Original Article

Adequacy of Opioid Analgesic Consumption at Country, Global, and Regional Levels in 2010, Its Relationship With Development Level, and Changes Compared With 2006

Béatrice Duthey, PhD, and Willem Scholten, PharmD, MPA

Access to Controlled Medicines, Department of Essential Medicines and Health Products, World Health Organization, Geneva, Switzerland

Abstract

Context. In most countries, patients do not have adequate access to opioid analgesics because of barriers resulting from the abuse potential of these medicines.

Objectives. To provide an analysis for the adequacy of the consumption of opioid analgesics for countries and World Health Organization regions in 2010 as compared with 2006.

Methods. We calculated the Adequacy of Consumption Measure using data for 2010 based on a method established by Seya et al. This method calculates the morbidity-corrected needs per capita for relevant strong opioid analgesics and the actual use for the top 20 Human Development Index countries. It determines the adequacy of the consumption for each country, World Health Organization region, and the world by comparing the actual consumption with the calculated need. Furthermore, the method allows us to calculate the number of people living in countries at various levels of adequacy. We compared our outcomes with data from Seya et al. for 2006.

Results. Most people have no access to opioids for pain relief in case of need; 66% of the world population has virtually no consumption, 10% very low, 3% low, 4% moderate, and only 7.5% adequate. For 8.9%, no data are available. Between 2006 and 2010, 67 countries increased the adequacy of opioid consumption per capita. These changes are independent of countries' level of development.

Conclusion. The consumption of opioid analgesics remains inadequate in most of the world and, as a result, patients with moderate and severe pain do not receive the treatment they need. Governments, health organizations, and nongovernmental organizations must collaborate to address this situation, targeting their efforts at educational, cultural, health policy and regulatory levels. J Pain Symptom Manage 2013;■:■−■. © *2013 World Health Organization. Published by Elsevier Inc. All rights reserved.*

Address correspondence to: Willem Scholten, PharmD, MPA, Consultant – Medicines and Controlled Substances, chemin du Lignolet 18A, 1260 Nyon, Switzerland. E-mail: wk.scholten@bluewin.ch

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Key Words
Opioid analgesics, pain treatment, morphine, palliative care, controlled medicines, health policy, access

Introduction

Opioid agonists are the only known effective medicines for the treatment of moderate and severe pain. Morphine is included in the World Health Organization (WHO) Model List of Essential Medicines and the WHO Model List of Essential Medicines for Children.[1,2] Several other opioid agonists are included in the WHO Guidelines on the Pharmacological Treatment of Persisting Pain in Children.[3]

Opioids also are included in the Schedules of the Single Convention on Narcotic Drugs, which restricts and regulates their use.[4] Because of this, opioid production, consumption, and importation are strictly controlled at the international and country levels to avoid abuse, dependence, and diversion. Many countries, because of the fear of abuse, restrict their medical use even further. In addition to policy and legal barriers, professional barriers such as lack of training of medical staff also account for the inadequate medical use of opioids, as do some attitudes both among health care professionals and the general population. In 2006, Seya et al. reported that 72% of the world population lived in countries with no access to opioids (per capita opioid consumption lower than 3% of the level assumed to be adequate) and 7% in countries with very low consumption (between 3% and 10% of the level assumed to be adequate).[5] Many examples of the barriers are described in the WHO policy guidelines *Ensuring Balance in National Policies on Controlled Substances: Guidance for Availability and Accessibility of Controlled Medicines*.[6] Because of these barriers, a large majority of the world population lives in countries where patients face immense difficulties in accessing opioid analgesics and, as a result, must live in pain that is often excruciating.

Pain is prevalent in almost any medical field including surgery, internal medicine, general practice, oncology, and palliative care, and it concerns everyone from newborns to the elderly. This study provides an overview of the adequacy of access to opioid analgesics around the world in 2010, and we analyze the differences in outcomes between 2006 and 2010. We show which countries and regions have inadequate access and, therefore, should take measures to meet the needs of their populations in this respect.

Methods

Methods Overview

We used the method developed by Seya et al. to evaluate the need for opioid analgesics at the country level and the adequacy of consumption, calculated as the Adequacy of Consumption Measure (ACM).[5] This method calculates needs per capita for relevant strong opioid analgesics based on three major causes of pain (terminal cancer, lethal injuries, and end-stage HIV/AIDS). The method includes consumption figures for morphine, fentanyl, oxycodone, hydromorphone, and pethidine and converts them to morphine equipotency, based on their Defined Daily Doses.[7,8] Comparison with the actual per capita use for the top 20 countries of the Human Development Index (HDI) establishes an extrapolation factor to calculate the need for treatment of pain from all causes. Subsequently, the method determines the adequacy of the consumption for each country, WHO region, and the world by comparing the actual consumption with the calculated need.

The method establishes the need for strong opioid analgesics for each country based on morbidity patterns. An adequate consumption level is defined by assuming that the mean per capita opioid consumption of the top 20 countries of HDI is an adequate level. ACM is calculated as the ratio between the actual consumption and the established need. We slightly modified the method by defining the adequate level as 100% and expressing ACM for each country as a percentage of the adequate level, whereas Seya et al. defined the adequate level defined as 1. The method defines five levels of adequacy: adequate, moderate, low, very low, and virtually no consumption. By using

Table 1
ACM for 2010 by Country for the WHO AFRO Region

	Consumption of mEq in mg Per Capita 2010		Consumption of mEq in kg 2010		
Country	Actual	Adequate	Actual	Adequate	ACM 2010 (%)
Algeria	0.95	150.44	33	5265	0.63
Angola	0.11	228.92	1	3053	0.05
Benin	0.01	179.71	0	1676	0.00
Botswana	0.30	394.72	1	815	0.07
Burkina Faso	0.02	212.21	0	3555	0.01
Burundi	No data	331.50	No data	3387	No data
Cameroon	0.11	329.78	2	6500	0.03
Cape Verde	1.15	151.93	1	78	0.75
Central African Republic	No data	364.35	No data	1804	No data
Chad	0.03	245.32	0	2639	0.01
Comoros	0.13	164.27	0	130	0.08
Congo	1.10	258.53	5	1097	0.43
Congo, Democratic Republic of the	No data	133.86	No data	9599	No data
Cote d'Ivoire	0.04	307.88	1	6621	0.01
Equatorial Guinea	No data	170.87	No data	114	No data
Eritrea	0.11	173.54	1	1031	0.06
Ethiopia	No data	154.46	No data	14,037	No data
Gabon	No data	284.32	No data	448	No data
Gambia	No data	223.78	No data	402	No data
Ghana	0.10	233.27	3	5783	0.04
Guinea	No data	216.91	No data	2299	No data
Guinea-Bissau	No data	235.53	No data	376	No data
Kenya	1.68	395.87	69	16,259	0.42
Lesotho	No data	870.90	No data	1676	No data
Liberia	No data	254.51	No data	964	No data
Madagascar	0.18	206.14	4	4520	0.09
Malawi	2.15	491.40	34	7803	0.44
Mali	0.07	224.03	1	3172	0.03
Mauritania	No data	201.28	No data	660	No data
Mauritius	9.85	188.16	13	245	5.24
Mozambique	0.33	490.74	8	11,261	0.07
Namibia	7.61	420.34	16	902	1.81
Niger	0.07	162.87	1	2682	0.04
Nigeria	No data	303.92	No data	47,173	No data
Rwanda	No data	225.31	No data	2562	No data
Sao Tome and Principe	No data	254.47	No data	46	No data
Senegal	0.09	192.93	1	2439	0.05
Seychelles	7.52	268.76	1	24	2.80
Sierra Leone	No data	223.04	No data	1196	No data
South Africa	43.71	931.53	2142	45,649	4.69
Swaziland	No data	668.52	No data	916	No data
Togo	0.34	265.58	2	1798	0.13
Uganda	0.75	415.57	26	14,384	0.18
United Republic of Tanzania	0.47	337.11	20	14,410	0.14
Zambia	0.57	515.20	8	7151	0.11
Zimbabwe	1.70	901.38	20	10,892	0.19

ACM = Adequacy of Consumption Measure; WHO AFRO = World Health Organization Africa Region; mEq = morphine equivalents.

the population figures for the countries at each level, we were able to calculate the number of people living in these countries at various levels of adequacy.

Data Collection

We used the statistics from the International Narcotics Control Board (INCB) for the consumption of relevant strong opioids and HDI for 2010. For cancer, HIV/AIDS mortality, and lethal injuries data, we used the statistics from the WHO Global Health Observatory Repository. We were able to obtain complete consumption data for 152 countries and, based on the collected data, we calculated ACM for 2010 for these countries. We had both HDI and ACM for 139 countries. Liechtenstein ranks number 6 on HDI for 2010, but no data were available on the consumption of opioid agonists. Our calculations for the

Table 2
ACM for 2010 by Country for the WHO AMRO Region

	Consumption of mEq in mg Per Capita 2010		Consumption of mEq in kg 2010		
Country	Actual	Adequate	Actual	Adequate	ACM 2010 (%)
Antigua and Barbuda	No data	213.96	No data	19	No data
Argentina	14.87	236.17	621	9865	6.30
Bahamas	25.70	353.17	8	111	7.28
Barbados	No data	280.68	No data	80	No data
Belize	No data	330.43	No data	106	No data
Bolivia	0.19	152.16	2	1540	0.12
Brazil	13.13	192.91	2671	39,244	6.81
Canada	657.27	210.29	22,367	7156	312.56
Chile	10.81	210.14	183	3549	5.14
Colombia	6.78	204.13	303	9130	3.32
Costa Rica	5.60	188.94	26	865	2.96
Cuba	2.97	229.28	33	2542	1.29
Dominica	8.72	255.21	1	18	3.41
Dominican Republic	1.03	195.07	10	1942	0.53
Ecuador	1.59	213.93	24	3210	0.74
El Salvador	4.45	184.29	27	1119	2.42
Grenada	2.78	271.09	0	29	1.02
Guatemala	2.01	211.26	28	2921	0.95
Guyana	4.34	206.76	3	158	2.10
Haiti	0.71	247.38	7	2404	0.29
Honduras	0.65	255.00	5	2077	0.26
Jamaica	7.97	248.88	23	714	3.20
Mexico	6.47	143.32	735	16,299	4.51
Nicaragua	1.34	169.25	8	959	0.79
Panama	4.36	219.30	15	759	1.99
Paraguay	2.17	208.59	14	1347	1.04
Peru	2.22	207.65	65	6073	1.07
Saint Kitts and Nevis	No data	236.83	No data	12	No data
Saint Lucia	10.79	199.16	2	32	5.42
Saint Vincent and the Grenadines	18.04	195.91	2	20	9.21
Suriname	1.16	199.29	1	98	0.58
Trinidad and Tobago	11.33	205.33	14	252	5.52
United States of America	481.99	209.88	150,973	65,742	229.65
Uruguay	5.91	294.51	20	974	2.01
Venezuela	3.22	162.64	89	4495	1.98

ACM = Adequacy of Consumption Measure; WHO AMRO = World Health Organization American Region; mEq = morphine equivalents.

adequate consumption level are based on the remaining 19 of the top 20 countries of HDI.[9]

Results

Extrapolation Factor

We found that the top 20 countries of HDI have an average consumption of opioid agonists of 216.7 mg morphine equivalents per capita. This amount that countries use to treat all pain is 30.72 times the need that we calculated for these countries to treat pain from cancer, HIV/AIDS, and lethal injuries alone. Therefore, 30.72 is the extrapolation factor to convert the amount needed to treat pain from these three diseases only, to the need for the treatment of pain from all causes together.

ACM

Tables 1–6 present ACM for 2010 by country and WHO world region. For quick reference, adequacy levels are visually presented in a world map (Fig. 1). Those countries for which insufficient data could be obtained are also listed in this table. Table 7 presents the number of people living in countries at various levels of adequacy of consumption by WHO region. For each level, it is indicated what percentage of the world population this constitutes; 5.6 billion people (79.3% of the world population) live in countries with a low consumption level or lower. An additional 630 million people (9.0%) live in countries that did not report their consumption to INCB, and given that their location is mostly in regions where almost no country has a moderate or adequate consumption level, we fear

Table 3
ACM for 2010 by Country for the WHO EMRO Region

Country	Consumption of mEq in mg Per Capita 2010		Consumption of mEq in kg 2010		ACM 2010 (%)
	Actual	Adequate	Actual	Adequate	
Afghanistan	0.02	5142	0.01	172.33	0.01
Bahrain	9.98	185	6.55	152.34	6.55
Djibouti	No data	215	No data	283.38	No data
Egypt	1.97	12,556	1.29	152.97	1.29
Iran (Islamic Republic of)	2.75	12,589	1.70	161.63	1.70
Iraq	0.37	5235	0.21	172.22	0.21
Jordan	8.70	1080	5.24	165.98	5.24
Kuwait	14.46	285	13.16	109.89	13.16
Lebanon	8.26	963	3.55	232.49	3.55
Libyan Arab Jamahiriya	3.92	1067	2.43	161.77	2.43
Morocco	1.16	4544	0.82	142.14	0.82
Oman	3.92	396	2.99	130.94	2.99
Pakistan	No data	30,194	No data	161.17	No data
Qatar	7.05	141	4.24	166.23	4.24
Saudi Arabia	6.99	3171	5.76	121.33	5.76
Somalia	No data	1857	No data	187.15	No data
Sudan	No data	6841	No data	151.87	No data
Syrian Arab Republic	4.87	2124	5.16	94.35	5.16
Tunisia	4.31	1736	2.64	163.31	2.64
United Arab Emirates	4.96	545	4.68	105.90	4.68
Yemen	0.33	3393	0.24	140.59	0.24

ACM = Adequacy of Consumption Measure; WHO EMRO = World Health Organization Eastern Mediterranean Region; mEq = morphine equivalents.

that many of them have equally poor access to opioid analgesics. These people live in 38 countries for which data were not available, no less than 17 of them being from the WHO Africa Region (AFRO). WHO AFRO, South-East Asia (SEARO), and Western Pacific (WPRO) regions are areas where patients are dramatically lacking access to these medicines. Only 529 million people (7.5%) live in countries with an adequate consumption level; these countries are all located in the WHO American and European (EURO) Regions and are highly developed.

Relationship Between ACM and Development

Fig. 2 shows the relationship between ACM and HDI for those 139 countries for which an HDI_{2010} and an ACM_{2010} is available. This relationship is approximately logarithmic (log $ACM_{2010} = 5.6921 \times HDI_{2010} - 5.5429$; correlation coefficient R^2: 0.7583). The country with the highest ACM value (Canada; HDI: 0.888, ACM: 312.56%) has a 72,000 times higher ACM than the country with the lowest ACM value (Benin; HDI: 0.435, ACM: 0.0044%).

We also analyzed the relationship between the log ACM and HDI for the WHO regions separately. Again, the relationship is logarithmic; the correlation between adequacy of consumption and development ranges from 0.31 in the SEARO region to 0.94 in the WPRO region.

Comparison Between 2006 and 2010

By referring to the mean strong opioid consumption in a group of countries in the year of analysis, ACM is a dynamic measure that adapts to changing views on adequate pain management over time. It is also an impartial measure, as it takes the most developed countries as the reference, regardless of which ones they are. This approach circumvents the problem that there is no objective way to define the best consumption level for a country. However, as a consequence, the reference has a drift from one year to another. Of the top 20 HDI countries in 2010, Italy and Iceland are no longer on the list, whereas Germany and Israel joined the group.

Because of these changes, the mean value for the top 20 countries in HDI, representing 100% adequacy, changed from 175.2 mg per capita in 2006 to 216.7 mg per capita in 2010. The extrapolation factor indicating the ratio of the calculated need for controlled opioid analgesics for cancer, HIV/AIDS, and injuries in the top 20 HDI countries and these

Table 4
ACM for 2010 by Country for the WHO EURO Region

	Consumption of mEq in mg Per capita 2010		Consumption of mEq in kg 2010		
Country	Actual	Adequate	Actual	Adequate	ACM 2010 (%)
Albania	2.00	247.99	6	742	0.81
Andorra	48.84	178.12	4	15	27.42
Armenia	0.88	305.56	3	907	0.29
Austria	459.27	208.66	3774	1715	220.11
Azerbaijan	0.29	232.02	2	1942	0.12
Belarus	4.83	257.23	46	2464	1.88
Belgium	242.04	214.34	2525	2236	112.92
Bosnia and Herzegovina	8.94	182.22	41	842	4.91
Bulgaria	13.27	236.05	94	1674	5.62
Croatia	47.31	285.50	212	1280	16.57
Cyprus	13.61	138.35	15	155	9.84
Czech Republic	89.11	265.78	908	2708	33.53
Denmark	301.93	259.83	1669	1437	116.21
Estonia	18.39	310.09	24	398	5.93
Finland	169.27	179.19	890	942	94.47
France	171.62	233.47	11,209	15,248	73.51
Georgia	2.20	164.03	10	752	1.34
Germany	389.98	213.45	31,772	17,390	182.70
Greece	98.32	214.42	1058	2307	45.85
Hungary	76.31	325.96	761	3252	23.41
Iceland	52.54	229.79	16	71	22.87
Ireland	121.92	228.46	569	1067	53.36
Israel	82.56	195.12	617	1458	42.31
Italy	71.06	208.94	4336	12,748	34.01
Kazakhstan	0.68	273.17	11	4240	0.25
Kyrgyzstan	0.35	203.87	2	1139	0.17
Latvia	19.64	332.56	43	733	5.91
Lithuania	28.31	279.13	100	987	10.14
Luxembourg	153.18	227.96	77	115	67.19
Macedonia, the Former Yugoslav Rep of	0.84	216.97	2	451	0.39
Malta	14.97	215.88	6	88	6.94
Moldova, Republic of	1.56	248.91	7	1074	0.63
Monaco	No data	203.46	No data	6	No data
Montenegro, Republic of	26.15	214.65	17	142	12.18
The Netherlands	111.15	244.20	1873	4114	45.51
Norway	196.12	217.91	920	1022	90.00
Poland	35.76	292.00	1375	11,225	12.25
Portugal	38.42	230.31	413	2478	16.68
Romania	9.36	245.49	205	5377	3.81
Russian Federation	1.88	237.90	261	33,006	0.79
San Marino	No data	192.70	No data	6	No data
Serbia, Republic of	40.06	285.61	293	2088	14.02
Slovakia	74.28	275.76	407	1510	26.94
Slovenia	112.63	271.88	225	544	41.43
Spain	217.38	208.15	10,164	9732	104.44
Sweden	189.71	191.96	1724	1745	98.83
Switzerland	282.10	188.82	2155	1442	149.40
Tajikistan	0.04	144.09	0	1099	0.03
Turkey	14.31	196.50	1127	15,481	7.28
Turkmenistan	0.14	177.89	1	889	0.08
Ukraine	1.45	254.80	65	11,500	0.57
United Kingdom of Great Britain and Northern Ireland	149.60	225.38	9379	14,131	66.38
Uzbekistan	0.21	121.12	6	3407	0.17

ACM = Adequacy of Consumption Measure; WHO EURO = World Health Organization European Region; mEq = morphine equivalents.

countries' actual use changed from 22.96 in 2006 to 30.72 in 2010.

Table 8 shows, by WHO region, the number of countries in which the adequacy of opioid consumption per capita has increased or decreased by 10% or more compared with 2006, as well as their population and the percentage they constitute of the world population. Sixty-seven countries have an adequacy of opioid consumption per capita that increased

Table 5
ACM for 2010 by Country for the WHO SEARO Region

	Consumption of mEq in mg Per Capita 2010		Consumption of mEq in kg 2010		
Country	Actual	Adequate	Actual	Adequate	ACM 2010 (%)
Bangladesh	0.63	177.25	100	28,106	0.35
Bhutan	17.29	222.70	12	158	7.76
India	0.31	141.50	363	168,269	0.22
Indonesia	0.34	207.82	83	51,042	0.16
Korea, Democratic People's Republic of	0.63	225.23	16	5509	0.28
Maldives	No data	112.88	No data	44	No data
Myanmar	0.01	237.69	1	12,835	0.01
Nepal	0.82	210.62	24	6190	0.39
Sri Lanka	1.11	144.37	24	3073	0.77
Thailand	3.63	220.37	242	14,703	1.65
Timor-Leste, Democratic Republic of	No data	181.43	No data	214	No data

ACM = Adequacy of Consumption Measure; WHO SEARO = World Health Organization South-East Asia Region; mEq = morphine equivalents.

10% or more, representing 3.18 billion people or 45.4% of the world population who have better access to opioid analgesics in 2010. Fifty-four countries have an adequacy of opioid consumption per capita that decreased 10% or more, representing 1.04 billion people or 14.7% of the world population who have worse access than in 2006. Adequacy remained unchanged (defined as a change of under 10%) in 22 countries, accounting for almost 30.5% of the world population. More countries reported consumption data to INCB in 2010 than in 2006: 46 countries did not report to INCB in 2006, and this number dropped to 38 in 2010. For 51 countries, no data are available for either 2006 or 2010 and, therefore, we could not calculate the difference in ACM for these countries.

Table 6
ACM for 2010 by Country for the WHO WPRO Region

	Consumption of mEq in mg Per Capita 2010		Consumption of mEq in kg 2010		
Country	Actual	Adequate	Actual	Adequate	ACM 2010 (%)
Australia	208.22	195.21	4532	4249	106.67
Brunei Darussalam	5.60	162.15	2	65	3.45
Cambodia	0.22	217.82	3	3202	0.10
China	2.86	241.28	3822	322,525	1.18
Cook Islands	11.07	96.75	0	1	11.44
Fiji	No data	201.43	No data	178	No data
Japan	29.42	189.36	3721	23,950	15.54
Kiribati	2.55	85.80	0	9	2.97
Korea, Republic of	104.95	223.34	2567	5462	46.99
Lao People's Democratic Republic	0.20	216.96	1	1405	0.09
Malaysia	6.27	195.03	180	5603	3.22
Marshall Islands	No data	191.86	No data	13	No data
Micronesia, Federated States of	No data	140.74	No data	15	No data
Mongolia	2.28	357.96	7	1122	0.64
Nauru	No data	255.85	No data	2	No data
New Zealand	107.77	218.81	462	939	49.25
Niue	No data	133.44	No data	0	0.00
Palau	17.70	163.11	0	3	10.85
Papua New Guinea	No data	237.75	No data	1471	No data
Philippines	0.65	145.35	67	14,802	0.45
Samoa	No data	90.95	No data	18	No data
Singapore	11.47	195.86	54	928	5.86
Solomon Islands	No data	143.08	No data	82	No data
Tonga	2.73	134.00	0	14	2.04
Tuvalu	1.40	217.39	0	2	0.64
Vanuatu	No data	157.20	No data	35	No data
Viet Nam	1.35	208.67	123	18,894	0.65

ACM = Adequacy of Consumption Measure; WHO WPRO = World Health Organization Western Pacific Region; mEq = morphine equivalents.

Fig. 1. Adequacy of opioid analgesic consumption (2010).

Table 9 shows the global changes between the levels of adequacy. The repartition of adequacy among WHO regions remains unchanged between 2006 and 2010. Countries attaining adequacy continue to be among the top 20 HDI countries and are mainly located in North America and northwestern Europe.

Within WHO EURO, ACM decreased for 25 countries and increased for 14 countries. For WHO SEARO, three countries showed an increase and four a decrease. In WHO AFRO, in 13 countries ACM increased, and it decreased for 11 countries. WHO WPRO showed improvements, with 10 countries with an increased ACM; six countries in this region showed a decrease. Finally, WHO American Region showed the most improvement, with 18 countries increasing against only three countries where a small decrease was observed.

Tables 10 and 11 list countries with the highest and lowest change in ACM (10% and over) between 2006 and 2010, in rank order. Statistical analysis shows no correlation between the ratio ACM_{2010}/ACM_{2006} and the HDI values

Table 7
Number of People Living in Countries at Various Levels of Adequacy of Consumption by WHO Region and Globally

	Population in Thousands						
ACM	AFRO	AMRO	EMRO	EURO	SEARO	WPRO	Global, *n* (%)
≥100% (Adequate consumption)	0	347,262	0	160,041	0	21,766	529,069 (7.6)
30% ≤ ACM < 100% (moderate consumption)	0	0	0	260,507	0	28,747	289,254 (4.1)
10% ≤ ACM < 30% (low consumption)	0	0	2595	81,039	0	126,506	210,140 (3.0)
3% ≤ ACM < 10% (very low consumption)	50,307	425,279	66,509	117,418	708	33,869	693,382 (9.9)
ACM < 3% (virtually no consumption)	422,153	309,518	296,558	280,620	1,789,207	1,553,626	4,651,682 (66.4)
No data	376,477	745	243,071	62	1571	8241	630,167 (9.0)
Total world population	848,937	1,082,804	608,733	899,687	1,791,486	1,772,755	7,003,694 (100)

WHO = World Health Organization; ACM = Adequacy of Consumption Measure; AFRO = WHO African Region; AMRO = WHO American Region; EMRO = WHO Eastern Mediterranean Region; EURO = WHO European Region; SEARO = WHO South-East Asia Region; WPRO = WHO Western Pacific Region.
For country lists see: http://www.who.int/about/regions/en/index.html.

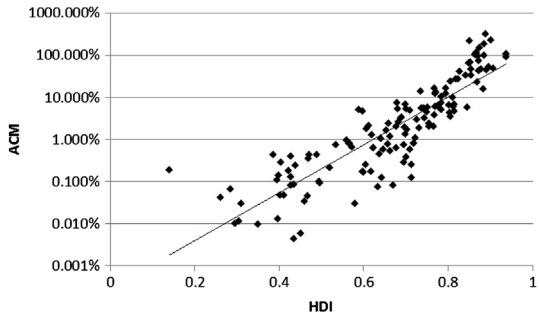

Fig. 2. Relation between log ACM_{2010} and HDI_{2010} (all countries). Log ACM = 5.6921 × HDI − 5.5429; $R^2 = 0.7583$. ACM = Adequacy of Consumption Measure; HDI = Human Development Index.

(correlation coefficient R^2: 0.181); also, we did not find a correlation for the WHO regions separately. Fig. 3, in which each country is represented by a dot, represents the changes between 2006 and 2010.

Global Need for Opioid Analgesics for Adequate Treatment

Results show that if all countries had an adequate consumption of opioid analgesics, production of 1448 tonnes of morphine equivalents per year would be necessary (2006: 1292 tonnes; +12%). The consumption for 2010 is 290 tonnes of morphine equivalents (2006: 231 tonnes; +25.5%).

Discussion

General Trend

Our study shows a global trend toward an increase in opioid adequacy in countries and world regions between 2006 and 2010. Sixty-six countries have increased opioid adequacy in this period. This represents 45% of the world population having better access to controlled opioid analgesics. Overall, attitudes concerning the use of opioids for medical purposes are starting to change and pain management in the world is better addressed.

Several countries made efforts in reforming their legislation related to access to controlled medicines, engaging in campaigns to inform health care professionals, regulators, and police forces. Successful interventions have been documented, for example, for Malawi, India, Panama, Serbia, Uganda, and Romania,[10–16] but only some of these countries had a measurable increase in ACM (Tables 10 and 11). When taking into account our suspicion that most countries that did not submit data to INCB are among those having the lowest ACM, we see that there is only a small shift of around 4% of the world population living in countries where ACM was previously at the level of "virtually no consumption" that went up now to the "very low" level. Although this can be a first sign of a change, in reality the levels for these countries remain below 10% of the level deemed adequate.

However, the extrapolation factor used to calculate ACM rose from 22.96 to 30.72 because of increased consumption in the top 20 HDI reference countries. This can be the result of changes in the composition of these top 20 countries, but also the result of a rise in per capita consumption in the top 20 HDI countries. Therefore, the pessimistic conclusion above can be balanced with the finding

Table 8

Countries Where the Adequacy of Opioid Consumption Per Capita Has Increased or Decreased 10% or More Between 2006 and 2010, by WHO Region

	Number of Countries	Population in Thousands	% of the World Population	Number of Countries	Population in Thousands	% of the World Population
WHO Region	Decrease ≥10%			Increase ≥10%		
AFRO	11	264,972	3.78	18	542,006	7.7
AMRO	3	11,508	0.16	13	219,144	3.1
EMRO	5	209,559	2.99	10	377,664	5.4
EURO	25	283,092	4.04	14	481,702	6.9
SEARO	4	258,310	3.69	3	1,285,284	18.3
WPRO	6	7172	0.10	9	273,676	3.9
Total	54	1,034,613	14.77	67	3,179,476	45.40

WHO = World Health Organization; AFRO = WHO African Region; AMRO = WHO American Region; EMRO = WHO Eastern Mediterranean Region; EURO = WHO European Region; SEARO = WHO South-East Asia Region; WPRO = WHO Western Pacific Region.
For country lists see: http://www.who.int/about/regions/en/index.html.

Table 9
Percentage of the World Population by ACM Level, 2006 and 2010

ACM Level	2006 (%)	2010 (%)
Adequate (≥100%)	7.1	7.5
Moderate (≥30% and <100%)	3.8	4.1
Low (≥10% and <30%)	3.9	3.0
Very low (≥3% and <10%)	6.9	9.9
Virtually no consumption (<3%)	71.7	66.4
No data	6.6	9.0

ACM = Adequacy of Consumption Measure.

that global consumption went up by 25.5% and that the increase in absolute terms of the 100% level of adequacy masks the improvements that many countries made. The countries with a low ACM did not appear to fall further behind in the period analyzed.

Over the past three decades, most of the increase in global consumption of opioids resulted from increases in high-income countries.[15–17] This epidemiological survey shows that the increase of ACM between 2006 and 2010 is unrelated to HDI, which may be a sign that a turning point has been reached. However, our data do not allow us to draw concrete conclusions at this time.

The fact that the populations of most countries still do not have access to opioid treatment for severe and moderate pain is caused by the many barriers that exist to accessing substances with abuse potential. These barriers include overly restrictive legislation because of the fear of diversion, poor education of health care professionals on the use of opioids, and failure to submit estimates of country need to INCB. The fear of diversion, abuse, and dependence are the main reasons why countries limit access to opioid analgesics, but the measures taken often do not address the problem, but, instead, negatively affect patients' access for legitimate purposes. To guide countries as to how to overcome these barriers, WHO published its policy guidelines *Ensuring Balance in National Policies on Controlled Substances: Guidance for Availability and Accessibility of Controlled Medicines* in 2011.[6] This publication contains 21 guidelines and a checklist to assess the situation at the country level regarding drug legislation and policy, authorities and their role in the system, policy planning for availability and accessibility, health care professionals, estimates and statistics, and procurement. The checklist can be used by governments, nongovernmental organizations, and interested individuals who want to improve pain management in their country. Much work also has been done by Cherny et al., who documented a number of the barriers in detail for the EURO region.[18–20] A similar study on AFRO, Eastern Mediterranean, SEARO, and WPRO Regions and the Latin American and Caribbean countries is underway.

Although some of the countries in the top 20 HDI have an ACM higher than 100%, this is not to state that they are overconsuming opioids. In fact, there are surveys for some of these countries showing that pain is not well treated in many patients,[21] and for other countries, there are signs that problems with opioid medicine misuse are not related to the prescription of these medicines to pain patients.[22,23] Disparities in access exist between individual patients within countries because of procurement disparities, regulations, and other causes.

Every human being has the right to the highest attainable standards of health and well-being. In various phrasing, this right has been established by various human right treaties and the WHO constitution. There is no country that did not sign any of these agreements and, therefore, it is universal.[24,25] As pain can be adequately treated in most cases, it can be substantiated that this right includes freedom from unnecessary pain.[26–28] Moreover, the United Nations Special Rapporteurs on the right to health and on torture and other cruel, inhuman or degrading treatment or punishment substantiated that failure to provide pain relief, if the state or state institutions are involved, can be equal to torture.[25,29,30]

Relationship With Development Level

Although there is a correlation between HDI and ACM, we do not think that the lack of access to opioids can be attributed directly to economic factors. Indeed, opioids are affordable medicines, and a patient's daily treatment costs are minimal. Rather, it is the unfamiliarity, ignorance, and overburdening of those who could work on improvement of the situation in developing countries that leads to lack of access. In the experience of one of the authors, negative reactions are rare once the situation, the background, and the urgency for improvement are explained.

Table 10

Countries Where Adequacy of Opioid Consumption Increased ≥10% Between 2006 and 2010, in Rank Order[a]

Rank	Country	WHO Region	Population, in Thousands (2010)[b]	HDI	Ratio ACM_{2010}/ ACM_{2006}
1	Malawi	AFRO	15,381	0.385	319.989
2	Romania	EURO	21,436	0.767	81.367
3	Republic of Korea	WPRO	48,391	0.877	76.663
4	Congo	AFRO	4140	0.489	17.133
5	Saint Vincent and the Grenadines	AMRO	109	No data	13.076
6	Angola	AFRO	19,618	0.403	9.620
7	Namibia	AFRO	2324	0.606	9.558
8	Mexico	AMRO	114,793	0.75	6.809
9	South Africa	AFRO	50,460	0.597	6.234
10	Haiti	AMRO	10,124	0.404	5.629
11	Paraguay	AMRO	6568	0.64	5.431
12	Argentina	AMRO	40,765	0.775	5.167
13	Mali	AFRO	15,840	0.309	4.509
14	Palau	WPRO	20.6	No data	3.609
15	Belarus	EURO	9559	0.732	3.212
16	Madagascar	AFRO	21,315	0.435	3.175
17	India	SEARO	1,241,492	0.519	2.876
18	Venezuela	AMRO	29,437	0.696	2.813
19	Niger	AFRO	16,069	0.261	2.689
20	Kuwait	EMRO	2818	0.771	2.585
21	United Arab Emirates	EMRO	7891	0.815	2.560
22	Mongolia	WPRO	2800	0.622	2.437
23	Nepal	SEARO	30,486	0.428	2.269
24	Togo	AFRO	6155	0.428	2.118
25	Burkina Faso	AFRO	16,968	0.305	1.953
26	Algeria	AFRO	35,980	0.677	1.946
27	Yemen	EMRO	24,800	0.439	1.916
28	Republic of Serbia	EURO	9854	0.735	1.826
29	Cape Verde	AFRO	501	0.534	1.786
30	Colombia	AMRO	46,927	0.689	1.727
31	Italy	EURO	60,789	0.854	1.707
32	Egypt	EMRO	82,537	0.62	1.690
33	Suriname	AMRO	529	0.646	1.590
34	Brunei Darussalam	WPRO	406	0.805	1.573
35	Morocco	EMRO	32,273	0.567	1.516
36	Mozambique	AFRO	23,930	0.284	1.506
37	Chile	AMRO	17,270	0.783	1.408
38	Saudi Arabia	EMRO	28,083	0.752	1.387
39	Czech Republic	EURO	10,534	0.841	1.371
40	Syrian Arab Republic	EMRO	20,766	0.589	1.361
41	Guatemala	AMRO	14,757	0.56	1.353
42	Spain	EURO	46,455	0.863	1.324
43	Viet Nam	WPRO	88,792	0.572	1.322
44	Luxembourg	EURO	516	0.852	1.311
45	El Salvador	AMRO	6227	0.659	1.309
46	Philippines	WPRO	94,852	0.638	1.280
47	Turkey	EURO	73,640	0.679	1.275
48	Dominican Republic	AMRO	10,056	0.663	1.266
49	Thailand	SEARO	69,519	0.654	1.250
50	Uzbekistan	EURO	27,760	0.617	1.248
51	Russian Federation	EURO	142,836	0.719	1.244
52	United Kingdom of Great Britain and Northern Ireland	EURO	62,417	0.849	1.241
53	Australia	WPRO	22,606	0.937	1.238
54	Canada	AMRO	34,350	0.888	1.227
55	New Zealand	WPRO	4415	0.907	1.192
56	Iran (Islamic Republic of)	EMRO	74,799	0.702	1.168
57	Brazil	AMRO	196,655	0.699	1.152
58	Jamaica	AMRO	2751	0.688	1.148
59	Japan	WPRO	126,497	0.884	1.143
60	Malta	EURO	418	0.815	1.140
61	Bahrain	EMRO	1324	0.801	1.136
62	Dominica	AMRO	71	No data	1.127
63	Singapore	WPRO	5188	0.846	1.120

(*Continued*)

Table 10
Continued

Rank	Country	WHO Region	Population, in Thousands (2010)[b]	HDI	Ratio ACM_{2010}/ACM_{2006}
64	Costa Rica	AMRO	4727	0.725	1.116
65	Austria	EURO	8413	0.851	1.111
66	Nicaragua	AMRO	5870	0.565	1.103
67	Israel	EURO	7562	0.872	1.102

WHO = World Health Organization; HDI = Human Development Index; ACM = Adequacy of Consumption Measure; AFRO = WHO African Region; EURO = WHO European Region; WPRO = WHO Western Pacific Region; AMRO = WHO American Region; SEARO = WHO South-East Asia Region; EMRO = WHO Eastern Mediterranean Region.
[a]The country with the largest increase in adequacy of opioid consumption is ranked number 1 and that with the smallest increase is ranked number 67.
[b]HDI figures are from United Nations Development Sources available from http://hdr.undp.org/en/reports/global/hdr2010/. Figures for population numbers are from the United Nations, available from http://unstats.un.org/unsd/demographic/products/socind/.

Supply of Opioid Analgesics

Although consumption in most countries is still well below the level of adequacy, the present rise in global opioid analgesic consumption raises the question of whether, in the long term, global production will be able to keep pace with medical demand. At present, both the global production and consumption are 290 tonnes, 20.0% of the estimated need to address pain adequately. If all countries had reached adequacy in 2010, a production of 1448 tonnes of morphine equivalents would have been necessary.

Between 2006 and 2010, the world population grew by more than 4%. Projections from the United Nations estimate that in 2030 there will be 8.2 billion people. Furthermore, the aging world population will lead inevitably to more people living with chronic disease and cancer,[31] which also will cause an additional increase in demand for controlled opioid analgesics. Although INCB estimates that global stocks of opioids correspond to 12 months' global consumption, in the long term, producer countries will have to increase production. The risk of harvest failures also should be taken into consideration when planning the cultivation of opium and poppy straw for opioids. These results show that, in the future, new areas of legal poppy production as well as laboratories for synthetic manufacture should be created to meet global needs for opioid medicines.

Possible Actions for Improvement

To improve access to controlled medicines (both opioids and others), WHO established the Access to Controlled Medicines Programme. The Access to Controlled Medicines Programme is committed to providing assistance to countries in carrying out assessments of legislation and policies. It also develops guidance documents for governments and health care professionals on issues related to controlled medicines and their use.[32]

WHO and INCB published the *Guide on Estimating Requirements for Substances under International Control* to help health authorities establish correct estimates regarding the needs of opioids and to provide them to INCB. These estimates are essential for importing controlled medicines as they are part of the international system to avoid diversion. Exporting countries will only issue an export license in case of a positive balance on the annual estimates for a country. In several countries, estimates provided do not reflect reality because statistics and estimates are not calculated appropriately. This guide describes methods on how to estimate basic needs for opioids at the country level; it should enable countries to access an uninterrupted supply of controlled medicines.

Many other organizations, such as Human Rights Watch, the International Organization for Hospice and Palliative Care, the International Association for the Study of Pain, the Union for International Cancer Control and the United Nations Office on Drugs and Crime, and individuals in many countries started initiatives for improving the situation. Fortunately, there is more recognition today that there is a problem than a few years ago.

Another aspect that should receive attention is that health care professionals are frequently not trained to prescribe opioid analgesics. This requires attention, as knowledge at the practitioner level is crucial for adequate pain relief. For this purpose, WHO is working on several

Table 11

Countries Where Adequacy of Opioid Consumption Decreased ≥10% Between 2006 and 2010, in Rank Order[a]

Rank	Country	WHO Region	Population, in Thousands (2010)	HDI 2010	Ratio ACM_{2010}/ ACM_{2006}
1	Ghana	AFRO	24,966	0.467	0.032
2	Democratic People's Republic of Korea	SEARO	24,451	0.877	0.039
3	Benin	AFRO	9100	0.435	0.084
4	Botswana	AFRO	2031	0.633	0.170
5	Myanmar	SEARO	48,337	0.451	0.216
6	Iceland	EURO	324	0.869	0.374
7	Ukraine	EURO	45,190	0.71	0.396
8	Grenada	AMRO	105	No data	0.443
9	Portugal	EURO	10,690	0.795	0.461
10	Slovakia	EURO	5472	0.818	0.471
11	Libyan Arab Jamahiriya	EMRO	6423	0.755	0.502
12	Estonia	EURO	1341	0.812	0.522
13	Bangladesh	SEARO	150,494	0.469	0.525
14	The Former Yugoslav Republic of Macedonia	EURO	2064	0.701	0.576
15	Qatar	EMRO	1870	0.803	0.600
16	Albania	EURO	3216	0.719	0.610
17	Lao People's Democratic Republic	WPRO	6288	0.497	0.617
18	Republic of Moldova	EURO	3545	0.623	0.639
19	Armenia	EURO	3100	0.695	0.645
20	Latvia	EURO	2243	0.769	0.648
21	Poland	EURO	38,299	0.795	0.663
22	Sri Lanka	SEARO	21,045	0.658	0.714
23	Bulgaria	EURO	7446	0.743	0.721
24	Bahamas	AMRO	347	0.784	0.746
25	Lebanon	EMRO	4259	0.907	0.751
26	Tonga	WPRO	105	0.677	0.757
27	Seychelles	AFRO	86	No data	0.758
28	Tunisia	EMRO	10,594	0.683	0.767
29	Azerbaijan	EURO	9306	0.713	0.811
30	Finland	EURO	5385	0.871	0.820
31	Slovenia	EURO	2035	0.828	0.823
32	Cyprus	EURO	1117	0.81	0.828
33	Turkmenistan	EURO	5105	0.669	0.848
34	Hungary	EURO	9966	0.805	0.849
35	Kyrgyzstan	EURO	5393	0.598	0.850
36	Greece	EURO	11,390	0.855	0.852
37	Denmark	EURO	5573	0.866	0.860
38	Lithuania	EURO	3307	0.783	0.862
39	Georgia	EURO	4329	0.698	0.867
40	Germany	EURO	82,163	0.885	0.876
41	Kenya	AFRO	41,610	0.47	0.889
42	The Netherlands	EURO	16,665	0.89	0.899

WHO = World Health Organization; HDI = Human Development Index; ACM = Adequacy of Consumption Measure; AFRO = WHO African Region; SEARO = WHO South-East Asia Region; EURO = WHO European Region; AMRO = WHO American Region; EMRO = WHO Eastern Mediterranean Region; WPRO = WHO Western Pacific Region.

[a]The country with the largest decrease in adequacy of opioid consumption is ranked number 1 and that with the smallest decrease is ranked number 42.

pain management guidelines that can serve as a reference for the use and prescription of opioid analgesics.[33]

Study Limitations

Seya et al. described the limitations of the method.[5] The method gives an indication of which level of consumption a country is in, rather than a precise value. It is suitable for determining whether it is urgent that a country develop special policies directed at improving access to opioid analgesics. However, the method is not suitable for planning purposes, such as the mandatory annual submissions of estimated needs to INCB. In this respect, WHO and INCB published a guide as to how to make annual estimates for opioid analgesics at the country level.[34]

Conclusion

The consumption of opioid analgesics is inadequate in most of the world and as a

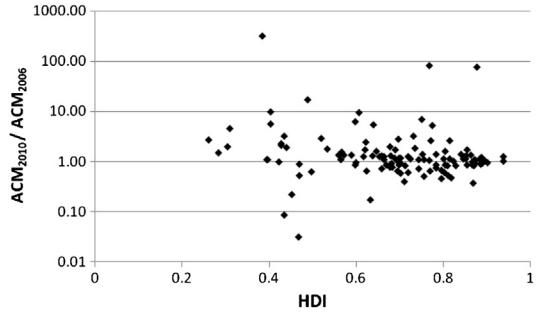

Fig. 3. Change in adequacy of opioid consumption for all countries between 2006 and 2010, expressed as the ratio ACM_{2010}/ACM_{2006}; ratio < 1 means decrease, ratio > 1 means increase. ACM = Adequacy of Consumption Measure; HDI = Human Development Index.

result, patients with moderate and severe pain do not receive the treatment they need. Governments, health organizations, and nongovernmental organizations must collaborate to change this situation. Countries should target their efforts at educational, cultural, health policy, and regulatory levels.

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