Journal of the Peripheral Nervous System 21:339–344 (2016)

RESEARCH REPORT

Incidence of Guillain-Barré syndrome in Chile: a population-based study

Gonzalo Rivera-Lillo[1,2], Rodrigo Torres-Castro[1,2], Pablo I. Burgos[1,3], Gonzalo Varas-Díaz[2], Roberto Vera-Uribe[1], Homero Puppo[1], and Mauricio Hernández[1]

[1] Department of Physical Therapy, Faculty of Medicine, University of Chile, Santiago de Chile, Chile; [2] Clínica Los Coihues, Center of Integrated Studies in Neurorehabilitation, Santiago de Chile, Chile; and [3] Research and Development Unit, Hospital El Carmen de Maipú, Santiago de Chile, Chile

Abstract The Guillain-Barré syndrome (GBS) incidence rate (IR) varies between 0.16 and 3.00 cases per 100,000 inhabitants. Little data exist on the epidemiology of GBS in Latin American countries. Our objective was to describe GBS epidemiology based on a national database in a Latin American country and to contribute to the global map of GBS epidemiology. This was a retrospective study that included all reported GBS cases in Chile between 2001 and 2012. Gender, age, seasonal occurrence, and geographical distribution were analyzed. A total of 4,158 GBS cases were identified from 19,513,655 registries. The mean age was 37 ± 24 years, and 59% of patients were male (male to female ratio of 1.5 : 1). Gender IR was 2.53/100,000 for males and 1.68/100,000 for females. The overall standardized IR was 2.1/100,000, although this varied between 1.61/100,000 (2001) and 2.35/100,000 (2010). The seasonal distribution was as follows: autumn 22%; winter 25%; spring 27%; and summer 26%. The geographical IR were as follows: far North 1.49/100,000; North 1.94/100,000; Central 1.97/100,000; South 3.18/100,000; and far South 2.78/100,000. The reported IR of GBS in Chile was similar to other studies based on national databases. In Chile, IR was greater in men and in the south.

Key words: Chile, epidemiology, Guillain-Barré syndrome, incidence

Introduction

Guillain-Barré syndrome (GBS) is an acute polyneuropathy characterized by flaccid paralysis, with symmetrical weakness of the limbs and hypo- or areflexia *(Van den Berg et al., 2014)*. Maximum severity occurs in the first 4 weeks of the disease. In most cases, the disease is preceded by an infection *(Van Doorn, 2013)* and may show seasonal variations in certain geographical regions *(Webb et al., 2015)*. GBS is a disease associated with significant impairment and long-term disability *(Khan et al., 2010)*. The natural course of the disease usually implies a slow recovery, leading to persistent, severe disability in 14% and at least minor functional disability in 40% of patients within the first year *(Rajabally and Uncini, 2012)*.

The scientific literature cites a yearly GBS incidence rate (IR) of 0.16 to 3.00 cases per 100,000 inhabitants worldwide *(McGrogan et al., 2008)*. In developed Western countries, IR varies between 0.81 and 1.89/100,000 *(Govoni and Granieri, 2001; Deceuninck et al., 2008)*. In developing countries most studies are based on a small sample and the IRs varying from 0.46/100,000 in Hong Kong *(Hui et al., 2005)*, 1.73/100,000 in Lybia *(Radhakrishnan et al., 1987)*, 2.11/100,000 in Iran *(Arami et al., 2006)*. In the Western Balkans the IR reported was 0.93/100,000 in

Address correspondence to: Rodrigo Torres-Castro, Department of Physical Therapy, Faculty of Medicine, University of Chile, Independencia 1027, Santiago de Chile, Chile. Tel: +(562) 29786513; Fax: +(562) 29786515; E-mail: klgorodrigotorres@gmail.com

Serbia and Montenegro *(Peric et al., 2014)*. Latin American IR range between 0.4 and 1.7/100,000 *(Rocha et al., 2004; Cea et al., 2015)* based on records kept by local hospitals. Information regarding the national IR of GBS from population-based studies is unavailable in the Latin American region.

Chile is a developing country that has a long north-south extension, variable weather climates, and social, cultural, and ethnic diversity. Despite being considered a developing country, the Chilean population has a very accessible, integrated public health system characterized as high performance by the World Health Organization (WHO) *(Chisholm and Evans, 2010)*. This integrated system includes a well-organized and publically accessible epidemiological database administered by the Ministry of Health.

The objectives of this study were to describe the epidemiology of GBS in Chile based on the national database and to contribute to the global map of GBS incidence.

Patients and Methods

This was a retrospective study that included all reported GBS cases in Chile from January 1, 2001 to December 31, 2012. Patient data collected by the Department of Statistics and Health Information (DEIS) of the Chilean Ministry of Health for all public and private health providers in Chile were examined. DEIS is a national database containing information on the mortalities, births, emergency visits, and medical discharges of the entire population (approximately 17 million people). This is an open database available to researchers and the general population. The Ministry of Health authorizes the use of these data, and the protocol was approved by the institutional review board (Clínica Los Coihues, Santiago, Chile).

We used DBF Manager software (Astersoft, Vancouver, Canada) to analyze the original database provided by DEIS. Registries from 2001 to 2012 were extracted if they contained the International Classification of Disease (10th revision) data code G610 (GBS) in the diagnosis field. All records were reviewed case by case to prevent duplicate data. Data were considered duplicates when two or more records coincided in the following features: age, gender, date, health insurance, and geographical location of the health provider.

Seasonal distribution was determined based on the following categorization: summer (January to March), autumn (April to June), winter (July to September), and spring (October to December). Chile is a very long country (4,329 km) that contains a nearly complete variety of climates. Geographical distribution was defined based on an analysis of government-defined regions and of climate characteristics, a factor considered due to seasonal variations between different climate types. The country was finally categorized into the following five zones: Far North (desert), North (semi-arid), Central (Mediterranean desert), South (temperate oceanic), and Far South (subpolar oceanic). In addition, we analyzed the seasonal distribution by geographical zone.

For statistical analysis, the SPSS Software version 21.0 (IBM, Armonk, NY, USA) was used. Descriptive statistics were presented as percentage, mean, and standard deviation. For categorical variables, frequencies and percentages were reported in contingency tables. Age (10 categories), gender (2 categories), season (4 categories), and geographical distribution (5 categories) were calculated. IRs over the 2001 to 2012 period were calculated per 100,000 inhabitants per year using official population estimates for each year in the period provided by the Instituto Nacional de Estadísticas (INE) of Chile *(INE, 2005)*. The rates were standardized to the WHO population *(Ahmad et al., 2000)*. The total population estimate has a predicted 2.92% level of error, which was used to adjust the determined IRs. We analyze the temporal trend line by simple linear regression. Chi-square analysis was applied to assess seasonal variations. A p value less than 0.05 was considered statistically significant.

Results

Of a total 19,513,655 registries included in the DEIS database for the 2001–2012 period, 4,308 GBS cases were identified, of which 150 (3.6%) were duplicates. The primary cause for duplicates was patient referral from primary care centers to tertiary care hospitals. Finally, 4,158 GBS cases were examined. The assessed period had an overall yearly standardized IR of 2.10 cases per 100,000 inhabitants, which varied between a yearly IR of 1.61 (in 2001) and 2.35 (in 2010) cases per 100,000 inhabitants (Fig. 1, Table 1).

The mean age for GBS was 37 ± 24 years. Males comprised 59% of cases, with a male to female ratio of 1.47 : 1. In regards to gender IRs, males presented a yearly IR of 2.53 cases per 100,000 inhabitants, while females presented yearly IR of 1.68 cases per 100,000 inhabitants.

The IR reported in the pediatric population was 2.17/100,000 among 0- to 4-year-olds and 2.23/100,000 among 5- to 9-year-olds. In adults, the yearly IR ranged between 1.22 cases per 100,000 inhabitants among 20- to 29-year-olds to 4.30 cases per 100,000 inhabitants among 70- to 79-year-olds (Fig. 2).

The distribution of GBS by season was as follows: summer 25.5%; autumn 22.3%; winter 25.3%;

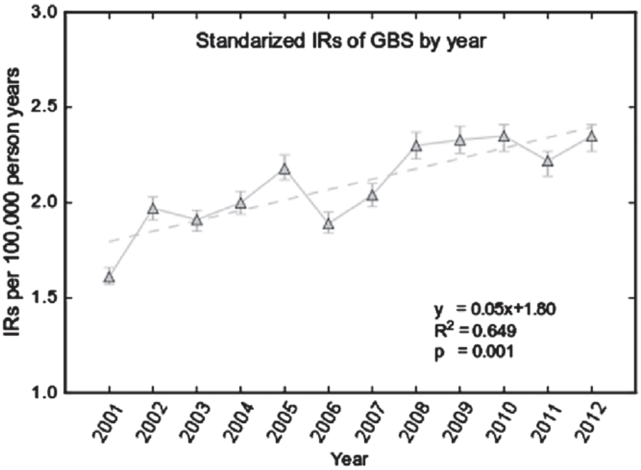

Figure 1. Incidence rate from 2001 to 2012.

and spring 26.9%. Yearly IRs per 100,000 inhabitants in each geographical zone was as follows: Far North 1.49/100,000; North 1.94/100,000; Central 1.97/100,000; South 3.18/100,000; and Far South 2.78/100,000 (Fig. 3).

Discussion

The present results demonstrated an overall GBS IR of 2.10/100,000, which is higher than previous local reports from Brazil and Chile, which estimated IRs of 0.4 and 1.7 cases per 100,000 inhabitants, respectively *(Rocha et al., 2004; Cea et al, 2015)*. In this previous report in Chile, the sample was obtained from one hospital belonging to the central zone of the country (metropolitan region). In general, these previous reports assessed local populations with one or two medical centers and, therefore, did not analyze information from a large population database. Indeed, this is the first population-based GBS incidence study in Latin America that used a national database.

Little data exist on the epidemiology of GBS in developing countries. In many cases there are no reliable records, and if records do exist, these often do not cover entire populations or else provide under- or overestimates of IRs. Information about GBS in developing countries is primarily obtained from hospital reports or from restricted geographic areas *(Paradiso et al., 1999; Molinero et al., 2003; Rocha et al., 2004; Nachamkin et al., 2007; Ramírez-Zamora et al., 2009; Domínguez-Moreno et al., 2014; Cea et al., 2015)*, providing only approximations for the epidemiology of a disease. Using a national database, such as provided by DEIS, would likely increase the accuracy of IR predictions.

In Chile, DEIS is the national institution responsible for the collection, processing, and dissemination of health-related information. This institution manages statistical information related to mortality, morbidity, medical discharge, emergency visits, and other indicators associated with health, even those based on sources outside of the health system *(Becerril-Montekio et al., 2011)*. This information facilitates estimates on national, regional, and local epidemiology. The DEIS database contains almost 20 million records for the last 10 years, providing a considerable number of points for analysis.

This study discovered a gradual increase in GBS incidence over the assessed 12-year period, which went from 1.61 to 2.35/100,000. These results were consistent with previous studies that calculated an increasing trend for GBS over the past several years *(Shui et al., 2012; Huang et al., 2015)*. The lowest incidence was in 2001 (1.61/100,000); however, the loss of data might be possible because the system of registry of DEIS started this year.

Table 1. Gender distribution, ratio, and incidence rate for GBS from 2001 to 2012.

Year	Male	Female	Total cases	Ratio (M : F)	Total population	Crude incidence	Normalized incidence
2001	147	103	250	1.43	15,571,679	1.61	1.61
2002	177	133	310	1.33	15,571,679	1.99	1.97
2003	178	126	304	1.41	15,745,583	1.93	1.91
2004	191	131	322	1.46	15,919,479	2.02	2.00
2005	227	128	355	1.77	16,093,378	2.21	2.18
2006	206	104	310	1.98	16,267,278	1.91	1.89
2007	199	139	338	1.43	16,432,674	2.06	2.04
2008	222	163	385	1.36	16,598,074	2.32	2.30
2009	243	151	394	1.61	16,763,470	2.35	2.33
2010	230	172	402	1.34	16,928,873	2.37	2.35
2011	224	157	381	1.43	17,094,270	2.23	2.22
2012	232	175	407	1.33	17,259,667	2.36	2.25
Total	2,476	1,682	4,158	1.47	196,246,104	2.12	2.10

F, female; GBS, Guillain-Barré syndrome; M, male.

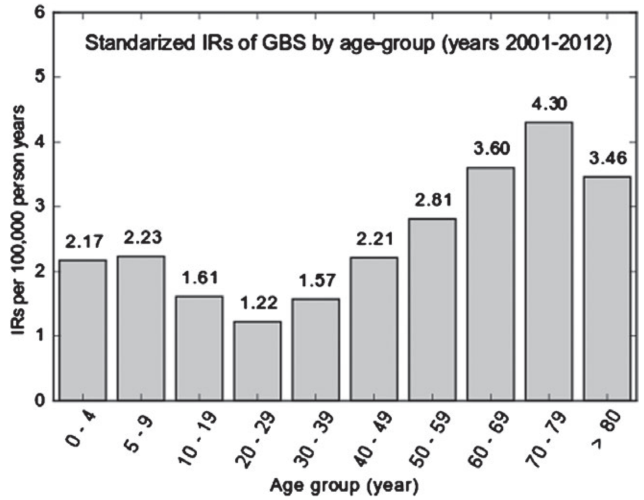

Figure 2. Age specific incidence rates of Guillain-Barré syndrome (GBS).

Concerning gender distribution, GBS presented a higher IR in men than women, with a male to female ratio of 1.47 : 1. This ratio is consistent with other national database studies, such as those by *Huang and coworkers (Huang et al., 2015)* in Taiwan (1.54 : 1) and *Shui and coworkers (2012) (Shui et al., 2012)* in the United States (1.41 : 1).

With respect to the age distribution, we reported a high incidence in children and in the adult group. We observed a sustained increase of IR over the groups, except in the group older than 80 years. The literature showed that GBS incidence steadily increases with age *(Sejvar et al., 2011)*. In several studies, a drop in GBS incidence after age 80 was reported *(Cuadrado et al., 2001; Chroni et al., 2004; Peric et al, 2014)*. Some authors tried to explain the low frequency of GBS in old-old with differing exposure to environmental factors at different ages or with immunosenescence *(Le Saux et al., 2012)*. It was also speculated that the lower frequency in older age may reflect a survivor bias in which individuals surviving into their eighties are less likely to develop GBS, although there is no biological basis for this hypothesis *(Sejvar et al., 2011)*. The most possible explanation is that incidence drop in old people could be due to the under ascertainment of GBS in this group, especially of atypical and mild GBS variants *(McKhann et al., 1993; Cuadrado et al., 2001; Peric. et al., 2014)*. In old people, symptoms of GBS may be mixed with other diseases more common in this age.

Evidence for a seasonal variation in GBS incidence is contradictory. A recent meta-analysis by *Webb and coworkers* reported a greater IR during winter as compared with summer in western countries (1.28 : 1), but in Latin America, this IR is inverted, with more cases registered in summer (0.75 : 1) *(Webb et al., 2015)*. A similar number of cases between summer and winter (0.99:1) was observed in our study. The *Webb and coworkers'* analysis of seasonal variation for Latin America was determined by analysis of five local reports (763 cases), where 39 cases (approximately 5%) corresponded to South America. In addition, this report is based on IR in the pediatric population *(Paradiso et al., 1999)*.

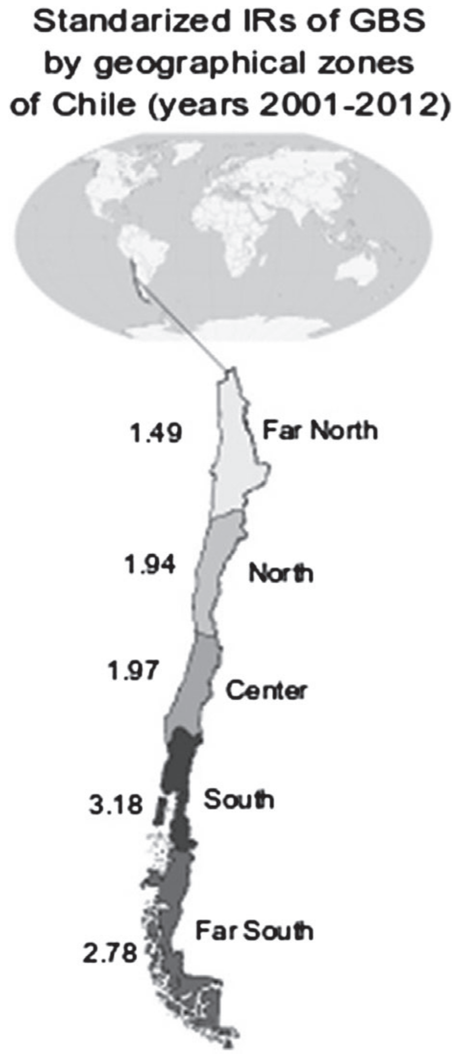

Figure 3. Geographic distribution of Guillain-Barré syndrome (GBS) incidence.

In terms of seasonal distribution, the number of GBS cases was not homogeneous between the central and southern regions. In the central region, which has a Mediterranean climate, fewer GBS cases were recorded in autumn (22.5%) as compared with spring (27.4%). In the southern region, which has a temperate oceanic climate, there were fewer GBS cases in the autumn, similar to the central region. However, GBS case distribution was more homogeneous between summer (27%), spring (26.4%), and winter (26.4%)

Table 2. Seasonal distribution by geographical/climate zones.

Geographical zones	Climate	Summer	Autumn	Winter	Spring	p
Far North	Desert	31.1% (57)	23.0% (42)	20.2% (37)	25.7% (47)	0.189
North	Semi-arid	26.2% (58)	26.2% (58)	24.4% (54)	23.1% (51)	0.890
Central	Mediterranean	24.9% (714)	22.5% (643)	25.2% (723)	27.4% (784)	0.003*
South	Temperate oceanic	27.0% (217)	20.3% (163)	26.4% (212)	26.4% (212)	0.022*
Far South	Subpolar oceanic	17.4% (15)	24.4% (21)	31.4%(27)	26.7% (23)	0.322
	Total	25.5% (1061)	22.3% (927)	25.3% (1053)	26.9% (1117)	<0.001*

*p-Value < 0.05.

(Table 2). Previous studies have reported that GBS is more common during winter in countries with temperate climates (e.g., United States and UK) *(Stowe et al., 2009; Shui et al., 2012)* and during spring in countries with warmer climates (e.g., Israel and Taiwan) *(Zelig et al., 1988; Huang et al., 2015)*. Nevertheless, the presently obtained results did not evidence significant relationships between season, the geographical zone of Chile, and the number of GBS cases.

The present study also found differences in IR between the geographical zones of Chile. Rates similar to the global IRs were observed in the Far North (1.49/100,000), North (1.94/100,000), and Central zones (1.97/100,000) *(Sejvar et al., 2011)*. However, a higher IR was found in the South (3.18/100,000) and Far South (2.78/100,000). It is possible that these differences may be due to certain types of infections related to cultural factors, such as *Campylobacter jejuni* that has been associated with fecal-oral transmission through contaminated food and water and rurality *(Nichols et al., 2012; Pitkänen, 2013)*, possibly in combination with different genetic susceptibilities of individuals or groups living in different zones *(Van den Berg et al., 2014)*. Although investigating the causes for regional variations was not the aim of this work, interestingly in this region there is a major proportion of "mapuche" people (around 30% of total population vs. 10% of the rest of Chile), and 50% of the population live in rural areas (13% national rurality) *(INE, 2002)*. In addition, this zone has the highest poverty index in the country (that decreased from 29 to 16.2 in the analyzed period, in comparison with the national mean that diminished from 18.8 to 14.4) *(Ministerio de Desarrollo Social Chile (MIDEPLAN), 2011)*.

Interestingly, it seems that in Europe the incidence of GBS decreases from North (Sweden, UK, and Germany) to South (Spain, Italy, Western Balkans, and Greece) *(Congia et al., 1989; Cheng et al., 2000; Cuadrado et al., 2001; Chroni et al., 2004; Hughes et al., 2006; Hense et al., 2014; Peric et al., 2014)*. We found the opposite case in the southern hemisphere with an increase from the north of Chile (North and Far North) to the south (South and Far South). Unfortunately, in South America we have few data, however, this comparison is possible because Chile is the same length as the distance from the north of Sweden to Rome, Italy.

This study has limitations. The DEIS database does not discriminate between GBS subtype or treatment, which would have given the results greater depth. However, this aspect has been addressed by *Cea and coworkers* in a local report in Chile *(Cea et al., 2015)*. Finally, patients with mild cases of GBS might not be hospitalized, and, therefore, not recorded in the national database.

References

Ahmad OA, Boshi-Pinto C, López AD, Murray CJL, Lozano R, Inoue M (2000). Age Standardization of Rates: A New WHO Standard GPE Discussion Paper Series No. 31. Geneva, World Health Organization.

Arami MA, Yazdchi M, Khandaghi R (2006). Epidemiology and characteristics of Guillain-Barre syndrome in the northwest. Ann Saudi Med 26:22–27.

Becerril-Montekio V, Reyes JD, Manuel A (2011). Sistema de salud de Chile. Salud Publica Mex 53:s132–s142.

Cea G, Jara P, Quevedo F (2015). Clinical features of Guillain-Barre syndrome in 41 patients admitted to a public hospital. Rev Med Chile 143:183–189.

Cheng Q, Jiang GX, Fredrikson S, Link H, De Pedro-Cuesta J (2000). Incidence of Guillain-Barré syndrome in Sweden 1996. Eur J Neurol 7:11–16.

Chisholm D, Evans DB (2010). Improving Health System Efficiency as a Means of Moving Towards Universal Coverage. Background Paper No. 28. World Health Report, Geneva.

Chroni E, Papapetropoulos S, Gioldasis G, Ellul J, Diamadopoulos N, Papapetropoulos T (2004). Guillain-Barre syndrome in Greece: seasonality and other clinico-epidemiological features. Eur J Neurol 11:383–388.

Congia S, Melis M, Carboni MA (1989). Epidemiologic and clinical features of the Guillain-Barre syndrome in Sardinia in the period. Acta Neurol 11:15–20.

Cuadrado JI, de Pedro-Cuesta J, Ara JR, Cemillán CA, Díaz M, Duarte J, Fernández MD, Fernández O, García-López F, García-Merino A, García-Montero R, Martínez-Matos JA, Palomo F, Pardo J, Tobías A, Spanish GBS Epidemiological Study Group (2001). Guillain-Barré syndrome in Spain, 1985–1997: epidemiological and public health views. Eur Neurol 46:83–91.

Deceuninck G, Boucher R-M, De Wals P, Ouakki M (2008). Epidemiology of Guillain-Barré syndrome in the province of Quebec. Can J Neurol Sci 35:472–475.

Domínguez-Moreno R, Tolosa-Tort P, Patiño-Tamez A (2014). Mortalidad asociada al diagnóstico de síndrome de Guillain-Barré en adultos ingresados en instituciones del sistema sanitario mexicano. Rev Neurol 58:4–10.

Govoni V, Granieri E (2001). Epidemiology of the Guillain-Barré syndrome. Curr Opin Neurol 14:605–613.

Hense S, Schink T, Kreisel SH, Marcelon L, Simondon F, Tahden M, Garbe E (2014). Estimation of background incidence rates of Guillain-Barré syndrome in Germany – a retrospective cohort study with electronic healthcare. Neuroepidemiology 43:244–252.

Huang W-C, Lu C-L, Chen S-C (2015). A 15-year nationwide epidemiological analysis of Guillain-Barré syndrome in Taiwan. Neuroepidemiology 44:249–254.

Hughes RA, Charlton J, Latinovic R, Gulliford MC (2006). No association between immunization and Guillain-Barre syndrome in the United Kingdom, 1992 to 2000. Arch Intern Med 166:1301–1304.

Hui AC, Chow K, Tang AS, Fu M, Kay R, Wong K (2005). Electrophysiological, clinical and epidemiological study of Guillain–Barré syndrome in Hong Kong Chinese. J Clin Neurosci 12:134–136.

Instituto Nacional de Estadísticas, Chile (2002). Estadísticas Sociales de los pueblos indígenas en Chile - Censo 2002. INE, Santiago.

Instituto Nacional de Estadísticas, Chile (2005). Proyecciones y estimaciones de población. Total país 1950–2050. INE, CEPAL, Santiago.

Khan F, Ng L, Amatya B, Brand C, Turner-Stokes L (2010). Multidisciplinary care for Guillain-Barré syndrome. Cochrane Database Syst Rev 10:CD008505.

Le Saux S, Weyand CM, Goronzy JJ (2012). Mechanisms of immunosenescence: lessons from models of accelerated immune aging. Ann N Y Acad Sci 1247:69–82.

McGrogan A, Madle GC, Seaman HE, De Vries CS (2008). The epidemiology of Guillain-Barré syndrome worldwide. Neuroepidemiology 32:150–163.

McKhann GM, Cornblath DR, Griffin JW, Ho TW, Li CY, Jiang Z, Wu HS, Zhaori G, Liu Y, Jou LP, Liu TC, Gao CY, Mao JY, Blaser MJ, Mishu B, Asbury AK (1993). Acute motor axonal neuropathy: a frequent cause of acute flaccid paralysis in China. Ann Neurol 33:333–342.

Ministerio de Desarrollo Social Chile (2011). Indicadores de Pobreza. CASEN 2011. MIDEPLAN, Santiago.

Molinero MR, Varon D, Holden KR, Sladky JT, Molina IB, Cleaves F (2003). Epidemiology of childhood Guillain-Barre syndrome as a cause of acute flaccid paralysis in Honduras: 1989–1999. J Child Neurol 18:741–747.

Nachamkin I, Arzarte Barbosa P, Ung H, Lobato C, Gonzalez Rivera A, Rodriguez P, Garcia Briseno A, Cordero LM, Garcia Perea L, Perez JC, Ribera M, Aldama PC, Guitérrez GD, Sarnat LF, García MR, Veitch J, Fitzgerald C, Cornblath DR, Rodriguez Pinto M, Griffin JW, Willison HJ, Asbury AK, McKhann GM (2007). Patterns of Guillain-Barre syndrome in children: results from a Mexican population. Neurology 69:1665–1671.

Nichols GL, Richardson JF, Sheppard SK, Lane C, Sarran C (2012). Campylobacter epidemiology: a descriptive study reviewing 1 million cases in England and Wales between 1989 and 2011. BMJ Open 2:e001179.

Paradiso G, Tripoli J, Galicchio S, Fejerman N (1999). Epidemiological, clinical, and electrodiagnostic findings in childhood Guillain-Barré syndrome: a reappraisal. Ann Neurol 46:701–707.

Peric S, Milosevic V, Berisavac I, Stojiljkovic O, Beslac-Bumbasirevic L, Marjanovic I, Djuric V, Djordjevic G, Rajic S, Cvijanovic M, Babic M, Dominovic A, Vujovic B, Cukic M, Petrovic M, Toncev G, Komatina N, Martic V, Lavrnic D (2014). Clinical and epidemiological features of Guillain-Barré syndrome in the Western Balkans. J Peripher Nerv Syst 19:317–321.

Pitkänen T (2013). Review of *Campylobacter* spp. in drinking and environmental waters. J Microbiol Methods 95:39–47.

Radhakrishnan K, El-Mangoush MA, Gerryo SE (1987). Descriptive epidemiology of selected neuromuscular disorders in Benghazi, Libya. Acta Neurol Scand 75:95–100.

Rajabally YA, Uncini A (2012). Outcome and its predictors in Guillain–Barré syndrome. J Neurol Neurosurg Psychiatry 83:711–718.

Ramírez-Zamora M, Burgos-Ganuza CR, Alas-Valle DA, Vergara-Galán PE, Ortez-González CI (2009). Guillain-Barré síndrome in the paediatric age. Epidemiological, clinical and therapeutic profila in a hospital in El Salvador. Rev Neurol 48:292–296.

Rocha MSG, Brucki SMD, Carvalho AAS, Lima ÚWP (2004). Epidemiologic features of Guillain-Barré syndrome in São Paulo, Brazil. Arq Neuro-Psiquiat 62:33–37.

Sejvar JJ, Baughman AL, Wise M, Morgan OW (2011). Population incidence of Guillain-Barré syndrome: a systematic review and meta-analysis. Neuroepidemiology 36:123–133.

Shui IM, Rett MD, Weintraub E, Marcy M, Amato AA, Sheikh SI, Ho D, Lee GM, Yih WK (2012). Guillain-Barré syndrome incidence in a large United States cohort (2000–2009). Neuroepidemiology 39:109–115.

Stowe J, Andrews N, Wise L, Miller E (2009). Investigation of the temporal association of Guillain–Barre syndrome with influenza vaccine and influenza-like illness using the United Kingdom General Practice Research Database. Am J Epidemiol 169:382–388.

Van den Berg B, Walgaard C, Drenthen J, Fokke C, Jacobs BC, Van Doorn PA (2014). Guillain-Barre syndrome: pathogenesis, diagnosis, treatment and prognosis. Nat Rev Neurol 10:469–482.

Van Doorn PA (2013). Diagnosis, treatment and prognosis of Guillain-Barré syndrome (GBS). Presse Med 42:e193–e201.

Webb AJ, Brain SA, Wood R, Rinaldi S, Turner MR (2015). Seasonal variation in Guillain-Barré syndrome: a systematic review, meta-analysis and Oxfordshire cohort study. J Neurol Neurosurg Psychiatry 86:1196–1201.

Zelig G, Ohry A, Shemesh Y, Bar-On Z, Blumen M, Brooks ME (1988). The rehabilitation of patients with severe Guillain-Barré Syndrome. Paraplegia 26:250–254.