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## ARTICLE

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# A First Comparison Between the Consumption of and the Need for Opioid Analgesics at Country, Regional, and Global Levels

Marie-Josephine Seya, Susanne F. A. M. Gelders, Obianuju Uzoma Achara, Barbara Milani, and Willem Karel Scholten

### ABSTRACT

The objective of this study was to propose a rough but simple method for estimating the total population need for opioids for treating all various types of moderate and severe pain at the country, regional, and global levels. We determined per capita need of strong opioids for pain related to three important pain causes for 188 countries. These needs were extrapolated to the needs for all the various types of pain by using an adequacy level derived from the top 20 countries in the Human Development Index. By comparing with the actual consumption levels for relevant strong opioid analgesics, we were able to estimate the level of adequacy of opioid consumption for each country. Good access to pain management is rather the exception than the rule: 5.5 billion people (83% of the world's population) live in countries with low to nonexistent access, 250 million (4%) have moderate access, and only 460 million people (7%) have adequate access. Insufficient data are available for 430 million (7%). The consumption of opioid analgesics is inadequate to provide sufficient pain relief around the world. Only the populations of some industrialized countries have good access. Policies should seek a balance between maximizing access for medical use and minimizing abuse and dependence. Countries should aim to increase the medical consumption to the magnitude needed to address the totality of moderate and severe pain.

**KEYWORDS** Access, accidents and injuries, cancer, consumption, demographics, education and training, health policy, HIV/AIDS treatment, legislation (health), need, opioid, pharmaceuticals products, policy, statistics, substance abuse

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### INTRODUCTION

Oral opioids are key components for the treatment of moderate to severe pain, and several are regarded as essential medicines (1). Despite the effectiveness of opioid analgesics, many people live in pain because they do not receive appropriate treatment. The realization of Millennium Development Goal (MDG) 8e, i.e., "... to provide access to affordable essential drugs in developing countries," is likely to be further away for opioid analgesics than for any other class of medicines. Pain can vary from mild to severe, and different pain levels require different analgesics. Paracetamol, acetylsalicylic acid, nonsteroidal anti-inflammatory medicines (NSAIDs) and opioids with a ceiling effect (often called "weak-acting opioids") are not effective for moderate to severe pain. NSAIDs can have serious side effects, leading to concerns over

the long-term safety of chronic use. Despite a century of medical chemistry, suitable alternatives to strong opioids for treatment of moderate to severe pain have not been found.

Indeed, several barriers contribute to the insufficient utilization of opioid analgesics. These barriers are multifaceted and may be related to legal aspects, policy, knowledge, or attitudes. In many countries several of these aspects are present. Most of these barriers trace back to fears of abuse and dependence of opioids, particularly the fear of prescribed opioids being diverted to illicit circuits (2, 3). Therefore, many laws and government policies primarily focus on rendering opioids unavailable, without acknowledging that their rational medical use is beneficial to patients in pain (2, 4, 5). Still today, in many countries, patient access to opioids for cancer pain is profoundly restricted through legislation (6). However, for terminal patients dependence is irrelevant. Moreover, during treatment of chronic noncancer pain, dependence rarely results (7). Diversion of prescription medicines from domestic distribution channels has been reported (8). However, this is not a reason not to prescribe opioids to patients. Reports from India and Malaysia show that diversion by patients is rare or nonexistent (9, 10). When patients cannot access pain relief, this may result in excruciating suffering, suicide, or the use of street-bought heroin (11).

In recent years the problem of inadequate pain relief has attracted more and more the attention of the international community. United Nations (UN) bodies, including the World Health Assembly, the Economic, Social and Cultural Council, the Commission on Narcotic Drugs, and the International Narcotics Control Board (INCB), declared that access should improve (9, 12–15). Since 2006, the INCB has requested annually that all governments promote rational medical treatment with narcotic drugs and psychotropic substances (8, 16–19). There is recognition now that pain relief is part of the human right to the highest attainable standard of mental and physical health, or is even a human right on its own (20–22). Some countries (e.g., Uganda, Romania, Colombia) have made serious efforts to improve opioid accessibility (23–26).

A comparison of consumption of and need for opioids is an important tool to recognize inadequacies of access to opioids as medicine. Various simple methods have been suggested to establish the morphine needs of a country (27–29). However, these methods fail to take into account the specific morbidity patterns in the countries themselves and do not relate to the adequacy of the actual use of opioid analgesics.

## METHODS

At country level, we collected mortality data for cancer, human immunodeficiency virus (HIV), and injuries, and calculated the per capita amounts of opioids that would be sufficient to treat the pain related to these diseases (“Need of morphine equivalents (selected diseases) in mg per capita”). Cancer and HIV/AIDS (acquired immunodeficiency syndrome) are the two major causes of chronic severe malignant pain, and injuries are an important cause of acute moderate to severe pain. Pain can also have many other causes. We also calculated the *actual* per capita consumption of relevant strong opioids (morphine, fentanyl, oxycodone, hydromorphone, and pethidine) from the per capita consumption of each of them (“Consumption of morphine equivalents in mg per capita”). These statistics are relatively reliable, because governments cannot import strong opioids without submitting these figures to the INCB.

No objective standard exists for an adequate level of opioid consumption, and we therefore had to develop such a standard ourselves. The selection of reference countries should be independent from the opioid consumption. Therefore, we took the top 20 countries from the Human Development Index (HDI) for 2004 as reference countries (30). We arbitrarily took their average ratio between calculated per capita consumption and per capita need as a standard for an adequate consumption level. We normalized the ratio by designating this average to be an “adequacy of consumption measure” (ACM) of 1.00. Furthermore, we calculated for each country the amount of opioids that could be adequate for pain treatment (“Adequate consumption (all pain conditions) in kg”), and from this we calculated the global requirements.

## Data Collection

We collected data from 188 countries. For the actual consumption figures, we used 2006 data from the INCB for all relevant strong opioids and calculated their joint consumption in “morphine equivalents,” i.e. the dosage of a substance that equals the analgesic potency of 1 mg oral morphine (using multiplication factors inversely proportional to their Defined Daily Dosages). We excluded methadone, because this is usually used for treatment of opioid dependence.

For each country, we retrieved population data (2006), the age-standardized mortality rate for cancer (2002), and the age-standardized mortality rate for lethal injuries (2002) from the World Health Organization (WHO) Statistical Information System (WHOSIS) Database. For deaths due to HIV/AIDS

TABLE 1a. Adequacy of Consumption Measure (ACM) of Countries in the WHO African Region

Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents in mg per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)	Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents in mg per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)
Algeria	5.95	0.44	4530	0.0033	Lesotho	50.82	No data	2316	No data
Angola	16.14	0.02	6104	0.0000	Liberia*	11.45	No data	936	No data
Benin	12.23	0.14	2447	0.0005	Madagascar	8.54	0.05	3737	0.0003
Botswana	41.16	4.15	1747	0.0044	Malawi	28.58	0.01	8858	0.0000
Burkina Faso	11.90	0.02	3904	0.0001	Mali	11.78	0.02	3220	0.0001
Burundi	13.86	0.12	2587	0.0004	Mauritania	10.30	0.29	716	0.0013
Cameroon	17.68	No data	7341	No data	Mauritius	4.63	6.13	132	0.0580
Cape Verde**	6.88	0.67	82	0.0042	Mozambique	30.59	0.31	14,654	0.0004
Central African Republic	28.45	No data	2771	No data	Namibia	36.19	1.57	1692	0.0019
Chad	12.31	No data	2944	No data	Niger	11.04	0.04	3464	0.0002
Comoros	8.65	No data	162	No data	Nigeria	14.19	No data	46,899	No data
Congo	16.60	0.09	1399	0.0002	Rwanda	16.00	0.04	3459	0.0001
Cote d'Ivoire	20.82	0.06	8996	0.0001	Sao Tome and Principe**	7.23	0.07	26	0.0004
Dem. Rep. of the Congo	14.11	0.02	19,547	0.0000	Senegal	9.47	No data	2612	No data
Equatorial Guinea	15.20	No data	172	No data	Seychelles**	7.11	6.03	14	0.0371
Eritrea	11.52	0.17	1235	0.0007	Sierra Leone	12.72	No data	1668	No data
Ethiopia*	10.79	0.02	19,962	0.0001	South Africa	31.16	5.39	34,367	0.0076
Gabon	20.06	No data	601	No data	Swaziland	8.79	No data	228	No data
Gambia	10.74	No data	408	No data	Togo	13.00	0.18	1903	0.0006
Ghana	11.93	3.88	6268	0.0142	Uganda	18.64	0.79	12,726	0.0019
Guinea	11.07	No data	2322	No data	United Rep. of Tanzania	20.54	No data	18,509	No data
Guinea-Bissau	14.40	No data	541	No data	Zambia	34.97	0.82	9342	0.0010
Kenya	21.36	2.34	17,835	0.0048	Zimbabwe	53.36	No data	16,120	No data
					WHO AFRO region	17.06	1.03	301,500	0.0017

\*Calculations based on HIV data for 2007 from the WHO Statistical Information System (WHOSIS) Database.

\*\*Calculations based on cancer and injury mortality only (no data for HIV mortality available).

\*\*\*Mortality data for Serbia were quoted from Jancovic et al. (32) (Table 1d).

\*\*\*\*Calculations based on HIV data from UNAIDS Country factsheet 2008 for India (Table 1e).

\*\*\*\*\*In Austria morphine is also used for opioid agonist therapy (Table 1d).

TABLE 1b. Adequacy of Consumption Measure (ACM) of Countries in the WHO American Region

Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents in mg per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)	Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents in mg per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)
Antigua and Barbuda**	7.80	No data	15	No data	Guyana	10.10	5.21	170	0.0226
Argentina	8.07	2.26	7212	0.0122	Haiti	12.41	0.15	2678	0.0005
Bahamas	12.84	28.77	96	0.0981	Honduras	9.26	No data	1475	No data
Barbados	14.06	No data	94	No data	Jamaica	9.81	6.28	605	0.0280
Belize	14.73	No data	95	No data	Mexico	4.99	0.76	11,999	0.0067
Bolivia	14.21	No data	3035	No data	Nicaragua	6.86	1.13	867	0.0072
Brazil	7.98	10.83	34,522	0.0594	Panama	7.55	3.18	567	0.0185
Canada	7.81	456.59	5810	2.5601	Paraguay	7.98	0.35	1097	0.0019
Chile	7.76	6.51	2920	0.0367	Peru	10.16	No data	6405	No data
Colombia	7.00	3.09	7289	0.0193	Saint Kitts and Nevis**	5.86	No data	7	No data
Costa Rica	7.12	4.34	715	0.0267	Saint Lucia**	7.00	8.01	26	0.0501
Cuba	7.33	3.56	1887	0.0212	Saint Vincent and the Grenadines**	8.40	1.36	23	0.0071
Dominica**	7.80	5.43	12	0.0305	Suriname	13.98	1.18	145	0.0037
Dominican Republic	9.64	0.92	2117	0.0042	Trinidad and Tobago	11.49	No data	348	No data
Ecuador	7.42	1.24	2238	0.0073	United States of America	7.43	420.70	51,401	2.4787
El Salvador	6.78	2.87	1047	0.0185	Uruguay	10.90	No data	829	No data
Grenada**	10.77	5.72	26	0.0233	Venezuela	6.60	1.07	4102	0.0071
Guatemala	5.79	0.94	1722	0.0071	WHO AMRO region	7.51	171.40	153.60	0.9437

See Table 1a for definitions of footnotes.

TABLE 1c. Adequacy of Consumption Measure (ACM) of Countries in the WHO Eastern Mediterranean Region

Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents in mg per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)	Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents in mg per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)
Afghanistan	8.67	No data	5169	No data	Oman**	5.69	4.10	331	0.0315
Bahrain**	6.88	9.11	116	0.0580	Pakistan	5.90	0.07	21,692	0.0005
Djibouti	11.41	No data	213	No data	Qatar**	4.07	6.61	76	0.0710
Egypt	4.89	0.85	8289	0.0076	Saudi Arabia**	5.93	5.65	3272	0.0418
Iran (Islamic Republic of)	6.24	2.09	10,022	0.0146	Somalia	9.54	No data	1840	No data
Iraq**	6.13	No data	3989	No data	Sudan	9.31	0.27	8020	0.0013
Jordan**	7.83	10.39	1025	0.0581	Syrian Arab Republic**	3.27	2.84	1448	0.0381
Kuwait**	4.23	4.94	269	0.0512	Tunisia	4.59	3.63	1071	0.0346
Lebanon	5.25	5.71	486	0.0476	United Arab Emirates**	5.44	2.29	528	0.0184
Libyan Arab Jamahiriya**	4.30	4.76	593	0.0485	Yemen**	5.89	0.17	2923	0.0012
Morocco	3.78	0.47	2664	0.0054	WHO EMRO region	6.00	1.33	74.04	0.0086

See Table 1a for definitions of footnotes.

TABLE 1d. Adequacy of Consumption Measure (ACM) of Countries in the WHO European Region

Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents in mg per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)	Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents in mg per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)
Albania**	8.35	2.54	605	0.0133	Latvia	10.19	21.31	533	0.0916
Andorra**	6.82	42.97	12	0.2758	Lithuania	9.11	24.62	709	0.1184
Armenia	9.59	0.98	660	0.0045	Luxembourg	8.95	105.36	94	0.5153
Austria*****	7.22	328.23	1373	1.9913	Macedonia (the former Yugoslav Republic of)	8.21	1.27	382	0.0068
Azerbaijan	6.46	0.23	1239	0.0015	Malta	8.40	11.73	78	0.0612
Belarus*	8.16	1.09	1815	0.0059	Moldova	7.43	1.67	651	0.0098
Belgium	8.35	219.79	1990	1.1518	Monaco**	6.50	No data	5	No data
Bosnia and Herzegovina**	6.56	No data	588	No data	Netherlands	8.72	101.32	3262	0.5087
Bulgaria*	6.82	12.20	1198	0.0784	Norway	7.76	155.92	827	0.8802
Croatia**	9.05	32.73	941	0.1584	Poland	10.09	42.80	8787	0.1858
Cyprus**	5.09	13.89	98	0.1194	Portugal	7.92	65.84	1913	0.3642
Czech Republic	9.92	55.74	2309	0.2459	Romania*	7.80	0.08	3837	0.0005
Denmark	9.38	290.79	1163	1.3576	Russian Federation*	9.15	1.34	29,947	0.0064
Estonia*	9.44	24.63	289	0.1142	San Marino**	7.57	No data	5	No data
Finland	6.58	174.07	791	1.1580	Serbia/Montenegro***	7.27	12.81	1635	0.0772
France	7.76	145.15	10,874	0.8187	Slovakia**	9.21	120.98	1133	0.5752
Georgia	6.62	2.35	670	0.0155	Slovenia	9.01	104.09	412	0.5058
Germany	7.97	381.66	15,039	2.0972	Spain	7.26	131.53	7277	0.7932
Greece	7.49	92.49	1902	0.5410	Sweden	6.62	161.47	1372	1.0682
Hungary*	10.93	69.14	2510	0.2771	Switzerland	6.62	216.76	1127	1.4337
Iceland	9.05	126.88	62	0.6138	Tajikistan	5.23	No data	794	No data
Ireland	8.51	100.21	821	0.5155	Turkey**	5.15	6.76	8701	0.0574
Israel*	7.30	64.31	1135	0.3858	Turkmenistan**	5.39	0.12	603	0.0009
Italy	7.42	33.94	9963	0.2002	Ukraine	9.17	3.03	9749	0.0145
Kazakhstan	9.45	No data	3304	No data	United Kingdom	8.07	99.14	11,159	0.5376
Kyrgyzstan	6.11	0.28	734	0.0020	Uzbekistan	4.36	0.14	2688	0.0014
					WHO EURO region	7.89	87.19	159,763	0.4699

See Table 1a for definitions of footnotes.

TABLE 1e. Adequacy of Consumption Measure (ACM) of Countries in the WHO Southeast Asian Region

Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents in mg per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)	Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents in mg per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)
Bangladesh	6.39	0.99	22, 760	0.0068	Myanmar	8.73	0.05	9650	0.0003
Bhutan	6.45	No data	96	No data	Nepal	7.07	0.28	4466	0.0017
Democratic People's Republic of Korea**	5.54	0.78	3002	0.0062	Sri Lanka	6.76	1.67	2964	0.0109
India****	7.34	0.13	193, 184	0.0008	Thailand	8.12	2.46	11, 768	0.0133
Indonesia	7.24	0.29	37, 869	0.0018	Timor-Leste**	6.44	No data	164	No data
Maldives*	7.81	No data	53	No data	WHO SEARO region	7.28	0.34	285, 975	0.0020

See Table 1a for definitions of footnotes.

TABLE 1f. Adequacy of Consumption Measure (ACM) of Countries in the WHO Western Pacific Region

Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)	Country	Need of morphine equivalents (selected diseases) in mg per capita	Consumption of morphine equivalents per capita (2006)	Adequate consumption (all pain conditions) in kg	ACM (2006)
Australia	7.22	142.68	3383	0.8658	New Zealand*	7.61	72.18	719	0.4154
Brunei Darussalam	7.86	3.96	69	0.0221	Palau**	4.99	3.45	2	0.0302
Cambodia	11.88	No data	3852	No data	Papua New Guinea	8.32	No data	1179	No data
China	8.10	2.04	245, 892	0.0110	Philippines	5.28	0.43	10, 411	0.0035
Fiji	6.35	No data	121	No data	Republic of Korea	9.50	15.63	10, 427	0.0720
Japan	6.48	20.22	18, 942	0.1366	Samoa**	5.15	1.98	22	0.0168
Kiribati**	2.82	No data	6	No data	Singapore	7.26	8.72	727	0.0526
Lao People's Democratic Republic	8.52	0.29	1120	0.0015	Solomon Islands**	4.88	No data	54	No data
Malaysia	8.07	5.54	4816	0.0300	Tonga**	4.61	2.84	11	0.0270
Marshall Islands**	6.78	1.86	9	0.0120	Vanuatu**	4.99	0.67	25	0.0059
Micronesia (Federated States of)**	5.04	3.08	13	0.0267	Viet Nam	7.19	0.81	14, 154	0.0049
Mongolia	16.92	1.01	1006	0.0026	WHO WPRO region	7.87	5.50	316, 961	0.0302

See Table 1a for definitions of footnotes.



we used data for 2007 from the UNAIDS Report on the Global AIDS Epidemic 2008, except where the WHOSIS Database contained these data on HIV/AIDS. For India we used data from the UNAIDS Country Factsheet 2008 (figures for 2007) (see footnotes, Tables 1a–1f). Mortality data for Serbia were quoted from Jancovic *et al.* (2006) (31). Where AIDS mortality data are presented as “less than,” we used this limit for our calculations (e.g., if mortality was “ $\leq 10$ ,” we used 10 for our calculations).

### Calculation Methods

We calculated the need for morphine required for pain relief in terminal cancer patients, HIV patients, and lethal injuries patients in mg per capita, based on the assumptions that 80% of terminally ill cancer patients and 50% of AIDS patients will require 75 mg of morphine per person daily for an average of 90 days during the last year of their lives and that 15% of patients with lethal injuries will require 75 mg of morphine daily for an average of 5 days at the end of their lives (32).

This method of calculating morphine need does not account for pain from many other causes, including nonlethal cancers, nonlethal injuries, non-end-stage HIV, surgery, sickle cell episodes, childbirth, chronic nonmalignant pain, and many more. The actual extent of pain from these other diseases is difficult to quantify because of a lack of comprehensive epidemiological data at the national level and of data on how much morphine per patient is required on average for these conditions. Therefore, we had to correct for these other pain causes. Our correction is based on the assumption that total morbidity in each country is proportional to the morbidity for the three causes mentioned above. The correction factor is the average of the ratios of (actual consumption:calculated need) for the highest 20 countries in the HDI. The average ratio was 22.84. A consumption level equal to or higher than this average is assumed to be an adequate consumption level and we “normalized” the aforementioned ratio by introducing an ACM proportional to the ratio, designating the average ratio of 22.84 to be an ACM of 1.00. Consequently, an ACM of 1.00 or more represents a consumption level related to adequate access to opioid analgesics. Furthermore, we defined an ACM  $\geq 0.30$  and  $< 1.00$  as moderate consumption,  $\geq 0.10$  and  $< 0.30$  as low,  $\geq 0.03$  and  $< 0.10$  as very low, and  $< 0.03$  as virtually nonexistent. We calculated the ACM for all countries and the relation between the HDI and the logarithm of the ACM ( $\log(\text{ACM})$ ).

We also calculated the required absolute consumption in order to achieve an ACM of 1.00 at the coun-

try level, for each WHO region and for the world, based on the actual consumption and each region's ACM. For countries with an ACM higher than 1.00, we took the actual consumption as adequate.

## RESULTS

For each country, in Tables 1a to 1f we present the per capita need of morphine equivalents and the actual per capita opioid consumption, together with adequate consumption in kg and the ACM. Our calculation method is based on a number of assumptions (for instance, that the top 20 HDI countries have an opioid analgesics consumption that is more or less adequate to their need) and it does not take into account that variations in morbidity patterns between countries may lead to different needs for opioid analgesics. Therefore, the results should be considered an indication of the magnitude of adequacy and not an exact indication of the country needs. Thus, they should not be used to calculate the health care system's requirements for opioids, as our method does not take into account the capacity of the health care system. However, we recommend that the ACM and the calculated adequate consumption will be used for policy purposes and in setting mid- and long-term targets.

We were able to calculate the ACM for 145 countries. The countries for which the ACM could not be calculated did not report their consumption data to the INCB. We fear that many of these countries also have very minimal consumption, if any. The differences between countries are so large that the results best can be expressed on a logarithmic scale: the country with the highest ACM in our study (Canada) has a per capita consumption 50,000 times higher than the lowest country (Malawi).

Figure 1 shows the relation between the  $\log(\text{ACM})$  and the HDI for 139 countries. There is a close relationship between the development of a country and the  $\log(\text{ACM})$ . Most people who live in countries where they have adequate access live in the more industrialized regions and, conversely, worst access is found in developing countries. However, some industrialized countries also have inadequate consumption.

Table 2 presents the number of people living in the WHO regions based on their ACM. From this table we conclude that:

5.5 billion people (83% of the world's population) live in countries with low to nonexistent access;  
250 million (4%) have moderate access;  
460 million (7%) have adequate access;  
for 430 million (7%) insufficient data are available.

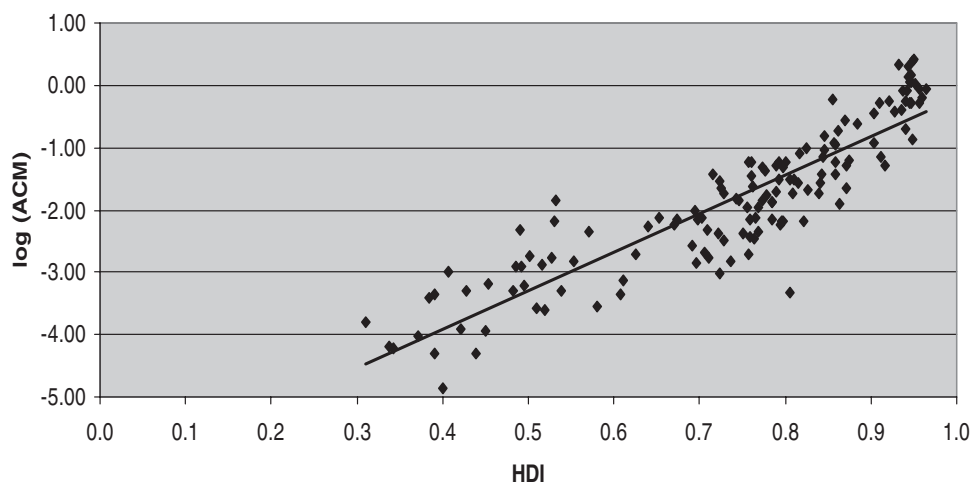


FIGURE 1. Relation between the log (ACM) and the Human Development Index (HDI) for 139 countries. (Function formula:  $\log(\text{ACM}) = -6.4113 + 6.200 \times \text{HDI}$ ;  $N = 139$ ; correlation coefficient: .895;  $P$  value: <.0001.)

In 2006, the world used 231 tonnes of morphine equivalents. If all countries increased their consumption to adequate levels, the required amount would be 1292 tonnes, or almost 6 times higher.

lem was not known to the extent that we have demonstrated in this study. We are aware that improvement of our method is possible, but because no similar method is available, we wanted to start a discussion and encourage that others build on our method.

## DISCUSSION

The method we developed and applied for all relevant strong opioids and to all countries, also taking into account morbidity levels, allows insight into which countries need to improve pain treatment and by what magnitude. So far there has been no overview available of the total per capita consumption for all combined strong opioids. Furthermore, the lack of access to opioid analgesics for pain treatment was known to be considerable, but up till now the scale of the prob-

## Study Limitations

Our method relies on an extrapolation based on the assumption that total pain prevalence is proportional to the morbidity from three diseases that result in moderate to severe pain. For the three diseases that we selected, most of the suffering is related to the end-of-life stage and, therefore, our choice is reasonable. It should be borne in mind that in countries where HIV or cancer mortality is extremely high, the method will exaggerate the opioid need.

TABLE 2. Number of People (in Thousands) Living in Countries, According to Adequacy of Consumption Measure (ACM) and Region

ACM	AFRO population (thousands)	AMRO population (thousands)	EMRO population (thousands)	EURO population (thousands)	SEARO population (thousands)	WPRO population (thousands)	Global population in thousands (%)
$\text{ACM} \geq 1$ (adequate consumption)	0	335418	0	128622	0	0	464040(7%)
$0.3 \leq \text{ACM} < 1$ (moderate consumption)	0	0	0	227658	0	24670	252328(4%)
$0.1 \leq \text{ACM} < 0.3$ (low consumption)	0	0	0	127390	0	127953	255343(4%)
$0.03 \leq \text{ACM} < 0.1$ (very low consumption)	1338	206346	76506	94160	0	78566	456916(7%)
$\text{ACM} < 0.03$ (virtually no consumption)	502501	303900	399919	283081	1718985	1510365	4718751(72%)
No data	269953	49280	63858	25944	2063	21810	432908(7%)
Total	773792	894944	540283	886855	1721048	1763364	6580286(100%)

However, owing to underreporting, morbidity statistics usually underestimate the actual morbidity, in particular in developing countries. Thus, for such countries, the needs we calculated will be too low. Also, we excluded methadone, because it is mostly used for treatment of opioid dependence. Therefore, our method underestimates the adequacy of opioid analgesic consumption for the few countries that use methadone mainly for pain management. Several opioids are also used in anesthesia. A validation of our method could be part of future work.

We related our standard of adequacy to the top 20 countries of the HDI. We realize that taking the top 10 or the top 30 would have influenced the outcome considerably. Not taking the latter is supported by the finding that the countries for which more impediments are reported rank 25 and higher, and from the countries ranking 1 to 20, hardly any is reported as having high access barriers (6). The former (i.e., taking the top 10) might be considered, but in that case we would be setting the targets for improvement even higher for those countries with lower levels of adequacy of opioid consumption.

### **Relation to Other Medicines' Accessibility and MDG 8e**

Only 460 million people live in countries with adequate consumption levels. This means that the remaining 6 billion will not be treated adequately when in pain. Cameron *et al.* collected availability data from 36 countries for a standard list of 15 core generic medicines and found a public sector availability ranging from 9.7% (Yemen) to 79.2% (Mongolia). Although the level of availability cannot be compared directly with the consumption level, merely considering that 72% of the world's population live in countries that do not consume strong opioids, it is not rash to conclude that the situation for strong opioid analgesics is much worse than it is for these 15 core medicines in general (33). Therefore, we conclude that MDG 8e on access to essential medicines is further away for opioid analgesics than for other classes of essential medicines.

### **Explanation for Inadequacy of Opioid Analgesic Consumption**

Patients have a right to be treated with controlled medicines listed in the WHO Model List of Essential Medicines and a right to be protected against drug abuse and dependence (2, 20). Therefore, drug control and public health policies should seek the optimum public health outcome, which is a balance between maximizing access for legitimate medical

use and minimizing abuse, dependence, and diversion. However, this is not currently the case in most countries. Exaggerated fear that pain patients will become dependent and that prescribed opioids will be diverted from their intended use prevents patients from receiving any pain treatment at all. There is no doubt that this balance should be ensured.

National policies, laws, and regulations often have a number of drawbacks that hamper adequacy of pain management. Lack of medical knowledge and bias towards pain management with opioids also affect the adequacy of opioid consumption. There is no economic reason why countries should not go through a transition towards adequate management of pain, as the prices in developed countries for morphine tablets and methadone syrup at supplier level are only a few US cents per unit. However, studies and surveys have reported that opioid analgesic cost at the patient level is higher in developing countries than in developed countries and this makes them unaffordable outside health system treatment programmes. The cost of opioid analgesics can be a limiting factor in developing countries where palliative care programs and pain relief are not subsidized by national health systems and where the market size is based on the out-of-pocket purchasing power of patients (34, 35).

### **Working on Improvement**

We suggest that countries that wish to improve access to these medicines take our figures as a working hypothesis to measure adequacy of access. For all countries with low access, this will work, because the difference between their current level and adequate consumption is so large. At the country level, we recommend that governments take the outcome of our method, which represents approximately the magnitude needed to address the totality of moderate and severe pain, as a long-term target for the development of the estimates that they have to submit to the INCB annually and strive for an adequate consumption level of opioid analgesics. This means that they will reach a level related to an ACM of 1.00 or more. For the estimates themselves, the INCB and WHO are currently preparing a *Joint INCB-WHO Manual for Calculating Estimates for Drugs Under International Control* and we recommend that countries apply this as soon as it is ready. Governments should not submit much higher estimates than the country can absorb for rational use by the health system, in order to prevent diversion to illicit circuits. However, estimates should always be slightly higher than the amount that actually will be required, in order to ensure that importations will not be blocked.

Consumption will not increase spontaneously, but only if countries address actively all barriers that impede access to adequate pain management. Governments can do so by implementing the guidelines on balanced controlled substances policies that the WHO Access to Controlled Medications Programme (ACMP) will publish approximately simultaneously with this article. These guidelines will address all relevant policy aspects of controlled medicines access. The guidelines will include a practical checklist and will also be available for interested individuals.

WHO has developed the ACMP in consultation with the INCB.<sup>34</sup> WHO will manage the ACMP, which will support countries when improving access to opioid analgesics and other medicines controlled under the international drug control conventions. Among other activities, the ACMP is developing treatment and policy guidelines and can assist when reviewing policies and legislation. INCB recommends that countries work with the ACMP and provide it with sufficient resources to reach its objectives (8).

### Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

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