of these types of drug use; and (c) examine the age of onset (AOO) distribution of such drug use.

Method

Participants

Eighteen surveys were carried out in 17 countries in the Americas (Colombia, Mexico, US), Europe (Belgium, France, Germany, Italy, Netherlands, Spain, Ukraine), the Middle East and Africa (Israel, Lebanon, Nigeria, South Africa), Asia (Japan, and separate surveys in Beijing and Shanghai in the People's Republic of China), and Oceania (New Zealand). This set of countries was determined by availability of collaborators in the country who were able to obtain funding for the survey and complete the World Mental Health Surveys (WMHS) protocol. Details of each sample are presented in Table 1 (see also http://www.hcp.med.harvard.edu/wmh/) [27].

All surveys were based on multistage probability samples. All interviews were carried out face-to-face by trained lay interviewers. The six Western European surveys were carried out jointly [28,29]. Consistent use of a standardized interview translation protocol, training procedures, and field quality control monitoring were used to minimize between-country variation in data quality [30].

Sample sizes ranged from 2,372 (Netherlands) to 12,992 (New Zealand), with a total of 85,052 participating adults. Response rates range from a high value of 88% (Colombia) to a low value of 46% (France), with a weighted average response rate of 70%. As described in detail elsewhere [27], internal subsampling was used to reduce respondent burden by dividing the interview into two parts. All participants completed Part I, which included core standardised items to assess conditions of central interest, including whether the participant was a current or former tobacco smoker. Part II included standardised items about correlates and disorders of secondary interest. Part II was administered to an enriched subsample ($n = 43{,}249$) that included 100% of those who met criteria for any Part I disorder and a random subsample of approximately 25% of other Part I respondents. As alcohol and illicit drug use were assessed in Part II, the Part II sample is considered in this report. Part II cases were weighted by the inverse of their probability of selection in order to adjust for differential sampling. There was also poststratification adjustment to bring the sample distributions into balance with population sociodemographic and geographic distributions [6]. The complexity of these adjustments differed across countries depending on the amount of population data available for poststratification. More details about sampling and weighting procedures are discussed elsewhere [27].

Measures

All WMH surveys used the WHO Composite International Diagnostic Interview, Version 3.0 (Composite International Diagnostic Interview [CIDI] 3.0), a fully structured diagnostic interview for psychiatric conditions [5,6]. Within this assessment, participants were asked if they had ever used (a) alcohol, (b) tobacco (cigarettes, cigars, or pipes), (c) cannabis (marijuana, hashish), and (d) cocaine. Those who had used these drugs were asked about the AOO of use of each drug class, except in New Zealand, Japan, France, Germany,

Table 1. Characteristics of Studies Included in the World Mental Health Survey

Country	Survey	Sample Characteristics[a]	Dates	Age	Sample Size			Response Rate[b]
					Part I	Part II	Part II and Age ≤44[4c]	
Belgium	ESEMeD	Stratified multistage clustered probability sample of individuals residing in households from the national register of Belgium residents. NR	2001–2002	18+	2,419	1,043	486	50.6
Colombia	NSMH	Stratified multistage clustered area probability sample of household residents in all urban areas of the country (approximately 73% of the total national population)	2003	18–65	4,426	2,381	1,731	87.7
France	ESEMeD	Stratified multistage clustered sample of working telephone numbers merged with a reverse directory (for listed numbers). Initial recruitment was by telephone, with supplemental in-person recruitment in households with listed numbers. NR	2001–2002	18+	2,894	1,436	727	45.9
Germany	ESEMeD	Stratified multistage clustered probability sample of individuals from community resident registries. NR	2002–2003	18+	3,555	1,323	621	57.8
Italy	ESEMeD	Stratified multistage clustered probability sample of individuals from municipality resident registries. NR	2001–2002	18+	4,712	1,779	853	71.3
Israel	NHS	Stratified multistage clustered area probability sample of household residents. NR	2002–2004	21+	4,859	4,859	2,502	72.6
Japan	WMHJ2002–2003	Unclustered two-stage probability sample of individuals residing in households in four metropolitan areas (Fukiage, Kushikino, Nagasaki, Okayama)	2002–2003	20+	2,436	887	282	56.4
Lebanon	LEBANON	Stratified multistage clustered area probability sample of household residents. NR	2002–2003	18+	2,857	1,031	595	70.0
Mexico	M-NCS	Stratified multistage clustered area probability sample of household residents in all urban areas of the country (approximately 75% of the total national population).	2001–2002	18–65	5,782	2,362	1,736	76.6
Netherlands	ESEMeD	Stratified multistage clustered probability sample of individuals residing in households that are listed in municipal postal registries. NR	2002–2003	18+	2,372	1,094	516	56.4
New Zealand	NZMHS	Stratified multistage clustered area probability sample of household residents. NR	2004–2005	16+	12,992	7,435	4,242	73.3
Nigeria	NSMHW	Stratified multistage clustered area probability sample of households in 21 of the 36 states in the country, representing 57% of the national population. The surveys were conducted in Yoruba, Igbo, Hausa, and Efik languages.	2002–2003	18+	6,752	2,143	1,203	79.3
People's Republic of China	B-WMH, S-WMH	Stratified multistage clustered area probability sample of household residents in the Beijing and Shanghai metropolitan areas.	2002–2003	18+	5,201	1,628	570	74.7
South Africa	SASH	Stratified multistage clustered area probability sample of household residents. NR	2003–2004	18+	4,315	4,315	3,130	87.1
Spain	ESEMeD	Stratified multistage clustered area probability sample of household residents. NR	2001–2002	18+	5,473	2,121	960	78.6
Ukraine	CMDPSD	Stratified multistage clustered area probability sample of household residents. NR	2002	18+	4,725	1,720	541	78.3
US	NCS-R	Stratified multistage clustered area probability sample of household residents. NR	2002–2003	18+	9,282	5,692	3,197	70.9

[a]Most WMH surveys are based on stratified multistage clustered-area probability household samples in which samples of areas equivalent to counties or municipalities in the US were selected in the first stage followed by one or more subsequent stages of geographic sampling (e.g., towns within counties, blocks within towns, households within blocks) to arrive at a sample of households, in each of which a listing of household members was created and one or two people were selected from this listing to be interviewed. No substitution was allowed when the originally sampled household resident could not be interviewed. These household samples were selected from census area data in all countries other than France (where telephone directories were used to select households) and the Netherlands (where postal registries were used to select households). Several WMH surveys (Belgium, Germany, Italy) used municipal resident registries to select respondents without listing households. The Japanese sample is the only totally unclustered sample, with households randomly selected in each of the four sample areas and one random respondent selected in each sample household. Nine of the 15 surveys are based on nationally representative (NR) household samples, while two others are based on nationally representative household samples in urbanized areas (Colombia, Mexico).

[b]The response rate is calculated as the ratio of the number of households in which an interview was completed to the number of households originally sampled, excluding from the denominator households known not to be eligible either because of being vacant at the time of initial contact or because the residents were unable to speak the designated languages of the survey.

[c]All countries, with the exception of Nigeria, People's Republic of China, and Ukraine (which were age restricted to ≤39) were age restricted to ≤44.

B-WMH, The Beijing World Mental Health Survey; CMDPSD, Comorbid Mental Disorders during Periods of Social Disruption; ESEMeD, The European Study of the Epidemiology of Mental Disorders; LEBANON, Lebanese Evaluation of the Burden of Ailments and Needs of the Nation; M-NCS, The Mexico National Comorbidity Survey; NCS-R, The US National Comorbidity Survey Replication; NHS, Israel National Health Survey; NR, nationally representative; NSMH, The Colombian National Study of Mental Health; NSMHW, The Nigerian Survey of Mental Health and Wellbeing; NZMHS, New Zealand Mental Health Survey; SASH, South Africa Health Survey; S-WMH, The Shanghai World Mental Health Survey; WMHJ2002–2003, World Mental Health Japan Survey.

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Belgium, the Netherlands, Italy, and Spain, where age of first tobacco smoking was not assessed.

Sex and age of all participants was recorded. The following covariates defined as at year of interview were also studied: (a) completed years of education (grouped as: no education, some primary, primary finished, some secondary, secondary finished, some college, and college or more); (b) relationship status (never married, previously married, married-cohabitating); (c) employment (homemaker, retired, other [including unemployed], working/student); and (d) family income (low, low-average, high-average, and high, defined via assessment of total household income, with in-country medians calculated). In the case of household income, the standard international labour economics method [31] was used to define low-income respondents as those whose after-tax household income per family member was less than half the median within their country. Low-average income was defined as up to the median income per family member in the country. High-average income was defined as income per family member above the median up to three times the median, while high income was defined as income per family member above three times the population median.

Retrospective AOO reports were based on a question series designed to avoid the implausible response patterns obtained in using the standard Composite International Diagnostic Interview [CIDI] AOO question [32]. Experimental research shows this question sequence yields responses with much more plausible AOO distributions than the standard Composite International Diagnostic Interview [CIDI] AOO question [33]. Although AOO questions were asked both about important symptoms (e.g., first panic attack) and full syndromes, the ages used here are for first use of each drug.

Training and Field Procedures

The central WMH staff trained bilingual supervisors in each country. Consistent interviewer training documents and procedures were used across surveys. The WHO translation protocol was used to translate instruments and training materials. Standardized descriptions of the goals and procedures of the study, data uses and protection, and participants' rights were provided in written and verbal form to all respondents before verbal informed consent was secured. Quality control protocols were standardized across countries to check on interviewer accuracy and to specify data cleaning and coding procedures. The institutional review board of the organisation that coordinated the survey in each country approved and monitored compliance with procedures for obtaining informed consent and protecting participants. A more detailed discussion of these procedures is presented elsewhere [27,30].

Data Analysis

The cumulative incidence of use was estimated in the conventional fashion, as the proportion of respondents who ever had a given disorder up to their age at interview. AOO distributions and projected lifetime risk at given ages were estimated using the two-part actuarial method implemented in SAS 8.2 [34]. The actuarial method differs from the more familiar Kaplan-Meier [35] method in using a more accurate way of estimating the timing of onsets within a given year [36], although both methods assume constant conditional risk of onset at a given year of life across cohorts. Sociodemographic predictors of lifetime risk were examined using discrete-time survival analysis with person-year as the unit of analysis [37]. The predictors considered here were sex, cohort, and a sex-by-cohort interaction. Cohort was defined by age at interview. We also examined a categorical version of the cohort variable, which distinguished respondents who were in the age ranges 18–29, 30–44, 45–59, and $\geq$60 y at interview. The sex-by-cohort interaction was examined to determine if the well-known gender difference in drug use has become smaller in recent years in some or all countries studied. Sociodemographic correlates of lifetime use at the time of interview were examined using logistic regression analysis [38]. Sociodemographic variables (e.g., family income, relationship status) were coded as of the time of interview, not as of the time of first drug use, which means that the associations examined might reflect influences of previous drug use on sociodemographic characteristics. It is consequently illegitimate to interpret the associations in temporal terms. Instead, the associations provide only cross-sectional descriptive information. Standard errors of cumulative incidence estimates, survival coefficients, and logistic regression coefficients were estimated using the Taylor series linearisation method [39] implemented in the SUDAAN software system [40,41]. Survival coefficients, logistic regression coefficients, and their 95% confidence intervals were exponentiated and are reported in the form of odds ratios (ORs) for ease of interpretation. Multivariate significance tests were made with Wald χ^2 tests using design-based coefficient variance-covariance matrices. Significance tests were consistently evaluated at the 0.05 level with two-sided tests.

Results

Cumulative Lifetime Incidence

Clear differences can be seen in the cumulative (lifetime) incidence of drug use across countries (Table 2). Lifetime alcohol use was reported by the vast majority of respondents in the Americas, Europe, Japan, and New Zealand, while considerably smaller proportions of respondents ever used alcohol in the Middle East, Africa, and China. Lifetime tobacco use was most common in the US (74%), Lebanon (67%), Mexico (60%), and in some European countries (Netherlands, 58%; Ukraine, 60%), with by far the lowest proportions in the African countries (South Africa, 32%; Nigeria, 17%). The proportions of respondents who ever used cannabis were highest in the US (42%) and New Zealand (42%), whereas lifetime cannabis use was virtually nonexistent in the Asian countries (Table 2). The US was an outlier in lifetime cocaine use, with 16% of respondents reporting that they had tried cocaine at least once compared to 4.0%–4.3% in Colombia, Mexico, Spain, and New Zealand, and extremely low proportions in countries in the Middle East, Africa, and Asia.

AOO Distributions

Figure 1 presents country-specific data on the AOO distributions of drug use among those reporting use of each drug type. As is clear from these graphs, there was remarkable similarity in the AOO distributions for specific types of drugs across countries. The median AOO was between 16–19 y for alcohol for all countries except South Africa (20 y), and for

Table 2. Estimated Cumulative Incidence of Drug Use

Region	Country	Unweighted *n*	Alcohol		Tobacco		Cannabis		Cocaine	
			Percent	SE	Percent	SE	Percent	SE	Percent	SE
Americas	Colombia	4,426	94.3	0.5	48.1	1.2	10.8	0.6	4.0	0.4
	Mexico	5,782	85.9	0.6	60.2	0.9	7.8	0.5	4.0	0.4
	US	5,692	91.6	0.9	73.6	1.2	42.4	1.0	16.2	0.6
Europe	Belgium	1,043	91.1	1.8	49.0	2.2	10.4	1.6	1.5	0.6
	France	1,436	91.3	1.2	48.3	2.1	19.0	1.6	1.5	0.4
	Germany	1,323	95.3	0.9	51.9	1.9	17.5	1.6	1.9	0.5
	Italy	1,779	73.5	1.8	48.0	1.3	6.6	0.8	1.0	0.3
	Netherlands	1094	93.3	1.4	58.0	1.9	19.8	1.3	1.9	0.2
	Spain	2,121	86.4	1.1	53.1	1.8	15.9	1.3	4.1	0.7
	Ukraine	1,719	97.0	0.6	60.6	1.8	6.4	1.0	0.1	0.0
Middle East and Africa	Israel	4,859	58.3	0.8	47.9	0.7	11.5	0.5	0.9	0.1
	Lebanon	1,031	53.3	3.0	67.4	2.6	4.6	0.9	0.7	0.3
	Nigeria	2,143	57.4	1.6	16.8	1.1	2.7	0.5	0.1	0.1
	South Africa	4,315	40.6	1.2	31.9	1.1	8.4	0.6	0.7	0.3
Asia	Japan	887	89.1	1.6	48.6	2.0	1.5	0.4	0.3	0.3
	People's Republic of China	1,628	65.4	1.8	53.1	1.8	0.3	0.1	0.0	0.0
Oceania	New Zealand	12,790	94.8	0.3	51.3	0.7	41.9	0.7	4.3	0.3

Data from the World Mental Health Surveys ($n = 54,068$). Note: weighted cumulative incidence proportions. Standard error (SE) from Taylor series linearisation.
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tobacco in all countries except Nigeria (21 y) and China (20 y). The median AOO of illegal drug use was slightly older in all countries. For cannabis, median AOO was between 18–19 y, with the exception of Nigeria and Israel (both 22 y) and Lebanon (21 y). Cocaine use typically began at a slightly older age, with median AOO between 21–24 y for all countries where sufficient data were available to make an estimate.

Equally remarkable as the consistent median AOO across countries is the age range of risk. Fully half the people who had ever used alcohol began using in the 7-y age range between 14–21 y. The interquartile range (IQR) (i.e., 25th–75th percentiles) of AOO distributions were typically 15–21 y for tobacco, 16–22 y for cannabis, and 19–28 y for cocaine.

Cross-National Differences in Lifetime Incidence in Recent Cohorts

Table 3 characterises the drug use history of young adults (22–29 y) in each country by age. Alcohol use by age 15 y was far more common in European countries than in the Middle East and Africa. By age 21 y, the vast majority of young adults in European countries (76%–99%), Japan (92%), New Zealand (94%), and the Americas (78%–93%) had begun using alcohol; estimates were lower in the Middle East and Africa (40%–63%). In the Netherlands, Belgium, France, Germany, and New Zealand, >60% of young people had started to drink by age 15 y. With three exceptions (South Africa, Lebanon, and Nigeria), this threshold value of 60% was crossed by age 21 y in all countries studied, with especially large proportions starting to drink between ages 15 and 21 y in the Ukraine and Japan.

Data on age at first tobacco smoking were available for fewer countries; nonetheless, among those aged 22–29 y, an estimated 46% of young adults in the Ukraine had started to smoke by age 15 y, and 72% by age 21 y; similar estimates were obtained in the US (44% and 72%, respectively). Nigeria had the smallest estimated cumulative incidence proportion for tobacco smoking by age 15 y (7%), and the following intermediate estimates were observed: Israel (9%), South Africa (11%), Colombia (12%), Peoples' Republic of China (15%), Lebanon (18%), Mexico (21%). The rank ordering of countries with respect to use by age 21 y was almost identical (Table 3).

Differences in illegal drug use were more marked among young adults: by age 15 y, those in New Zealand (27%) and the US (20%) had the highest levels of cannabis use, with almost no use in Asia, Middle East, or Africa among this cohort. Few young adults in the Netherlands had used cannabis by age 15 y (7%; Table 3). The majority of young adults in New Zealand (62%) and the US (54%) had used by age 21 y, compared to 35% of those in the Netherlands.

Among this youngest cohort, cocaine use was extremely rare in all countries at age 15 y. By age 21 y, young adults in the US had by far the highest cumulative incidence of cocaine use (16%; Table 3). In Colombia (the only cocaine-producing country in this group) the estimate was 3%; and for the Netherlands, 1%.

Sex and Cohort Differences in Lifetime Risk

Table 4 presents the results of discrete-time survival analyses examining the association between cohort and first onset of use of each drug type. The model adjusts for age differences in the cohorts by examining differential risk at each year of life assuming linear associations between cohort and risk. The associations are remarkably consistent across countries and drug types, in that every one of the ORs is <1.0, indicating that risk at any given age is consistently higher in more recent cohorts than in older cohorts. The ORs have been normed to reflect relative-odds per 10 y of life. An OR of 0.8, for example, indicates that the odds of first use in any given year of life is, on average, only 80% as high among respondents who were age A at the time of interview compared to respondents who were age $A - 10$ y at interview.

These coefficients assume, possibly incorrectly, that the same relative-odds hold throughout the life course and

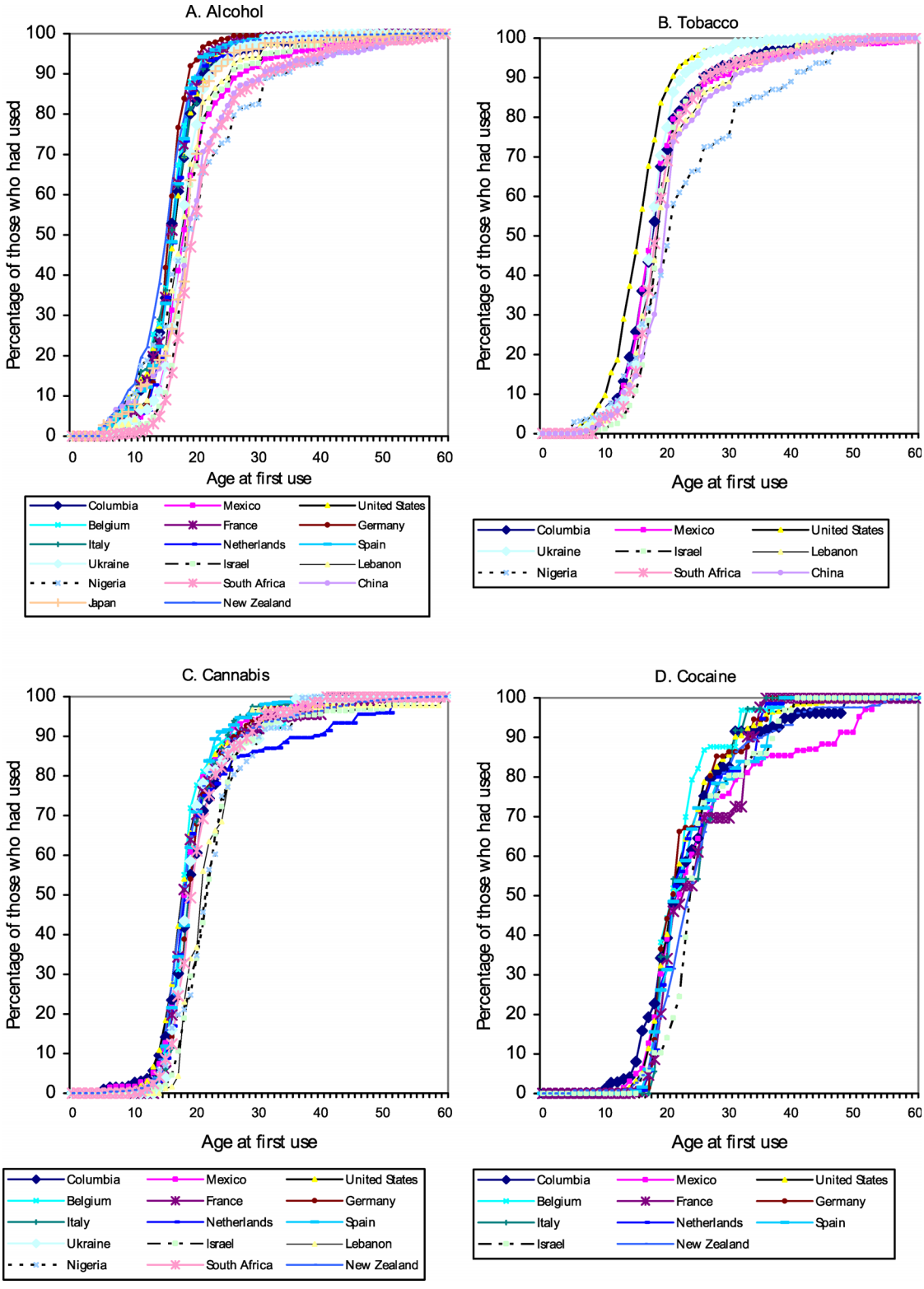

Figure 1. AOO of Drug Use among Those Reporting Any Use by Country

Note: Where lines are not presented for an individual country, either there was no assessment of the AOO of that drug, or fewer than 30 persons reported having used the drug (see Tables 2 and 5).

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Table 3. Estimated Cumulative Incidence of Drug Use by Age 15 and 21 y among 22–29 y Olds

Region	Country	Unweighted *n*	Alcohol				Tobacco				Cannabis				Cocaine			
			By 15 y		By 21 y		By 15 y		By 21 y		By 15 y		By 21 y		By 15 y		By 21 y	
			Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE
Americas	Colombia	4,426	57.4	2.3	92.2	1.2	12.3	1.3	37.5	1.9	2.9	0.6	10.2	1.2	0.8	0.3	3.1	0.8
	Mexico	5,782	29.0	1.9	77.5	1.2	21.4	1.4	52.5	1.6	2.2	0.5	8.0	1.1	0.6	0.3	4.1	0.7
	US	5,692	50.1	2.5	93.1	1.3	43.6	2.4	71.6	2.8	20.2	1.8	54.0	2.8	2.5	0.8	16.3	1.6
Europe	Belgium	1,043	67.0	8.3	88.5	6.1	—[a]	—	—[a]	—	4.7	2.5	22.2	6.6	0.0	0.0	0.6	0.4
	France	1,436	68.2	3.2	94.5	2.2	—[a]	—	—[a]	—	15.3	4.3	44.1	5.3	0.0	0.0	1.9	1.3
	Germany	1,323	82.1	3.2	97.8	1.1	—[a]	—	—[a]	—	13.0	3.3	41.0	4.8	0.0	0.0	6.1	2.7
	Italy	1,779	44.9	3.6	76.3	3.6	—[a]	—	—[a]	—	3.3	1.1	13.7	2.5	0.0	0.0	0.9	0.6
	Netherlands	1,094	59.6	7.7	89.7	6.4	—[a]	—	—[a]	—	7.0	3.0	34.6	7.1	0.0	0.0	1.0	0.6
	Spain	2,121	52.8	4.8	92.1	2.1	—[a]	—	—[a]	—	8.5	2.6	27.7	4.4	0.1	0.1	5.3	1.8
	Ukraine	1,719	39.3	3.9	98.5	1.1	46.0	4.9	72.1	3.9	1.3	0.7	12.3	2.6	—[b]	—	—[b]	—
Middle East and Africa	Israel	4,859	15.2	1.2	62.7	1.6	8.9	0.9	43.2	1.6	0.3	0.2	13.7	1.1	0.0	0.0	0.5	0.2
	Lebanon	1,031	24.3	5.2	45.8	6.5	18.0	2.8	51.1	6.4	0.4	0.3	5.7	2.7	—[b]	—	—[b]	—
	Nigeria	2,143	31.4	3.2	52.5	3.1	6.9	1.7	10.1	1.7	0.2	0.2	1.9	0.9	—[b]	—	—[b]	—
	South Africa	4,315	9.4	1.4	39.5	2.0	11.0	1.6	31.0	1.6	1.6	0.5	11.0	1.4	—[b]	—	—[b]	—
Asia	Japan	887	30.4	6.7	91.9	5.8	—[a]	—	—[a]	—	—[b]	—	—[b]	—	—[b]	—	—[b]	—
	People's Republic of China	1,628	31.7	5.1	73.6	5.2	15.2	3.7	54.7	5.0	—[b]	—	—[b]	—	—[b]	—	—[b]	—
Oceania	New Zealand	12,790	74.1	1.5	94.1	0.9	—[a]	—	—[a]	—	26.8	1.4	61.8	1.5	0.1	0.1	5.0	0.8

Data from the World Mental Health Surveys. Weighted data, Taylor series linearisation for variance estimation.
[a]Not asked in this country.
[b]Fewer than 30 persons in the entire sample of this country used this drug, so estimates have not been produced.
SE, standard error.
doi:10.1371/journal.pmed.0050141.t003

linearly across the age range of respondents at the time of interview, but simplifying assumptions of these sorts are needed to grasp such a wide range of associations all at once. These assumptions are investigated next, but within the context of these limitations, the data are clear in showing that the dominant tendency in the data across countries, and across drug types, is for risk to have increased over historical time, defined by the life courses of the respondents in these surveys.

The easiest way to investigate the linearity assumption in Table 4 is to examine AOO distributions across cohort, so as to determine the extent to which between-cohort divergence can be seen consistently over the life course. Such data are presented in Figure 2, where the AOO distributions of drug use are reconstructed based on retrospective AOO reports using the actuarial method pooled across countries.

Focusing first on the AOO curves for alcohol use, we can see a clear nonlinear association across cohorts, with respondents in the oldest cohort having a substantially lower AOO curve than respondents in the more recent cohorts. Although there is some evidence of higher risk of beginning use in the late teens among the youngest compared to the intermediate-aged cohorts, this difference is much less dramatic than the evidence of lower risk in the oldest cohort. It is also noteworthy that the intercohort variation, although discernible prior to the late teens, is relatively small up to this point in the life course, by which time roughly 60% of respondents in each age cohort had started to drink. It was largely in later-onset use rather than early-onset use that the intercohort variation emerged most clearly, with initiation of alcohol use continuing later on into young adulthood for those in the younger cohorts.

For tobacco, the interval for risk of starting use was similar, but the cumulative level was lower. There were no intercohort differences until around age 21 y, by which age around 40% in each cohort had used. Of notable significance, as for alcohol, were the changes across cohorts after this age. The highest overall level of use, reflecting continued initiation into the mid-20s, was in the second oldest cohort; lower cumulative levels (reflecting less initiation during the same period of life) were observed among those in the two youngest cohorts.

The interval of risk for starting cannabis use began in late adolescence and continued far longer in life for all cohorts, but very large intercohort differences were observed here, with the oldest cohort dramatically lower than all others, and the two youngest cohorts much higher than the second oldest cohort. Clear and important age-specific differences were also evident across cohorts: the two youngest cohorts were very similar until the age of around 18 y in their cumulative incidence of drug use—but initiation of cannabis use continued to occur at a higher level following this age. A similar and more marked difference between the second and third cohorts was also evident, with initiation of cannabis use highly unlikely to occur for the second oldest cohort after the age of around 25 y. Clearly, then, two trends are evident: early onset use is greater for the three youngest cohorts than for the oldest, but much more marked is the fact that with each successive cohort, there is a prolongation of the period of risk for initiation of cannabis use far beyond adolescence.

The estimated cumulative incidence of cocaine use to age

Table 4. Estimated Association between Cohort and Lifetime Risk of Each Drug, by Country

Region	Country	Alcohol		Tobacco		Cannabis		Cocaine	
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Americas	Colombia	0.7*	0.7–0.7	1.0	0.9–1.0	0.7*	0.6–0.8	0.5*	0.4–0.6
	Mexico	0.7*	0.7–0.7	0.8*	0.8–0.8	0.5*	0.4–0.6	0.2*	0.1–0.3
	US	0.8*	0.8–0.8	0.9*	0.9–0.9	0.6*	0.6–0.6	0.5*	0.5–0.6
Europe	Belgium	0.8*	0.8–0.9	—[a]	—	0.2*	0.1–0.3	0.1*	0.0–0.3
	France	0.8*	0.8–0.9	—[a]	—	0.3*	0.2–0.4	0.4*	0.3–0.6
	Germany	0.8*	0.8–0.9	—[a]	—	0.4*	0.3–0.5	0.2*	0.1–0.3
	Italy	0.9*	0.8–0.9	—[a]	—	0.3*	0.3–0.4	0.6*	0.4–0.9
	Netherlands	0.8*	0.8–0.9	—[a]	—	0.5*	0.4–0.5	0.5*	0.3–1.0
	Spain	0.8*	0.8–0.8	—[a]	—	0.4*	0.3–0.4	0.3*	0.2–0.3
	Ukraine	0.8*	0.8–0.8	0.7*	0.7–0.8	0.4*	0.3–0.5	—[b]	—
Middle East and Africa	Israel	0.8*	0.7–0.8	0.9*	0.8–0.9	0.4*	0.3–0.4	0.4*	0.3–0.5
	Lebanon	0.8*	0.8–0.9	0.8*	0.7–0.9	0.6*	0.4–0.9	—[b]	—
	Nigeria	0.9*	0.8–0.9	1.2*	1.1–1.3	0.8	0.6–1.0	—[b]	—
	South Africa	0.8*	0.7–0.8	0.9*	0.8–0.9	0.6*	0.5–0.7	—[b]	—
Asia	Japan	0.7*	0.7–0.8	—[a]	—	—[b]	—	—[b]	—
	People's Republic of China	0.7*	0.6–0.8	0.8*	0.7–0.9	—[b]	—	—[b]	—
Oceania	New Zealand	0.8*	0.8–0.9	—[a]	—	0.5*	0.5–0.5	0.4*	0.4–0.5

Note: Results are based on a multivariable discrete-time survival model with person-year as the unit of analysis, in which predictors included cohort, sex, and person-year. Cohort in this case is defined as a continuous variable.

[a]Not asked in this country.

[b]Fewer than 30 persons in the entire sample of this country used this drug, so estimates have not been produced.

*, significant at $p < 0.05$, two-sided test.

CI, confidence interval.

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60 y was much lower than for the other drugs, making it difficult to derive a useful "interval of risk," but the intercohort differences appeared more linear—as can be seen in Figure 2, the distance between curves for adjacent cohorts was fairly consistent. Also clear is the fact that for most cohorts, initiation of cocaine use continued into the third decade of life, flattening after age 30 y. It is unclear whether such a trend would be observed when the youngest cohort reached their thirties (given they have not yet passed that age).

Are Women Catching Up to Men?

Table 5 presents country-specific estimates of the sex-age interaction predicting incident drug use, again derived from a discrete-time survival model. Sex was coded 1 for female and 0 for male in this model. Evidence of women becoming more similar to men in more recent cohorts would be indicated by a sex-by-cohort interaction OR that was <1.0: this would mean that the relative-odds of use among women compared to men were lower in older cohorts than younger cohorts.

A negative interaction of exactly this sort was found fairly consistently across countries. All 17 interactions for alcohol use were <1.0 (14 of them significant at the 0.05 level). Seven of nine interactions were <1.0 in predicting tobacco use (five of them significantly so). The comparable counts were 13 of 15 interactions (five significant) in predicting use of cannabis, and six of 11 (two significant) in predicting cocaine use. It is noteworthy that the interactions are less consistent for illegal drugs, although the pattern is in the same direction as for the legal drugs.

Table 6 examines the possibility that given the sex-age interactions presented in Table 5 above, that younger age groups may no longer have sex differences in risk of incident use (given that the differences were particularly marked among older age groups). Two columns are shown for each drug type: one for the entire sample, and one for those aged 18–29 y, each being the ratio of cumulative incidence estimates according to sex (in any given year of life), derived from discrete-time survival models. As can be seen, for the overall sex association, there was an almost universal association across countries and drug types, whereby women were less likely than men in any given year of life to initiate drug use of all kinds. Among those aged 18–29 y, however, less consistent sex effects were found. In the European countries, there was no effect of sex on the likelihood of initiating alcohol use at any given age (with the exception of Italy and Ukraine, where females were still slightly less likely). This pattern was also found for cannabis and to a lesser extent cocaine initiation in these countries. In Japan, China, and New Zealand, no sex effect existed for alcohol initiation among this youngest age group. In the remaining countries, there remained a reduction of risk of incident drug use (of all types) among females relative to males (Table 6).

Sociodemographic Correlates of Lifetime Use

Finally, Table 7 presents pooled analyses of associations between drug use and six core demographic variables, with covariate adjustments via multiple logistic regression terms for each country (results from this pooled analysis are consistent with associations observed in country-level analyses; details of country-specific data are available upon request). Some demographic variables were consistently related to drug use of all kinds (Table 7). In particular, males were more likely than females to have used all drug types and younger adults were more likely than older adults to have used all drug types. As noted above, these two associations were consistent across drug types and countries. Income was

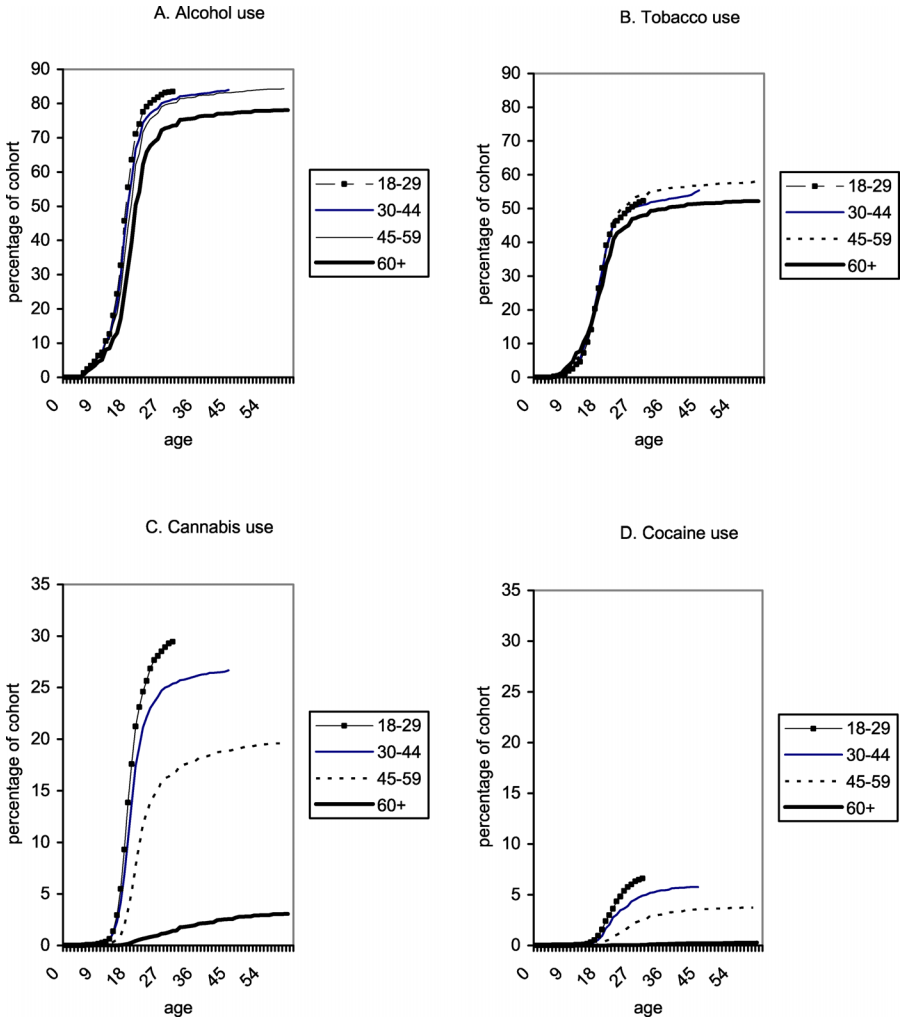

Figure 2. Age-Specific Cumulative Incidence of Drug Use by Birth Cohort
Pooled (weighted) data from the WMHSs ($n = 54,068$).
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positively related to lifetime use of both legal and illegal drugs. Marital status was also related to tobacco, cannabis, and cocaine use, but not alcohol use, (with the never married and previously married having higher odds of lifetime use than the currently married). Although education was related to drug use, the relationship was not consistent across drug types. Education was positively related to lifetime alcohol use, but negatively related to lifetime tobacco use, while education was unrelated to lifetime illegal drug use.

Discussion

Globally, drug use is not distributed evenly. In general, the US had among the highest levels of use of all drugs. Much lower levels were observed in lower income countries in Africa and the Middle East, and lower levels of use were reported in the Asian locales covered.

These variations cannot be regarded as static: there was greater drug involvement among younger than older adults in all countries, suggesting that drug use has and may continue to change over historical time. Interestingly, there was also evidence to suggest that male-female differences in risk of initiating drug use may be changing in more recent birth cohorts. This change was a consistent finding across countries, suggesting that a general shift may be occurring with respect to the traditional sex differences so often documented with drug use.

Consistent trends were also documented with respect to the period of risk for initiation of drug use. In most countries, the period of risk for initiation of use was heavily concentrated in the period from the mid to late teenage years; there was a slightly older and more extended period of risk for illegal drugs compared to legal drugs. Analyses of possible intercohort differences in risk of initiation suggested not only that the levels of illegal drug use were higher, but also that in more recent cohorts, the period of risk was extending further into adulthood. This extension of the period of risk has implications for drug use prevention efforts, which often focus upon adolescents and do not actively target young adults. Clearly, for illegal drugs, there continues to be a window of risk of initiation of illegal drug use that persists well beyond that of most commonly targeted ages.

Legal and illegal use of drugs was most strongly associated

Table 5. Estimated Sex–Age Interaction Predicting Incident Use of Each Drug, by Country

Region	Country	Unweighted *n*	Alcohol		Tobacco		Cannabis		Cocaine	
			OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Americas	Colombia	4,426	0.7*	0.6–0.7	0.9	0.8–1.0	0.8	0.6–1.2	0.6	0.4–1.1
	Mexico	5,782	0.6*	0.5–0.7	0.7*	0.7–0.8	0.7*	0.5–0.9	0.6*	0.4–0.8
	US	5,692	0.9*	0.8–0.9	0.9*	0.9–0.9	1.0	0.9–1.0	0.9	0.9–1.0
Europe	Belgium	1,043	0.8*	0.7–0.9	—[a]	—	0.9	0.7–1.4	2.2*	1.0–5.0
	France	1,436	0.7*	0.6–0.8	—[a]	—	0.8	0.6–1.1	0.8	0.6–1.2
	Germany	1,323	0.8*	0.7–0.9	—[a]	—	0.9	0.7–1.1	1.1	0.6–1.8
	Italy	1,779	0.9*	0.8–1.0	—[a]	—	1.0	0.8–1.4	1.8	0.8–4.0
	Netherlands	1,094	0.9	0.7–1.1	—[a]	—	0.8	0.6–1.2	1.0	0.5–1.8
	Spain	2,121	0.7*	0.7–0.8	—[a]	—	0.8	0.6–1.0	0.9	0.7–1.1
	Ukraine	1,719	0.7*	0.6–0.9	0.6*	0.5–0.6	0.4*	0.2–0.7	—[b]	—
Middle East and Africa	Israel	4,859	0.9*	0.8–0.9	0.8*	0.8–0.9	0.8*	0.7–1.0	0.9	0.6–1.4
	Lebanon	1,031	0.9	0.8–1.1	0.9	0.8–1.1	0.6	0.3–1.2	—[b]	—
	Nigeria	2,143	0.9*	0.8–1.0	1.1	0.9–1.4	0.3*	0.1–0.5	—[b]	—
	South Africa	4315	0.9	0.8–1.0	1.0	0.9–1.2	0.9	0.7–1.1	—[b]	—
Asia	Japan	887	0.8*	0.7–0.9	—[a]	—	—[b]	—	—[b]	—
	People's Republic of China	1,628	0.8*	0.7–0.9	0.8*	0.7–0.9	—[b]	—	—[b]	—
Oceania	New Zealand	12,790	0.9*	0.9–0.9	—[a]	—	0.9*	0.8–0.9	1.0	0.8–1.1

Note: Results are based on multivariate discrete-time survival model with person-year as the unit of analysis, in which the predictors included sex, cohort, sex-by-cohort, and person-year. Sex was coded 1 for female and 0 for male. Age cohort was divided by 10, such that a person aged 25 y would have a value of 2.5. In this way, a sex-by-cohort interaction with an OR <1.0 means that the relative-odds of use among woman compared to men is increasing in more recent cohorts (i.e., in cohorts with the lowest age at interview).

[a]Not asked in this country.

[b]Fewer than 30 persons in the entire sample of this country used this drug, so estimates have not been produced.

*, significant at $p < 0.05$, two-sided test.

CI, confidence interval.

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with age, sex, and income. Higher income was associated with a greater likelihood of drug use for all drug types examined, which is perhaps not surprising given that drug use requires disposable income. Relationship status was linked to illegal (but not legal) drug use: both cocaine and cannabis use were more likely among persons who had never been married or previously been married. These associations remained statistically robust after adjustment for age, sex, and the other variables considered here. These associations are consistent with previous research in the developed countries, which has linked illegal drug use with an individual's marital status.

The use of drugs seems to be a feature of more affluent countries. The US, which has been driving much of the world's drug research and drug policy agenda, stands out with higher levels of use of alcohol, cocaine, and cannabis, despite punitive illegal drug policies, as well as (in many US states), a higher minimum legal alcohol drinking age than many comparable developed countries. The Netherlands, with a less criminally punitive approach to cannabis use than the US, has experienced lower levels of use, particularly among younger adults. Clearly, by itself, a punitive policy towards possession and use accounts for limited variation in nation-level rates of illegal drug use.

Limitations

This study has limitations. We were limited to inclusion in the study of the countries that had the resources and interest in being involved in this exercise. Considerable effort was expended to ensure that countries from every region worldwide were represented in the consortium, but we did not succeed in getting as much coverage as we would have liked; for example, French-speaking West Africa is not represented in the WMHS. This has meant that the current data do not represent every world region sufficiently.

One limitation that certainly may have affected this study's estimates is the level of survey participation and nonresponse, which varied across countries. This is a likely source of underestimation of illegal drug involvement (and perhaps alcohol and tobacco use), but not necessarily a source of bias with respect to estimated associations with other variables [42]. In the WMHS initiative, we compensated for survey nonresponse via poststratification adjustments, but this approach is limited if nonresponse is associated with drug use in other ways.

A considerable strength of the WMHS initiative is that the population survey research approach generally has been held constant. Each respondent has been sampled via advanced population survey methods, has been presented with the same type of survey introduction, and has completed a highly structured and standardised field survey interview assessment using the same questions in each country, in accord with standardised translations. One exception to this was France, whose sampling frame only included households that had a telephone, although interviewing itself was conducted face-to-face.

Nonetheless, in a cross-national study such as this one, there might be differential social stigma and legal practices in each country that might affect self-reported drug use. Attempts were made to ensure that truthful, honest answers were provided by participants in these surveys in four major ways. First, pilot testing in each country was carried out to determine the best way to describe study purposes and auspices in order to maximize willingness to respond honestly and accurately. Second, in countries that do not have a tradition of public opinion research, and where the notions

Table 6. Estimated Association between Sex and Incident of Use of Each Drug among the Total Sample, and among Young Adults (18–29 y), by Country

Region	Country	Alcohol				Tobacco				Cannabis				Cocaine			
		Total		18–29 y		Total		18–29 y		Total		18–29 y		Total		18–29 y	
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Americas	Colombia	0.5*	0.5–0.6	0.6*	0.4–0.7	0.5*	0.4–0.5	0.4*	0.3–0.5	0.2*	0.1–0.3	0.3*	0.2–0.4	0.1*	0.1–0.2	0.2*	0.1–0.5
	Mexico	0.4*	0.4–0.4	0.5*	0.4–0.6	0.4*	0.3–0.4	0.4*	0.3–0.5	0.1*	0.1–0.1	0.1*	0.1–0.2	0.1*	0.1–0.2	0.1*	0.1–0.2
	US	0.7*	0.7–0.8	0.7*	0.6–0.9	0.7*	0.6–0.7	0.6*	0.5–0.7	0.6*	0.6–0.7	0.6*	0.5–0.7	0.5*	0.4–0.6	0.5*	0.4–0.7
Europe	Belgium	0.7*	0.6–0.8	1.3	0.8–2.2	—[a]	—	—[a]	—	0.7	0.5–1.0	0.6	0.3–1.1	0.6	0.2–1.5	0.1*	0.0–0.9
	France	0.5*	0.5–0.6	0.7	0.4–1.1	—[a]	—	—[a]	—	0.8	0.6–1.1	0.9	0.4–1.7	0.4	0.2–1.1	0.0*	0.0–0.4
	Germany	0.7*	0.6–0.8	0.8	0.5–1.2	—[a]	—	—[a]	—	0.6*	0.5–0.9	0.9	0.4–1.8	0.2*	0.1–0.5	0.2*	0.1–0.5
	Italy	0.5*	0.4–0.6	0.6*	0.4–0.9	—[a]	—	—[a]	—	0.3*	0.1–0.5	0.3*	0.1–0.6	0.3	0.1–1.1	0.3	0.0–4.7
	Netherlands	0.7*	0.5–1.0	0.8	0.4–1.8	—[a]	—	—[a]	—	0.7*	0.5–1.0	1.3	0.4–3.9	0.6	0.3–1.4	0.4	0.1–2.0
	Spain	0.5*	0.5–0.6	0.7	0.5–1.2	—[a]	—	—[a]	—	0.4*	0.3–0.5	0.6	0.3–1.1	0.3*	0.1–0.5	0.4	0.1–1.4
	Ukraine	0.7*	0.6–0.8	0.7*	0.5–1.0	0.2*	0.2–0.2	0.3*	0.2–0.4	0.2*	0.1–0.4	0.4*	0.2–1.0	—[b]	—	—[b]	—
Middle East and Africa	Israel	0.5*	0.4–0.5	0.4*	0.4–0.5	0.4*	0.4–0.5	0.5*	0.4–0.7	0.5*	0.4–0.6	0.5*	0.4–0.7	0.2*	0.1–0.5	0.3*	0.1–0.9
	Lebanon	0.4*	0.3–0.5	0.4*	0.2–0.7	0.6*	0.4–0.7	0.5*	0.2–0.9	0.2*	0.1–0.5	0.5	0.1–2.1	—[b]	—	—[b]	—
	Nigeria	0.5*	0.5–0.6	0.5*	0.4–0.7	0.0*	0.0–0.1	0.0*	0.0–0.1	0.0*	0.0–0.1	0.0*	0.0–0.4	—[b]	—	—[b]	—
	South Africa	0.3*	0.3–0.4	0.3*	0.2–0.4	0.2*	0.2–0.3	0.2*	0.1–0.2	0.2*	0.1–0.2	0.2*	0.1–0.3	—[b]	—	—[b]	—
Asia	Japan	0.6*	0.5–0.8	0.8	0.4–1.5	—[a]	—	—[a]	—	—[b]	—	—[b]	—	—[b]	—	—[b]	—
	People's Republic of China	0.5*	0.4–0.6	0.8	0.5–1.2	0.2*	0.1–0.2	0.3*	0.1–0.5	—[b]	—	—[b]	—	—[b]	—	—[b]	—
Oceania	New Zealand	0.7*	0.7–0.8	0.9	0.8–1.0	—[a]	—	—[a]	—	0.7*	0.7–0.8	0.9	0.8–1.1	0.4*	0.3–0.6	0.4*	0.2–0.6

Results are based on multivariable discrete-time survival model with person-year as the unit of analysis, controlling for cohort

[a]Not asked in this country.

[b]Fewer than 30 persons in the entire sample of this country used this drug, so estimates have not been produced.

*, significant at $p < 0.05$, two-sided test.

CI, confidence interval.

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of anonymity and confidentiality are unfamiliar, we contacted community leaders in sample sites to explain the study, obtain formal endorsement, and have the leaders announce the study to community members and encourage participation. The announcements were most typically made by religious leaders as part of their weekly sermons, although there are other cases, such as the formal community leaders in each neighbourhood in Beijing and Shanghai, where secular community leaders, who were given presents by the study organizers, made formal announcements and encouraged members of their neighbourhood to participate in the survey. Third, interviewers were centrally trained in the use of nondirective probing, a method designed to encourage thoughtful honest responding. Finally, especially sensitive questions were asked in a self-report format rather than an interviewer-report format, although this could be done only for respondents who could read. These methods were not completely effective in removing cross-national differences in willingness to report though, so it is important to recognise the possible existence of remaining differences of this sort in interpreting cross-national differences in results.

In future cross-national surveys, bioassays of drug use might be included. In the interim, we must use population survey data such as these to complement macro-level taxation records that summarise only legal alcohol and tobacco use across countries. These data are reasonable for developed countries, but are likely to significantly underestimate consumption in some developing countries. The findings of this study are consistent, however, with data collected in some countries from other epidemiological studies, which have been consistent with the findings here. The large cross-national differences documented here are consistent with approximations of drug use levels given in the United Nations World Drug Report [43] and with country-specific research—for example, researchers have documented high levels of cannabis use and early onset alcohol use in New Zealand [44], early onset alcohol use in Europe, and cocaine use in the US [45].

It is important to note that we kept full age ranges because we did not wish to truncate age in 90% of countries in order to accommodate the few that had more restricted age ranges, but we also wished to retain those few surveys in the total. The presentation of estimates specific to the 18–29-y age range is unaffected by these differences however, and the same patterns of cross-country results was observed in that instance. We also do not have an "urbanicity" variable in most countries that could be considered comparable, so thus far in the WMHS papers we have not studied urbanicity in cross-national work.

Any cross-sectional survey research has limitations [46]. Some of the observed cohort differences might be traced to higher mortality among individuals in the older cohorts who began drug use at an early age. Nonetheless, we believe that differential mortality is unlikely to explain the rather large differences in cumulative incidence for illegal drug use across age groups observed: in the case of cannabis, with substantial age-related variations observed, there is no convincing evidence of substantial premature mortality [47]. Conversely, the evidence of tobacco-related premature mortality is substantial, but tobacco use showed the least prominent age-associated variation.

Table 7. Bivariate and Adjusted Associations between Selected Variables and Drug Use. Pooled Data from the World Mental Health Surveys

Category	Variable	Alcohol				Tobacco				Cannabis				Cocaine			
		OR[a]	95% CI	AOR[b]	95% CI	OR[a]	95% CI	AOR[b]	95% CI	OR[a]	95% CI	AOR[b]	95% CI	OR[a]	95% CI	AOR[b]	95% CI
Age (y)	18–29	1.8*	1.6–2.0	1.5*	1.3–1.8	1.0	0.9–1.2	1.0	0.9–1.2	22.5*	19.0–26.6	14.4*	11.6,18.0	22.2*	13.5–36.3	16.0*	7.8–32.8
	30–44	1.9*	1.7–2.0	1.6*	1.4–1.8	1.3*	1.1–1.4	1.2*	1.0–1.4	17.9*	15.3–21.0	12.1*	9.9–14.8	25.6*	15.6–42.0	20.4*	10.5–39.9
	45–59	1.9*	1.7–2.1	1.7*	1.4–1.9	1.4*	1.3–1.6	1.3*	1.1–1.5	9.6*	8.2–11.4	6.2*	5.0–7.6	14.8*	9.0–24.3	11.3*	5.9–21.9
	60+	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
	χ^2_3 (*p*)	203.0	<0.001	61.4	<0.001	51.7	<0.001	22.5	0.001	1606.3	<0.001	805.0	<0.001	203.3	<0.001	117.9	<0.001
Sex	Female	0.3*	0.3–0.3	0.3*	0.3–0.4	0.2*	0.2–0.3	0.3*	0.2–0.3	0.5*	0.5 - 0.5	0.5*	0.5–0.6	0.4*	0.3–0.4	0.4*	0.3–0.4
	Male	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
	χ^2_1 (*p*)	971.2	<0.001	683.2	<0.001	1,216.9	<0.001	924.0	<0.001	496.8	<0.001	282.8	<0.001	260.6	<0.001	185.4	<0.001
Education	None	0.3*	0.3–0.4	0.6*	0.5–0.7	1.0	0.8–1.3	1.5*	1.1–1.9	0.2*	0.1–0.4	0.7	0.4–1.3	0.1*	0.1–0.4	0.3*	0.1–0.8
	Some primary	0.4*	0.4–0.5	0.7*	0.6–0.8	1.3*	1.1–1.5	1.6*	1.3–1.9	0.3*	0.2–0.4	0.8	0.6–1.0	0.4*	0.3–0.6	0.8	0.5–1.1
	Primary finished	0.5*	0.4–0.5	0.7*	0.5–0.8	1.3*	1.1–1.5	1.6*	1.4–1.9	0.4*	0.3–0.5	0.9	0.8–1.2	0.6*	0.4–0.8	1.0	0.6–1.5
	Some secondary	0.5*	0.5–0.6	0.7*	0.6–0.8	1.4*	1.3–1.6	1.7*	1.5–2.0	0.7*	0.7–0.8	1.1	1.0–1.2	1.0	0.8–1.2	1.2	1.0–1.5
	Secondary finished	0.7*	0.6–0.8	0.8*	0.7–1.0	1.3*	1.1–1.4	1.4*	1.3–1.6	0.9*	0.8–1.0	1.0	0.9–1.1	1.0	0.8–1.2	1.1	0.9–1.3
	Some college	0.8*	0.7–1.0	0.9	0.8–1.0	1.2*	1.0–1.3	1.3*	1.1–1.4	0.8*	0.8–0.9	1.0	0.9–1.1	1.0	0.8–1.2	1.1	0.9–1.3
	College or more	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
	χ^2_3 (*p*)	232.5	<0.001	43.1	<0.001	38.4	<0.001	57.9	<0.001	175.5	<0.001	9.9	0.128	44.7	<0.001	14.7	0.023
Relationship status	Never married	1.1*	1.0–1.2	1.0	0.9–1.1	0.9*	0.8–0.9	0.8*	0.7–0.9	2.1*	1.9–2.2	1.2*	1.1–1.3	1.7*	1.4–1.9	1.2*	1.0–1.5
	Previously married	0.7*	0.6–0.8	1.1	1.0–1.2	0.9*	0.8–1.0	1.2*	1.1–1.4	0.7*	0.7–0.8	1.6*	1.4–1.7	1.0	0.9–1.2	1.8*	1.6–2.2
	Married/Cohabiting	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
	χ^2_2 (*p*)	43.0	<0.001	2.7	0.259	16.2	<0.001	26.0	<0.001	420.5	<0.001	70.0	<0.001	53.7	<0.001	49.5	<0.001
Employment	Homemaker	0.3*	0.3–0.3	0.7*	0.6–0.7	0.4*	0.3–0.4	0.7*	0.6–0.9	0.4*	0.4–0.5	0.7*	0.6–0.8	0.4*	0.3–0.5	0.8	0.6. 1.1
	Retired	0.5*	0.5–0.6	0.9*	0.8–1.0	0.7*	0.6–0.8	0.8*	0.7–0.9	0.1*	0.0–0.1	0.4*	0.3–0.5	0.1*	0.0–0.1	0.6	0.3. 1.3
	Other	0.7*	0.6–0.8	0.9*	0.8–1.0	1.1	1.0–1.3	1.1	1.0–1.3	1.1	0.9–1.2	1.2*	1.0–1.3	1.4*	1.1–1.7	1.5*	1.2 1.8
	Working/student	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
	χ^2_3 (*p*)	620.7	<0.001	49.5	<0.001	289.2	<0.001	30.7	<0.001	1,020.9	<0.001	80.8	<0.001	131.8	<0.001	15.7	<0.001
Family income	Low	0.4*	0.4–0.5	0.5*	0.5–0.6	0.7*	0.7–0.8	0.8*	0.7–0.9	0.7*	0.6–0.8	0.6*	0.6–0.7	0.9	0.7–1.0	0.9	0.7–1.1
	Low-average	0.6*	0.5–0.6	0.7*	0.6–0.8	0.9*	0.8–1.0	0.9	0.8–1.0	0.6*	0.6–0.7	0.7*	0.6–0.7	0.7*	0.6–0.9	0.8*	0.7–0.9
	High-average	0.7*	0.7–0.8	0.8*	0.7–0.9	1.0	0.9–1.1	1.0	0.9–1.1	0.8*	0.7–0.9	0.8*	0.7–0.9	1.0	0.8–1.2	1.0	0.8–1.2
	High	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
	χ^2_3 (*p*)	283.5	<0.001	113.7	<0.001	48.7	<0.001	17.4	<0.001	97.2	<0.001	73.5	<0.001	16.6	<0.001	9.9	0.019

[a]Results are based on bivariate logistic regression models, controlling for country. Country-specific results are available upon request.
[b]Results are based on multiple logistic regression models with covariate terms for all listed variables, controlling for country. Country-specific results are available upon request.
*, weighted data, Taylor series linearisation for variance estimation, signifies $p < 0.05$ level, two-sided test.
AOR, adjusted odds ratio; CI, confidence interval.
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This study found very strong cohort differences in illegal drug use in particular. Although this may reflect actual cohort differences in drug use, they may also reflect response biases. Retrospective reporting of age of first drug use may be subject to error, given that respondents are being asked about events that, for older persons, may have occurred decades ago. Longitudinal studies of adolescents have found that estimates of the age of first use do tend to increase upon repeat assessment (i.e. as people age), but the rank ordering for different drugs remains the same [48–50].

It is unlikely that response or other biases completely account for the strong trends observed here. In this study, there were contrasting cohort trends across different drug types, suggesting that a uniform bias or pattern of "forgetting" did not apply. Similar birth cohort trends in age of initiation of illegal drug use have been observed in other epidemiological studies in the US [51,52] and Australia [53], some of which used data collected across time (rather than relying solely on retrospective reports; e.g., see [51]).

In this paper, we have examined the cumulative incidence (sometimes referred to as "lifetime prevalence") of use—this includes both experimental and heavier use. We also focused upon cumulative incident use rather than past year prevalence of use. Detailed examinations of prevalent (past year) use, and of transitions to dependent use of these drugs, were beyond the scope of the present paper, but are of obvious interest and importance. These are the subjects of future work currently being undertaken.

Conclusions

This study presents novel data on the epidemiology drug use from representative, cross-national samples representing all regions of the world. Clear differences in drug use existed across the regions of the world, with the US estimated to have among the highest levels of both legal and illegal drug use among all countries surveyed. These differences may be closing in more recent birth cohorts, with higher levels of drug use seen among young adults across countries. Drug use is related to income, but does not appear to be simply related to drug policy, since countries with more stringent policies towards illegal drug use did not have lower levels of such drug use than countries with more liberal policies.

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Author contributions. RCK, JCA, GdG, AK, JPL, JHO, and DJS designed the experiments/the study. LD, W-TC, NS, RCK, MA, RB, GdG, OG, AK, SK, JPL, MEMM, YN, JHO, JP-V, DJS, and JEW collected data or did experiments for the study. W-TC, RCK, JCA, GdG, YH, AK, and MEMM analysed the data. RCK, MA, RB, GdG, AK, JPL, and JHO enrolled patients. LD wrote the first draft of the paper. LD, W-TC, RCK, JCA, MA, RB, GdG, OG, YH, AK, SK, JPL, MEMM, YN, JHO, AP-M, JP-V, and JEW contributed to writing the paper.

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Editors' Summary

Background. Understanding how much disability and death a particular disease causes (known as the "burden of disease") is important. Knowing the burden of a disease in a country contributes to the development of healthier nations by directing strategies and policies against the disease. Researchers' understanding of the burden of diseases across different countries was piecemeal until the 1990 launch of a special World Health Organization (WHO) project, the Global Burden of Disease Project. In 2002, on the basis of updated information from this ongoing project, the WHO estimated that 91 million people were affected by alcohol use disorders and 15 million by drug use disorders.

Why Was This Study Done? It is widely accepted that alcohol, tobacco, and illegal drug use are linked with a considerable amount of illness, disability, and death. However, there are few high-quality data quantifying the amount across different countries, especially in less-developed countries. The researchers therefore set out to collect basic patterns of alcohol, tobacco, cannabis, and cocaine use in different countries. They documented lifetime use of these substances in each county, focusing on young adults. They also wanted to examine the age of onset of use and whether the type of drugs used was affected by one's social and economic status.

What Did the Researchers Do and Find? Data on drug use were available from 54,069 survey participants in 17 countries. The 17 countries were determined by the availability of collaborators and on funding for the survey. Trained lay interviewers carried out face-to-face interviews (except in France where the interviews were done over the telephone) using a standardized, structured diagnostic interview for psychiatric conditions. Participants were asked if they had ever used (a) alcohol, (b) tobacco (cigarettes, cigars or pipes), (c) cannabis (marijuana, hashish), or (d) cocaine. If they had used any of these drugs, they were asked about the age they started using each type of drug. The age of first tobacco smoking was not assessed in New Zealand, Japan, France, Germany, Belgium, The Netherlands, Italy, or Spain. The interviewers also recorded the participants' sex, age, years of education, marital status, employment, and household income.

The researchers found that in the Americas, Europe, Japan, and New Zealand, alcohol had been used by the vast majority of survey participants, compared to smaller proportions in the Middle East, Africa, and China. The global distribution of drug use is unevenly distributed with the US having the highest levels of both legal and illegal drug use among all countries surveyed. There are differences in both legal and illegal drug use among different socioeconomic groups. For example, males were more likely than females to have used all drug types; younger adults were more likely than older adults to have used all drugs examined; and higher income was related to drug use of all kinds. Marital status was found to be linked only to illegal drug use—the use of cocaine and cannabis is more likely in people who have never been married or were previously married. Drug use does not appear to be related to drug policy, as countries with more stringent policies (e.g., the US) did not have lower levels of illegal drug use than countries with more liberal policies (e.g., The Netherlands).

What Do These Findings Mean? These findings present comprehensive and useful data on the patterns of drug use from national samples representing all regions of the world. The data will add to the understanding of the global burden of disease and should be useful to government and health organizations in developing policies to combat these problems. The study does have its limitations—for example, it surveyed only 17 of the world's countries, within these countries there were different rates of participation, and it is unclear whether people accurately report their drug use when interviewed. Nevertheless, the study did find clear differences in drug use across different regions of the world, with the US having among the highest levels of legal and illegal drug use of all the countries surveyed.

Additional Information. Please access these Web sites via the online version of this summary at http://dx.doi.org/10.1371/journal.pmed.0050141.

- Facts and figures on alcohol are available from the World Health Organization, including information about the burden of disease worldwide as a result of alcohol
- Information on the management of substance abuse is available from WHO
- Information on the Global Burden of Disease Project is also available from WHO
- Researchers from the University of New South Wales, Australia and the University of Queensland co-chair, sponsors the Global Burden of Disease Mental Disorders and Illicit Drug Use Expert Group, which examines illicit drug use and disorders
- The UN World Drug Report is available from the UN Office on Drugs and Crime
- The University of New South Wales also runs the Secretariat for the Reference Group to the United Nations on HIV and Injecting Drug Use