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The 2008 Global Burden of Disease study in Brazil: a new methodological approach for estimation of injury morbidity

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ABSTRACT

Objective. *To present the methodological approach used to estimate injury morbidity (Years Lived with Disability, YLD) in the 2008 Global Burden of Disease study in Brazil (GBD-Br).*
Methods. *YLD was based on the admission rate for injuries from both public and private sector facilities. Morbidity arising from emergency room (ER) visits was estimated using logistic regression models of the likelihood of hospitalization for different types of injuries, controlling for sex, age and geographic region. Data was obtained from the Mortality Information System, the Hospitalization Information System of the Unified Health System and the 2009 survey for the Surveillance System for Violence and Accidents (VIVA).*
Results. *Injuries accounted for 10.0% of the total burden of disease in Brazil in 2008, corresponding to 19 years of life lost per 100 000 inhabitants. YLD accounted for 10% of total years of life lost.*
Conclusions. *This approach represents a methodological advance, particularly due to the inclusion of the VIVA survey, which provides a more reliable measurement of the burden of injury in Brazil than other sources.*

Key words Health information systems; external causes; homicide; accidents; prevalence; Brazil.

Injuries are estimated to account for over 5 million deaths annually worldwide (1). In Brazil in 2011, approximately 145 000 people died of injuries and 1 million were hospitalized (2). Survivors of injury often experience temporary or permanent disabilities, and consequently decreased capacity to work and quality of life (3). Injuries have a correspondingly high impact on the healthcare system—in Canada, 14 000 people died of injuries in 2004, and over 60 000 were partially disabled, generating about 20 billion Canadian dollars in associated costs (4).

Health information systems are crucial for the evaluation and monitoring of population health. In Brazil, injury deaths and hospitalizations can be tracked through the Mortality Information System (Sistema de Informação sobre Mortalidade, SIM) and the Hospitalization Information System (Sistema de Informações Hospitalares, SIH) of the Unified Health System (Sistema Único de Saúde, SUS). Both datasets are maintained by Brazil's Ministry of Health (2). No national information system systematically records emergency room (ER) visits. The only source for such data is the Surveillance System for Violence and Accidents (VIVA), a survey conducted by the Ministry of Health of Brazil in 2006, 2007, 2009, and 2011 which collects data on violence and accidents in order to analyze trends and describe the profile of ER visits (5).

The Disability-Adjusted Life Year (DALY) is an indicator of years of life lost due to death or disability. It is used to demonstrate changes in population

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health, particularly in the context of the demographic and epidemiological transition (6), and is considered a better way to measure the impact of injuries than raw incidence, since it takes into account the duration and severity of such events.

DALYs are composed of the sum of two parts: 1) an estimate of years of life lost due to premature mortality (Years of Life Lost, YLL); and 2) an estimate of years of life lived with disability (Years Lived with Disability, YLD). DALYs are estimated using clinical and epidemiological parameters: incidence, prevalence, lethality, remission, duration and proportion of treated cases (7).

The Global Burden of Disease study (GBD) was conducted as part of a broader review of global health by Murray and Lopez in 1990 (7); since then, it has undergone methodological adjustments and been periodically updated (8–10). There have been two editions of the GBD study in Brazil (GBD-Br): the first produced estimates for 1998 (11) and the second for 2008 (12). Important methodological adjustments for estimating injury-related YLDs were applied in the 2008 GBD-Br. Whereas the first edition used international parameters to estimate the impact of ER visits on morbidity, the 2008 edition incorporated data from the 2009 VIVA survey, allowing for more reliable assessment of the impact of injuries in Brazil.

This paper describes the methodological approach taken to estimate injury morbidity (YLD) in the 2008 GBD-Br.

MATERIALS AND METHODS

The YLD calculation comprised the following steps: 1) definition of injury type with reference to Chapter XX of the Tenth Revision of the International Classification of Diseases (ICD-10) (13); 2) definition of disabilities, weights and durations (i.e., short-term or lifelong); 3) calculation of incidence based on hospital admissions for injuries and an estimate of ER visits adjusted by a factor derived from the 2009 VIVA Survey (5) and the Australia GBD study (14); 4) calculation of YLD by sex, age and type of injury, un-weighted by age group, at a discount rate of 3%.

In the GBD study (7), diseases are subdivided into the following groups: I) communicable diseases, maternal/perinatal conditions and nutritional conditions; II) non-communicable diseases; and III) injuries.

Group III, the focus of this paper, comprises the entirety of ICD-10 Chapter XX (13), which is subdivided into two main sub-groups: unintentional injuries (IIIA) and intentional injuries (IIIB). The first sub-group includes transport-related injuries (IIIA01, V01–V89, Y85), accidental poisoning (IIIA02; X40–X49), falls (IIIA03; W00–W19), fire/burns (IIIA04; X00–X19), drowning (IIIA05; W65–W74), other unintentional injuries (IIIA06, V90–V99, W20–W64, W75–W99, X10–X39, X50–X59, Y86) and complications of medical/surgical care (IIIA07; Y40–Y84, Y88). The second sub-group includes intentional self-harm/suicides (IIIB01; X60–X84), assaults/homicides (IIIB02; X85–Y09;Y87) and war (IIIB03; Y35–Y36).

Criteria applied in the Australia GBD study (14) were used to classify short- and long-term disabilities according to type of injury, sex, age and nature of injury (ICD-10 Chapter XIX, S00–T98). The duration of short-term disabilities is given by the length of stay in hospital, and of long-term by life expectancy in 2008. Disability weights range from 0 to 1, representing, respectively, lower versus higher degrees of impairment of quality of life and/or injury severity. The disability weights applied by the Australia GBD study are very similar to those used by Murray & Lopez (8), although some small adjustments are described in the study report (14). This was the only study to make available a complete and transparent calculation methodology for all 32 categories of disease and 10 groups of injuries, stratified by age and sex.

The hospitalization database, based on data from SIH (2), listed the average number of hospitalizations during 2007–2009 according to: sex, age group, federal unit, procedure performed, primary and secondary diagnosis, discharge/death, and type of procedure for reimbursement; admissions records that listed injury as a primary or secondary diagnosis on the basis of the nature of the injury (ICD-10, Chapter XIX, S00–T98) or injury type (ICD-10, Chapter XX) were included. Hospitalizations resulting in deaths were excluded, as they are registered in the YLL calculation. Records where nature of injury was unclassified (12.8%) were also excluded. Injuries listed as caused by an "event of undetermined intent" (codes Y10–Y34) were proportionally redistributed according to federal unit, sex, age (five-year GBD age group) and nature of injury. Finally, a correction factor (15) was applied to estimate hospital admissions in facilities (e.g., hospitals, health care centers) not linked to SUS.

Table 1 presents injury-related hospital admissions in Brazil by injury sub-

TABLE 1. Total hospital admissions by injury type in Brazil, 1998 and 2007–2009

Group (code)	1998		Average 2007–2009		Difference in percent (1998/2008)	Admissions ratio (1998/2008)
	No.	%	No.	%		
Transport-related injuries (IIIA01)	103 819	16.4	103 713	15.0	–1.4	1.0
Accidental poisoning (IIIA02)	10 258	1.6	8 340	1.2	–0.4	0.8
Falls (IIIA03)	239 467	37.8	305 100	44.1	6.3	1.3
Fire/Burns (IIIA04)	10 093	1.6	6 813	1.0	–0.6	0.7
Drowning (IIIA05)	494	0.1	1 826	0.3	0.2	3.7
Other unintentional injuries (IIIA06)	191 453	30.2	184 895	26.7	–3.5	1.0
Complications of medical care (IIIA07)	18 249	2.9	23 096	3.3	0.5	1.3
Self-harm/suicides (IIIB01)	9 415	1.5	9 079	1.3	–0.2	1.0
Assaults/homicides (IIIB02)	34 411	5.4	35 560	5.1	–0.3	1.0
War (IIIB03)	392	0.1	206	0.0	0.0	0.5
Unclassified	15 237	2.4	13 605	2.0	–0.4	0.9
Total	633 288	100.0	692 233	100.0	—	—

Source: Hospitalization Information System (SIH): 1998, 2008.

group from SIH records, comparing 1998 (when the first GBD study was performed in Brazil) with the average for the 2007–2009 triennium (the reference period for the GBD-Br). A change in the proportional distribution of admissions for injury subgroups was observed, highlighted by an increase of about 6% of hospital admissions caused by falls. This may reflect the increasing number of elderly people in the Brazilian population (6). A greater than 3% decrease in hospitalizations was observed for "other unintentional injuries," perhaps due to improvement in the quality of data.

Dedicated information on ER visits is needed in order to calculate YLD, since not all visits generate a hospital admission record—the only information tracked by SIH. This study used data from the 2009 VIVA survey, a cross-sectional study collecting data on injury victims who sought treatment in one of the 136 hospitals within the SUS equipped for urgent and emergency care. Data were collected on 30 days from September through November 2009, with 12-hour interview shifts selected randomly. The survey gathered information on: the general characteristics of the victim (name, age, sex, race/ethnicity, education, presence of disability); type of injury; nature of injury; and outcome in the first 24 hours (i.e., discharge, outpatient referral, referral to other services, hospitalization, evasion or death).

More detailed information on the methodology of the 2009 VIVA survey, including sampling criteria and data collection procedures, can be found in the research report, available online (5). Because it did not attain full coverage at the national level, a set of inflation factors derived from logistic regression models were used to produce representative estimates of ER visits, as detailed in the next section.

Table 2 shows the proportions of hospital admissions by injury and age group. Less severe injury subgroups with lower lethality, such as falls and other unintended injuries, account for a lower proportion of hospital admissions. Overall, only 9.6% of ER visits for injuries resulted in hospital admissions. This suggests that SIH, which registers only admissions information, captures just one in ten injuries that require medical care. Calculating YLD without considering ER visits would seriously underestimate the total impact of injuries.

Inflation factors were calculated based on logistic regression models estimating the odds of hospital admission, based on the nature of injury, sex, age and place of occurrence, for each of the most common injury subgroups, namely: transport-related injuries (IIIA01), falls (IIIA03), fire/burns (IIIA04), assaults/homicides (IIIB02), other injuries (IIIA06) and all injuries.

The following explanatory variables were included:

- region of residence: Midwest (reference category), North, Northeast, Southeast or South;
- sex: male or female (reference category);
- age group: less than 1 year, 1–4 years, 5–14 years, 15–29 years, 30–44 years, 45–59 years, 60–69 years, 70–79 years, 80 years and over (reference category);
- nature of injury: without lesion (physical), contusion, cut/laceration, sprain/dislocation, fracture, traumatic brain injury (TBI), poly trauma. or other (reference category).

The models were assessed by comparing the predicted probability of hospital admissions with the actual proportion of hospital admissions to estimate the overall accuracy of classification. This ranged from 77.1% in the model for falls (IIIA03) to 56.6% in the model for assaults/homicides (IIIB02).

Given the high specificity of the overall model and the small number of individu-

TABLE 2. Number of emergency room visits and proportion of injury-related visits leading to hospital admissions by age group in the VIVA survey, Brazil, 2009

	Age group in years (Global Burden of Disease study)									
Group[a]	< 1	1–4	5–14	15–29	30–44	45–59	60–69	70–79	≥ 80	Total
Emergency room visits										
IIIA01	249	793	2 956	14 186	7 930	3 214	851	424	173	30 777
IIIA02	152	162	99	240	165	63	14	28	10	933
IIIA03	2 475	3 713	10 325	8 658	6 930	5 348	2 259	1 741	1 184	42 633
IIIA04	227	178	291	827	582	304	67	42	15	2 535
IIIA05	8	0	7	11	15	8	8	6	0	62
IIIA06	958	2 247	7 700	13 278	8 992	4 808	1168	559	222	39 930
IIIB01	12	10	76	602	342	77	44	11	3	1 179
IIIB02	203	178	893	5 642	3 120	1 199	153	102	42	11 532
IIIB03	4	0	1	111	45	5	0	0	5	171
Total	4 289	7 280	22 347	43 556	28 121	15 027	4 565	2 913	1 654	129 752
Proportion of hospital admissions										
IIIA01	6.2	9.4	13.6	14.8	18.3	18.9	22.4	17.7	23.3	16.1
IIIA02	18.2	19.0	16.1	11.2	0.0	5.6	0.0	16.3	40.0	12.1
IIIA03	8.5	6.9	6.1	5.4	7.5	7.3	9.8	14.1	23.0	7.5
IIIA04	29.3	35.5	27.6	14.9	9.2	15.4	18.3	19.2	28.8	18.1
IIIA05	46.9	—	100.0	29.0	49.6	0.0	0.0	0.0	—	33.5
IIIA06	7.5	3.5	3.9	3.0	4.2	5.3	5.4	5.9	4.2	4.0
IIIB01	12.8	22.0	7.2	23.9	28.4	49.3	42.0	0.0	100.0	26.3
IIIB02	19.4	10.5	6.7	17.2	16.2	14.8	19.0	10.9	47.6	15.9
IIIB03	0.0	—	0.0	22.3	7.4	24.6	—	—	0.0	17.1
Total	10.1	7.2	6.7	9.8	10.7	10.1	11.7	12.9	21.3	9.6

Source: Surveillance System for Violence and Accidents, 2009.

[a] Transport-related injuries (IIIA01), accidental poisoning (IIIA02), falls (IIIA03), fire/burns (IIIA04), drowning (IIIA05), other unintentional injuries (IIIA06) and complications of medical/surgical care (IIIA07); self-harm/suicides (IIIB01), assaults/homicides (IIIB02) and war (IIIB03).

als in each category of analysis (i.e., gender, age, region, external cause), a smaller model was adopted even though other data is available in the 2009 VIVA survey.

Table 3 shows estimated odds ratios (ORs) and confidence intervals for the explanatory variables in each of the injury-type-specific logistic models. In models for "all injuries" and falls, all major regions were statistically significantly associated with hospital admission, while in models for transport-related injuries and assaults/homicides, this was only the case for North and Northeast regions. Several injury categories were not significantly associated with the South and Southeast regions, while all types displayed significant relationships with the Northeast and North. In all models, the North region was associated with a higher likelihood of hospital admissions (OR > 1) than the Midwest, the reference category.

Sex was significantly associated with all types of injuries, with men having a higher likelihood of hospital admission, ranging from OR = 2.31 (95% confidence interval (CI): 1.98–2.69) in the "assaults/homicides" model to OR = 1.09 (95% CI: 1.01, 1.18) for transport-related injuries.

Compared with the reference category of 80 years or older, those 60–69 and 70–79 years old were significantly more likely to be admitted to hospital in the "all injuries" model. The odds of falling for individuals older than 45 years increased significantly with age, as expected. Strikingly, those in the age group 70–79 years were the most likely to be admitted to hospital for "assaults/homicides" (OR = 3.29, 95% CI: 1.59–6.81). This figure includes both victims and perpetrators that survived the event, which usually has a high mortality rate, especially among young individuals. All age groups were significantly associated with hospital admissions for transport-related injuries, except for those at the extremes—under one year and 70–79 years.

The highest likelihoods of hospitalization in the "all injuries" model were related to fracture and TBI, both approximately 13 times higher than for "other" lesions (the reference category). For transport-related injuries and falls, fractures carried the highest odds of hospitalization (respectively, OR = 19.81, 95% CI: 14.00–28.03; and OR = 7.34, 95% CI: 5.88–9.15), while for models of other unintentional injuries and assaults/homicides, TBI was associated with the

TABLE 3. Results of logistic regression models for injury-related hospital admissions by injury types, Brazil, 2009

	All injuries		IIIA01 (Transport-related injuries)		IIIA03 (Falls)		IIIA04 (Fire/burns)		IIIA06 (Other unintentional injuries)		IIIB02 (Assaults/homicides)	
Explanatory variables	OR adj[a]	95% CI[b]	OR adj[a]	95% CI[b]	OR adj[a]	95% CI[b]	OR adj[a]	95% CI[b]	OR adj[a]	95% CI[b]	OR adj[a]	95% CI[b]
Midwest region[c]	1	—	1	—	1	—	1	—	1	—	1	—
North region	1.39[d]	(1.30, 1.48)	1.39[d]	(1.25, 1.55)	1.29[d]	(1.13, 1.47)	2.02[d]	(1.44, 2.82)	1.5[d]	(1.28, 1.75)	1.31[d]	(1.12, 1.54)
Northeast region	0.62[d]	(0.58, 0.67)	0.81[d]	(0.71, 0.92)	0.65[d]	(0.56, 0.76)	0.49[d]	(0.32, 0.75)	0.49[d]	(0.40, 0.60)	0.6[d]	(0.49, 0.74)
Southeast region	0.71[d]	(0.66, 0.77)	0.94	(0.82, 1.08)	0.72[d]	(0.61, 0.84)	0.32[d]	(0.21, 0.49)	0.59[d]	(0.48, 0.73)	0.98	(0.80, 1.19)
South region	0.90[d]	(0.83, 0.98)	1.01	(0.89, 1.15)	0.61[d]	(0.51, 0.73)	0.64	(0.33, 1.23)	1.17	(0.93, 1.47)	0.88	(0.68, 1.13)
Female[c]	1	—	1	—	1	—	1	—	1	—	1	—
Male	1.42[d]	(1.35, 1.48)	1.09[d]	(1.01, 1.18)	1.44[d]	(1.32, 1.56)	2.3[d]	(1.82, 2.92)	1.67[d]	(1.47, 1.90)	2.31[d]	(1.98, 2.69)
≥ 80 years[c]	1	—	1	—	1	—	1	—	1	—	1	—
< 1 year	0.68[d]	(0.59, 0.78)	1.22	(0.66, 2.26)	0.77[d]	(0.63, 0.94)	1.06	(0.67, 1.66)	0.49[d]	(0.35, 0.70)	0.57	(0.31, 1.07)
1–4 years	0.63[d]	(0.55, 0.71)	1.9[d]	(1.08, 3.33)	0.65[d]	(0.54, 0.78)	0.78	(0.52, 1.18)	0.47[d]	(0.35, 0.62)	0.43[d]	(0.27, 0.68)
5–14 years	0.93	(0.83, 1.05)	2.09[d]	(1.20, 3.64)	0.78[d]	(0.65, 0.95)	0.37[d]	(0.26, 0.54)	0.35[d]	(0.26, 0.46)	0.97	(0.67, 1.42)
15–29 years	1.07	(0.95, 1.20)	2.73[d]	(1.56, 4.76)	1.07	(0.89, 1.29)	0.23[d]	(0.15, 0.35)	0.52[d]	(0.39, 0.70)	0.98	(0.67, 1.44)
30–44 years	1.03	(0.91, 1.16)	2.66[d]	(1.51, 4.66)	1.03	(0.85, 1.25)	0.43[d]	(0.27, 0.68)	0.68[d]	(0.51, 0.92)	0.93	(0.62, 1.40)
45–59 years	1.15	(0.99, 1.33)	3.08[d]	(1.72, 5.51)	1.28[d]	(1.03, 1.59)	0.81	(0.39, 1.71)	0.70	(0.48, 1.02)	0.86	(0.47, 1.55)
60– 69 years	1.28[d]	(1.09, 1.50)	2.47[d]	(1.33, 4.58)	1.76[d]	(1.41, 2.18)	0.8	(0.34, 1.88)	0.93	(0.60, 1.46)	0.74	(0.35, 1.55)
70–79 years	2.04[d]	(1.72, 2.42)	1.73	(0.86, 3.45)	3.13[d]	(2.51, 3.90)	1.3	(0.35, 4.79)	0.48[d]	(0.23, 0.98)	3.29[d]	(1.59, 6.81)
Others[c]	1	—	1	—	1	—	—	—	1	—	1	—
Without lesion (physical)	0.94	(0.82, 1.09)	1.27	(0.89, 1.81)	0.68[d]	(0.54, 0.85)	—	—	1.02	(0.70, 1.50)	0.68	(0.36, 1.26)
Contusion	1.99[d]	(1.74, 2.26)	2.17[d]	(1.54, 3.05)	0.92	(0.74, 1.15)	—	—	2.95[d]	(2.21, 3.96)	3.84[d]	(2.20, 6.70)
Cut/ laceration	0.65[d]	(0.56, 0.76)	1.12	(0.78, 1.61)	0.45[d]	(0.36, 0.57)	—	—	0.99[d]	(0.69, 1.41)	0.63	(0.30, 1.33)
Sprain/dislocation	8.74[d]	(7.67, 9.96)	12.58[d]	(8.97, 17.64)	4.72[d]	(3.84, 5.80)	—	—	15.93[d]	(11.75, 21.59)	6.63[d]	(3.71, 11.83)
Fracture	13.46[d]	(11.71, 15.48)	19.81[d]	(14.00, 28.03)	7.34[d]	(5.88, 9.15)	—	—	23.06[d]	(15.73, 33.81)	8.05[d]	(4.49, 14.41)
Traumatic brain injury	12.88[d]	(11.18, 14.84)	14.74[d]	(10.46, 20.75)	5.48[d]	(4.18, 7.18)	—	—	25.67[d]	(16.01, 41.14)	8.58[d]	(4.79, 15.35)
Polytrauma	4.60[d]	(4.01, 5.28)	3.28[d]	(2.26, 4.77)	1.22	(0.85, 1.74)	—	—	6.22[d]	(4.54, 8.50)	7.89[d]	(4.43, 14.06)
Constant	0.03	—	0.01	—	0.05	—	0.28	—	0.02	—	0.03	—

Source: Surveillance System for Violence and Accidents, 2009.
[a] OR adj = Adjusted Odds Ratio.
[b] Confidential interval.
[c] OR reference category.
[d] $P < 0.05$ (*Wald* test).

highest risks (respectively, OR = 25.67, 95% CI: 16.01–41.14; and OR = 8.58, 95% CI: 4.79–15.35).

Figure 1 shows means and 95% confidence intervals for the rate of hospitalization, as reported by the VIVA survey, and for the predicted values from the logistic regression model for each group of injuries. The model-adjusted predictions show less variation, and yield estimates close to the original data, an indicator that the model is accurate.

Table 4 shows VIVA inflation factors by sex and age group for all injury types. Causes with higher inflation factors are less serious; they generate a large number of ER visits but fewer admissions than other injuries. These factors were calculated as the inverse of the predicted probability of the rate of hospitalization for the specific external cause; e.g., for the cause "other unintentional injuries," the inflation factor was about 46 for females, which means that for every 46 ER visits one hospitalization is expected.

Nature of injury comprises five categories in the 2009 VIVA survey, but 32 in the GBD study (7). Accordingly, a further adjustment was applied based on the factors proposed in the Australia GBD study (14), and ER visits leading to hospitalizations were estimated using these two models in parallel. Specifically, the ratios between the values estimated using the 2009 VIVA survey and Australia GBD models were applied to the sum of hospital admissions from SIH in order to obtain final estimates of ER visits nationwide by sex, age group and nature of injury.

The incidence of injuries was calculated from the estimates of hospitalizations and ER visits described above, and, along with disability weights and duration, used to calculate YLD. For each injury type and region, the following procedures were applied:

- calculation of short-term durations by sex and age group;
- calculation of long-term durations by sex and age group;
- calculation of short-term YLDs (unweighted by age group, at a discount rate of 3%);
- calculation of long-term YLDs (unweighted by age group, at a discount rate of 3%);
- calculation of final YLDs by injury type, sex, age group and region;
- calculation of YLD rates, based on the resident population in 2008.

RESULTS

Injuries accounted for 10.0% of the total burden of disease in Brazil in 2008, corresponding to 19 DALYs per 100 000 inhabitants. DALYs for injuries were skewed towards men, with a male/female ratio of 4.8; among women, unintentional injuries predominated. The 15–29 year age group experienced the highest burden. YLD accounted for 10% of total DALYs, with most (95%) coming as a result of unintentional injuries; of these, falls accounted for the largest proportion (36.3%).

In descending order, the injury groups accounting for the most YLD were as follows: other unintentional injuries (IIIA06): 82 per hundred thousand inhabitants, 38% of total; falls (IIIA03): 81, 37%; transport-related injuries (IIIA01): 28, 13%; fire/burns (IIIA04): 9, 4%; assaults/homicides (IIIB02): 9, 4%; intentional self-harm/suicides (IIIB01): 7, 3%; and all other groups combined represented less than 1%.

Complete results for 2008 DALYs (sum of YLLs and YLDs) in Brazil, stratified by sex, age group and geographic region, are presented elsewhere (16).

DISCUSSION

The methodology applied in the 2008 GBD-Br study introduced improvements in the assessment of injury incidence in Brazil, when compared to both the first version of the GBD-Br in 1998 and the standard international methodology for the GBD (7).

In 1998, GBD-Br injury estimates were based on hospital admissions and parameters from the Australia GBD. At the time, no information was available on ER visits, since the first VIVA survey was not performed until 2006. ER visits that did not generate a hospital admission were estimated using only parameters from the Australia GBD (14), an important weakness.

The country-level estimate for injuries in Brazil proposed by Murray *et al*. (17) has significant shortcomings, including the impossibility of stratification by region, which limits the power of analysis. Moreover, the methodology used to calculate YLD is not described in detail, nor is there any information on whether ER visits that did not generate hospital admissions were included or adjusted for in the analysis; it is also unclear whether private sector data, generally unavailable in Brazil, was factored into estimates of hospital admissions.

Despite the methodological advances described here for calculating YLD for injuries in the 2008 GBD-Br, some limitations remain:

1) the 2009 VIVA survey used to estimate ER visits does not cover the nation fully, but rather is restricted to 136 public hospital facilities spread throughout the country; to address this, logistic models were used to estimate the number of ER visits at country level, and the results adjusted using parameters from the Australia GBD Australia (14) to account for the 32 types of injuries recognized in the ICD-10;

2) the hospital information system only collects data on public facilities; thus, the 2008 GBD-Br inflated the number of admissions based on coverage estimates of the public and private sectors, a procedure that needs to be improved, in light of the complexity of the adjustment procedure;

3) the weights used to calculate morbidity in GBD-Br are from the Australian GBD, hence they do not address the specificities of the Brazilian health system; a recent study proposes to address this limitation by including information on quality of life (18); the use of parameters from the Australian GBD may also introduce errors and inconsistencies in calculating the likelihood of hospital admissions in Brazil, given that the health systems involved are quite different.

The GBD-Br 2008 improved the methodology for calculating YLD due to injuries; nevertheless, continuous improvements and methodological innovation should be encouraged since there is always room for improvement.

Data on hospital admissions and ER visits in the Brazilian private sector would be extremely valuable, obviating the need for a correction factor. Current information on ER visits should be improved through the implementation of a dedicated national information system to gather such data—the VIVA survey, though valuable, has limitations with respect to coverage and the cross-sectional nature of the data. Studies of the burden of disease in Brazil would benefit from: 1) automation of the calculation of YLD, which would improve the continuity of GBD-Br editions; 2) disaggregation

FIGURE 1. Proportion of Emergency Room (ER) visits leading to hospitalizations from the 2009 VIVA survey (light grey) and predicted probability from logistic regression models (dark grey) for A: all injuries; B: transport-related injuries; C: falls; D: fire/burns; E: other unintentional injuries; F: assaults/homicides. Brazil, 2009

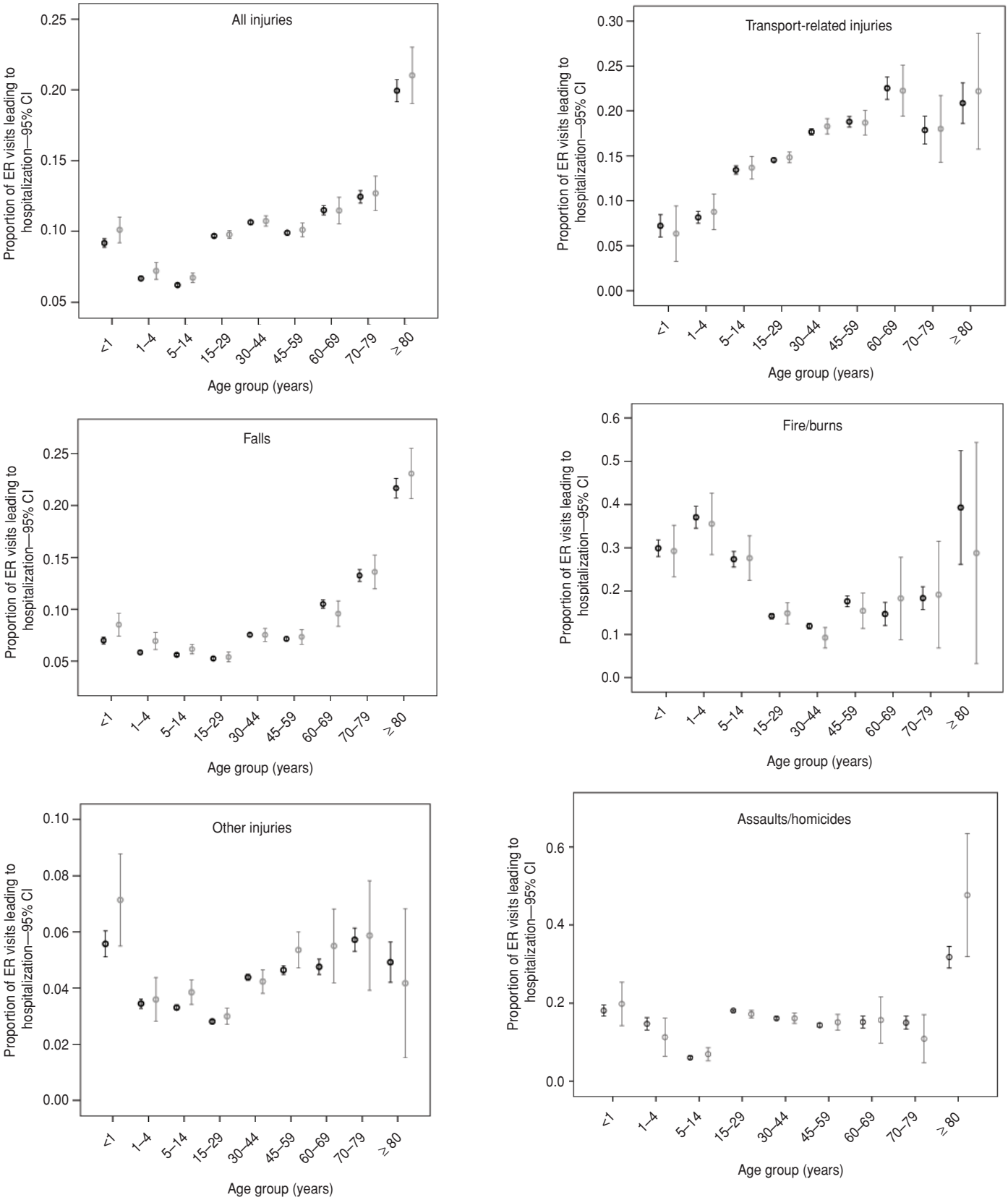

TABLE 4. Inflation factors for injuries by age group and sex from the 2009 Violence and Accidents (VIVA) Survey, Brazil, 2009

Injuries[a]	Age group in years (Global Burden of Disease study, GBD)									Total
	<1	1–4	5–14	15–29	30–44	45–59	60–69	70–79	≥ 80	
Inflation factor by VIVA survey										
Female										
IIIA01	11.9	12.8	7.9	7.7	6.5	7.3	4.9	7.1	6.5	7.3
IIIA03	18.3	19.8	24.3	27.9	19.1	16.9	10.6	7.8	4.9	16.0
IIIA04	4.5	4.1	5.6	11.5	13.9	8.2	9.8	5.6	5.9	8.0
IIIA06	25.9	43.3	56.7	61.2	42.5	37.2	33.2	23.7	33.6	45.6
IIIB02	8.3	14.7	28.1	11.2	12.2	14.5	11.0	9.4	4.4	12.4
All injuries[d]	13.5	18.0	22.0	14.6	13.6	14.4	10.6	9.0	5.8	14.3
Male										
IIIA01	15.5	12.0	7.3	6.6	5.4	4.8	4.2	4.9	4.4	6.0
IIIA03	12.1	15.6	15.5	15.8	10.9	11.8	8.2	7.0	4.0	12.7
IIIA04	2.8	2.3	2.7	5.5	6.6	4.7	5.3	5.0	1.9	4.3
IIIA06	13.6	23.4	23.8	30.9	19.3	17.3	17.5	13.7	15.7	22.7
IIIB02	4.5	5.0	13.7	4.8	5.2	5.7	5.9	5.8	2.9	5.2
All injuries[d]	9.4	13.4	14.0	9.2	8.2	8.4	7.4	7.0	4.2	9.4
Inflation Factor by VIVA and Australian GBD Study										
Female										
IIIA01	68.3	44.5	8.8	5.6	7.5	5.8	4.5	14.6	13.8	5.4
IIIA02	13.9	19.9	37.8	25.6	35.3	48.7	77.6	455.0	160.8	29.2
IIIA03	4.1	4.7	4.9	7.2	7.0	7.0	6.8	5.2	2.9	5.8
IIIA04	2.4	1.8	5.2	9.4	17.2	9.5	61.3	164.9	433.2	7.5
IIIA05	13.5	18.0	22.0	14.6	13.6	14.4	10.6	9.0	5.8	14.3
IIIA06	13.2	20.0	11.6	18.1	18.8	19.0	16.4	11.8	16.2	16.5
IIIB01	13.5	18.0	54.4	26.1	40.0	48.8	43.1	147.2	100.2	36.2
IIIB02	15.0	33.6	57.4	4.3	3.0	24.7	18.1	23.7	4.4	6.1
IIIB03	13.5	18.0	22.0	14.6	13.6	19.9	10.6	9.0	5.8	96.1
Male										
IIIA01	51.8	40.4	5.4	5.0	5.1	5.6	7.2	13.8	10.7	7.0
IIIA02	9.3	13.5	35.0	21.1	18.4	32.2	102.9	84.7	16.0	21.0
IIIA03	2.9	4.6	4.0	4.1	4.3	6.1	6.5	5.6	3.4	4.3
IIIA04	1.7	1.2	2.5	10.6	8.8	12.7	7.3	4.4	30.6	5.5
IIIA05	9.4	13.4	14.0	9.2	8.2	8.4	7.4	7.0	4.2	9.4
IIIA06	3.0	5.1	6.8	11.8	7.3	8.6	11.9	12.7	15.3	8.6
IIIB01	9.4	13.4	114.6	6.2	19.9	40.7	129.0	7.0	4.2	14.1
IIIB02	8.3	13.6	27.4	1.4	2.6	4.4	6.7	5.2	2.9	2.2
IIIB03	9.4	13.4	14.0	0.8	1.3	8.4	7.4	7.0	4.2	1.7

Source: Surveillance System for Violence and Accidents, 2009 (5) and Australian GBD Study (14).
[a] Transport-related injuries (IIIA01), accidental poisoning (IIIA02), falls (IIIA03), fire/burns (IIIA04), drowning (IIIA05), other unintentional injuries (IIIA06) and complications of medical/surgical care (IIIA07); self-harm/suicides (IIIB01), assaults/homicides (IIIB02) and war (IIIB03).
[b] Included the following injury types: IIIA02, IIIA05, IIIB01 e IIIB03.

of YLD, YLL and DALY, not only by region but also at state level, which would provide the latter with important information to support policy-making in this area; 3) assessment of risk factors responsible for a significant fraction of disease burden due to injuries; and finally 4) a comparative analysis of the 1998 and 2008 GBD-Br studies to characterize changes over time in the burden of diseases, updating 1998 data and applying the methodology used here—this will be explored in a separate paper; and finally 5) a comparative study among different methodological approaches applied in GBD-Br and international studies. The authors were unable to find detailed descriptions on the methodology used to calculate the burden of injuries in most international studies, even after exhaustive searches, except in GBD-Australia. Such information is critical for comparative analysis of the data.

This paper presents a new methodological approach used to estimate YLD for injuries in Brazil. Given the high impact of injuries on population health and, frequently, their preventability, it is essential that different methodologies and existing databases be made public, in order to broaden dialogue within the international scientific community, support initiatives for assessing overall health, and strengthen the use of such information to support the decision making-process in policies in this area.

Conflicts of interest. The authors declare that they have no conflicts of interest.

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RESUMEN

El estudio sobre la Carga Mundial de Morbilidad del 2008 en el Brasil: un nuevo enfoque metodológico para calcular la morbilidad por lesiones

Objetivo. Presentar el enfoque metodológico usado para calcular la morbilidad por lesiones (Años Vividos con Discapacidad, AVD) en el estudio sobre la Carga Mundial de Morbilidad del 2008 en el Brasil.

Métodos. El cálculo de los AVD se basó en la tasa de ingresos por lesiones en establecimientos sectoriales tanto públicos como privados. La morbilidad, obtenida a partir de las visitas a los servicios de urgencias, se calculó usando modelos de regresión logística de la probabilidad de hospitalización por diferentes tipos de lesiones, con control del sexo, la edad y la región geográfica. Los datos se obtuvieron del Sistema de Información de Mortalidad, el Sistema de Información de Hospitalización del Sistema de Salud Unificado y la encuesta del Sistema de Vigilancia de Violencias y Accidentes correspondiente al 2009.

Resultados. Las lesiones representaron el 10,0% de la carga total de morbilidad del Brasil en el 2008, lo que correspondía a 19 años de vida perdidos por 100 000 habitantes. Los AVD representaron un 10% del total de años de vida perdidos.

Conclusiones. Este enfoque representa un adelanto metodológico, en particular como consecuencia de la inclusión de la encuesta del Sistema de Vigilancia de Violencias y Accidentes, que proporciona una medición de la carga de lesiones en el Brasil más fiable que la de otras fuentes.

Palabras clave Sistemas de información en salud; causas externas; homicidio; accidentes; prevalencia; Brasil.