PREVALENCE OF EARLY NEURODEVELOPMENTAL DISABILITIES IN MEXICO

A systematic review

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Abstract – Objective: Early neurodevelopment disabilities (END) such as cerebral palsy (CP), deafness, blindness, epilepsy, and mental retardation (MR) are very important public health concerns. Although no strong data on END can be obtained in Mexico, the few papers concerning END epidemiology deserve systematic and critical review. Thus, this was the objective of the present paper. **Method:** We performed a systematic review of papers published reporting on the prevalence of END in Mexico. We performed a search in several medical data bases such as PubMed, Artemisa, ImBioMed, and LiLaCS. Each paper was downloaded, read and discussed. We only selected papers published between 1999 and 2008. **Results:** No data on CP and epilepsy prevalence in infants have been found. Data on deafness prevalence report hearing loss in 0.65/1,000 healthy newborns, and in 2.6/100 in high-risk very premature infants. With regard to blindness, prevalence of retinopathy of premature infants in any stage was reported at ca 10.61 and 22.2/100 in high-risk premature infants. Congenital hypothyroidism (CH) prevalence in infants was found in 4.2/10,000 live newborns after a national universal screening survey. **Conclusion:** No universal data regarding the prevalence of END in Mexico have been investigated, with the exception of CH. Mexico needs more research to determine epidemiologic data focused on designing actions to prevent, treat, and rehabilitate END.

KEY WORDS: prevalence, Mexico, infants, cerebral palsy, deafness, blindness, epilepsy, mental retardation, congential hypothyroidism, early development.

Prevalencia de neuro-discapacidades tempranas en México: una revisión sistemática

Resumen – Objetivo: Las neuro-discapacidades tempranas (NDT) como la parálisis cerebral (PC), hipoacusia, debilidad visual, epilepsia y retardo mental (RM) son problemas muy importantes de salud pública. Aunque no existen suficientes datos sobre la prevalencia de NDT en México, el objetivo de este trabajo es hacer comentarios sistemáticos y críticos sobre los ya estudios existentes. **Método:** Realizamos una búsqueda sistemática de artículos publicados sobre NDT en México. La búsqueda comprendió las siguientes bases de publicaciones: PubMed, Artemisa, ImBioMed y LiLaCS. Cada artículo fue descargado, leído cuidadosamente y comentado. Se seleccionaron aquellos trabajos publicados entre 1999-2008. **Resultados:** No se han publicado datos sobre la prevalencia de PC y epilepsia en niños mexicanos. La prevalencia de hipoacusia se ha reportado entre 0.65/1,000 en recién nacidos sanos y 2.6/100 en recién nacidos de alto riesgo. La prevalencia de retinopatía de la prematurez como indicador de debilidad visual ha sido reportada entre 10.61-22.2/100 recién nacidos de alto riesgo. La prevalencia de hipotiroidismo congénito (HC) como indicador de RM ha sido encontrada en 4.2/10,000 recién nacidos en el estudio nacional de tamizaje. **Conclusión:** No hay datos sobre la prevalencia de NDT con la excepción del HC en México. Se necesita más investigación epidemiológica sobre NDT para poder diseñar programas de prevención, tratamiento y rehabilitación de las NDT.

PALABRAS-CLAVE: prevalencia, México, niños, parálisis cerebral, hipoacusia, debilidad visual, epilepsia, retardo mental, hipotiroidismo congénito.

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Early neurodevelopment disabilities (END) such as cerebral palsy (CP), deafness, blindness, epilepsy, and mental retardation (MR) are very important public health concerns. Because ENDs determine long-term life-span disabilities in individuals, decrease their quality of life (QOL), high treatment expenditures for families, and great demands on the resources of society, an increasing number of specialized professionals are working to solve the problem, to increase their productive life, and to decrease or eliminate social rejection[1]. The problem is higher in developing countries such as Mexico, a country with several social and economic inequalities[2].

The first step in solving this issue is to weight the size of problem or to measure basic epidemiologic data on END. However, the limited resources and the isolated efforts of several health institutions in Mexico have access to limited acquisition of this basic information. Few papers on END have been published; however, they deserve systematic and critical review.

This was the main objective of the present paper.

METHOD

We performed a systematic review of published papers reporting a prevalence of END in Mexico. We performed a search in several medical literature data bases including PubMed, and others. Because the topic is of great local interest, we searched in the Artemisa, ImBioMed, and LiLaCS data bases.

PubMed is the most important base when seeking information in the medical sciences and, is sponsored by U.S. National Library of Medicine; here, we performed at search by the following descriptors: "infants", "prevalence", and "Mexico". Word identifying the alteration, was added previously: "cerebral palsy", "hearing loss", "blindness", "epilepsy", and "mental retardation".

Artemisa is a free, open-line data base sponsored by the National University of Mexico (UNAM), and contains information from the main medical journals published in Spanish, and some in English, in Mexico. Imbiomed is a private, open-line data base that includes the principal and some new Mexican and Latin-American medical journals, mainly in the Spanish language. In both data bases, we performed the search by the following words in Spanish: "parálisis cerebral infantil" (cerebral palsy); "sordera" (deafness); "ceguera" (blindness);"epilepsia" (epilepsy); "retraso mental" (mental retardation), and "hipotiroidismo congénito" (congenital hypothyroidism). LiLaCS is a free, open-line data base sponsored by the Regional Latin-American and Caribbean Center of Information in Health Sciences of the Pan American Health Organization (PAHO), we performed the search as previously described with the following words in Spanish. "parálisis cerebral infantil"; "sordera"; "ceguera"; "epilepsia"; "retraso mental", and "hipotiroidismo congénito"; we has previously added the word "Mexico". We downloaded and read each paper to create our own database on END. We selected papers published only between 1999 and 2008, and only those reporting END prevalence. We rejected reviews and case reports. We found insufficient data for a meta-analysis study.

Ethics and Research Committees of the Institute approved the protocol.

RESULTS

Cerebral palsy (CP)

No data on the prevalence of CP in Mexico has been investigated. The sole calculation obtains from the paper of Rendón-Tavera et al.[3], who report a CP prevalence of 3–4/10,000 children, during the years from 1998–2002. No population study supports this data calculation. Prevalence was calculated after data consultation at the Department of Evaluation of the Ministry of Health, dividing the numbers of children with CP reported in its data base with the number of children born in each year, this data obtained from the National Institute of Statistics, Geography and Informatics of Mexico 2000 Census.

Deafness

In 1999 Montes de Oca-Fernández and Martínez carried out a study of auditory screening in 5,109 children <3 years of age and older whose parents or guardians, requested audiologic evaluation service in suburban and rural communities. Tests were conducted by means of behavioral audiometry in the case of children <3 years of age. Nonetheless, diagnoses were not confirmed, thus authors reported only a frequency of suspicion of children with sensory-neural hearing loss. They found a suspicion-of-deafness frequency of 1.17% and 0.75% in infants and in preschool age children respectively[4].

Peñaloza-López et al., reviewed the charts of 160 patients seen as out-patients at the Clinic of Audiology at the Institute of Communication Disorders in Mexico City. Average age of children was 4 ffl 1.7 years, 61% were males, 47% had a birth weight between 1,500 and 2,900 g, and 56% had a complicated delivery. Authors found an increased frequency of high-risk antecedents such as the following: respiratory distress; cyanosis, jaundice, and longer Neonatal Intensive Care Unit (NICU) stay days[5]. No calculation of prevalence could be performed.

Hernández-Herrera et al., conducted a comparative study on sensory-neural hearing loss frequency in an auditory screening in a population of high-risk infants from the NICU and in low-risk infants from one public hospital in Monterrey, Mexico. These authors studied 519 infants in two steps; the first was performed by distortion products-otoacoustic emissions (DP-OAE) recordings; while in the second step they performed brainstem auditory evoked potentials (BAEP) in infants with previously abnormal DP-OAE. The authors found 35 studies with abnormal DP-OAE. BAEP studies confirmed abnormal responses in 30 infants. Associated risk factors included: prematu-

rity, craniofacial anomalies, mechanical ventilation, amikacin use, and cytomegalovirus infection. Sensori-neural hearing loss was significantly higher in high- rather than in low- risk infants. Frequency of sensori-neural hearing loss among high- risk infants was 5%, while this with low-risk infants yielded a frequency of 2%[6]. No calculation of deafness prevalence could be performed.

One robust datum on deafness prevalence in infants in Mexico was obtained from a study carried out by Yee-Arellano et al.[7]. These authors studied 3,066 infants by means of automated- BAEP. They found a hearing loss prevalence of 0.65/1,000 newborns. However, infants in this study were born at one of the most heavily endowed private hospital in Mexico, located in Garza-García county in the State Nuevo León. Thus, the author's data represent only children from a population of low-risk infants and from the highest socio-economic strata of Mexico.

Recently, Martínez-Cruz et al. reported their results from 15 years of follow-up of high-risk newborns, mainly premature infants, from one of the better technically equipped public NICUs in Mexico City, at the National Institute of Perinatology. They followed around 6,000 infants with a battery of audiologic studies such as BAEP, tympanometry, audiometry, and behavioral audiometry. They reported that 146 infants developed severe-profound sensori-neural hearing loss with a prevalence of 2.6/100 infants on follow-up. These data represent the other extreme of the problem; they represent deafness prevalence in low-birth-weight, premature high-risk infants[8].

Blindness

Orozco-Gómez et al.[9] performed a prospective study to determine the prevalence of retinopathy of prematurity (ROP) at the 20th of November-Medical Center, a public hospital, between 1991 and 2004 in 170 preterm infants weighing <1,500 g and born at <35 weeks of pregnancy. Screening was conducted by means of indirect ophthalmoscopy. There were 46 infants (n=78) in ROP stages I–III, with a prevalence of 10.61/100; 12% of these (n=20) were at threshold stage, with a prevalence of 2.72/100.

Flores-Santos et al.[10] carried out a prospective study to determine ROP frequency at the Dr. Ignacio Morones Prieto, a public university medical hospital, in 449 preterm infants. Screening was performed by means of indirect ophthalmoscopy. They found a ROP prevalence of 22.2/100 in premature infants (449 infants); 11.42% had threshold retinopathy and underwent cryotherapy. In the group of 500–1,000 g weight-at-birth group (n=334), 48.2% had ROP in any stage, and 92 (27.5%) had threshold retinopathy. In the 1,001–1,500 group (n=1,374), 257 (18.7%) had any stage ROP and 122 (8.8%) had stage 3. In the 1,501–2,000 g group (n=306), 31 infants (10%), had any ROP stage and 16 (5.2%) underwent cryotherapy. A total of 198/230 infants (86%) with threshold retinopathy received cryotherapy, and experienced complete recovery, but 5% developed unilateral, and 9% bilateral retinal detachment.

Epilepsy

Ruiz-García et al.[11] studied a group of 719 infants and children with idiopathic, cryptogenic, and symptomatic epilepsy at the Department of Neurology, National Institute of Pediatrics, public hospital, in Mexico City. Children with idiopathic epilepsy had a mean age of 5 years 2 months (Standard Deviation [SD], 3 years 1 month), while patients with cryptogenic epilepsy had a mean age of 1 year 11 months (SD, 2 years 5 months), and children with symptomatic epilepsy had a mean age of 2 years 10 months (SD, 3 years 1 month). The most frequent type of epilepsy in the three groups was the generalized form, followed by partial epilepsy. The main etiologies were as follows: hypoxic-ischemic encephalopathy (24%), and neuro-infections (22%). No calculation of prevalence could be performed.

Mental retardation

Neonatal screening program against mental retardation in Mexico have been focused on detection of congenital hypothyroidism (CH). Universal screening of infants for CH has been mandatory in Mexico from 1993. The principal report on the epidemiology of CH in Mexico was published as a cross-sectional study that determined thyroid-stimulant hormone (TSH) level in 1,379,717 blood samples. CH prevalence in infants in Mexico was found at 4.2/10,000 live newborns. Abnormalities found in CH included 57.46% of ectopic glands, 35.91% of athyrosis, and 6.63% abnormal thyroid function[12,13].

DISCUSSION

In this paper we searched for data on END prevalence in Mexico. There were insufficient data for yielding a meta-analysis, and in the cases of CP and epilepsy, no prevalence data in infants were found. Our results represent an urge for the need to know the basic END epidemiologic data in Mexico. Despite the presence of several government and private institutions who care for patients with all END types, no systematic and universal efforts, except some for CH, the END alteration with the local lowest prevalence, has been carried-out to determine END prevalence. Absence of END prevalence data determines errors in planning strategies for prevention, consultations, and calculations for rehabilitation resources.

There is an estimate of 650 million disabled individuals worldwide[14], the majority residing in developing countries, and the majority at pediatrics ages. Developing countries have populations with the majority of disabled infants

and children; moreover, whether due to that are several inequalities in medical consultations, and state government policy-associated limited or no access to health care resources for poor patients[2] the increase in disability is a heavy burden for each individual, for her or his family, and the society.

Prevalence of CP has been described as a function of gestational age (GA), CP decreases as gestational age increases in the following manner: 14.6% at 22–27 GA weeks, 6.2% between 28 and 31 GA weeks, and 0.7% between 32 and 38 GA weeks[15]. CP prevalence has been studied in several countries. Overall, prevalence data estimate are *ca* 2/1,000 live newborns. In the U.S., prevalence was estimated in 3.6/1,000 live newborns, prevalence was high in boys, the boy/girl ratio was 1.4:1, in black non-hispanic children from low- and -middle income families[16]. In Spain, general prevalence has been estimated utilizing registration on a disability register. Investigators found a prevalence of 1.05/1,000, with regional differences, this datum is considered of low frequency with respect to other Western countries, but the authors call attention to possible under-registration of patients with CP[17]. Thus, taking the previously mentioned into consideration for Mexico[3], calculation is incomplete and lacks empirical data. PC prevalence in Mexico would be incredibly low as compared with data from other reports in Western countries, in addition, there was no reason to think that in Mexico PC prevalence is lower, because our socioeconomic conditions are lower than those in Western countries. Therefore, PC prevalence in Mexico is under-estimated. This must be the reason that in Mexico, physicians are always short of resources for caring for populations with PC at government and private rehabilitation centers. Thus, we need to pay more attention to developing epidemiological research on CP in future works.

Prevalence of deafness has been studied in many countries. In the U.S., one study estimated deafness prevalence at 1.8/1,000 infants[18]. In France, severe and profound hearing loss >70 decibels (dB) was investigated retrospectively; researchers found a prevalence of deaf infants of 0.54/1,000[19]. Another study was performed in Italy, which found a prevalence of deafness of 0.72/1,000 infants[20]. In a region in Spain, in the Cantabria county, investigators found a prevalence of 1.38/1,000 deaf infants[21]. Results of these studies are in agreement with data from the study of Yee-Arellano et al. and provide an identical picture of low hearing-loss prevalence. Nonetheless, these data are not representative of other regions of Mexico, because these study was carried-out in the richest county in Mexico. We found that in hospitals for high-risk infants, prevalence was higher[8]. Overall prevalence of deafness in Mexico may lie between the data of Yee-Arellano et al. and data from our team. Additional research and multi-center studies are required to know the prevalence of hearing loss among low- and high-risk infants in Mexico.

ROP prevalence in different world regions was reported by the World Bank; prevalence ranges between 0.1 and 37.4/100. The first figure corresponds to former socialistic economies, where a possible sub-registry of ROP exists, while the later cipher corresponds to Middle Eastern crescent economies. In established market economies, ROP prevalence was estimated in 10/100[22]. In the U.S., ROP prevalence in 4.67 million live births was calculated at 0.12% overall, and at 7.35% in premature infants[23]. The studies of Orozco-Gómez et al.[9] and Flores-Santos et al.[10] reported higher ROP prevalences than those found in other countries, but their data were obtained from high-risk premature infants. Their data are comparable to those on developing economies, but again do not reflect what is occurring in other socioeconomic strata and outside of NICU.

Neonatal seizures in preterm and very- low- birthweight infants comprise a sensitive indicator of brain sequelae during development. One study enrolled 1,338 premature infants in the Netherlands; 787 had neonatal seizures. Of these, 44 infants died and 11 developed epilepsy and a handicap[24]. The risk for epilepsy after perinatal complications increases five-fold as GA decreases from 39-41 to 22-32 GA weeks[25]. In Mexico, we need a multicenter study on perinatal brain injury-associated epilepsy prevalence in high risk infants because the prevalence of epilepsy in infants in Mexico is also unknown. Only one comprehensive study of epilepsy prevalence in Mexico was performed by García-Pedroza et al. in 1983[26], before the period considered in methods of the present search. The authors reported a prevalence in school-aged child population of Tlalpan county in Mexico City of 17%[26]. In Germany, epilepsy prevalence in infants and children was estimated at 60/100,000, with highest incidence in the first year of life[27]. The paper of Ruiz-García et al.[11] does not study a specific group of patients with epilepsy aged <3 years. Thus, epilepsy prevalence post- neonatal brain insult in Mexico is unknown but may be as high as reported by García-Pedroza et al.[26] many years ago, because premature births frequency are not decreasing in Mexico, and rather, are in increasing.

Mental retardation prevalence has not been quantified in Mexico. Instead, universal detection of CH provided data on prevalence of abnormal congenital thyroid function. In Europe prevalence reached varying but stable numbers as follows: Austria, 1/3,930 live newborns; Belgium, 1/3,750; Czechoslovakia, 1/6,037; Denmark, 1/3,777; Finland, 1/3,969; France, 1/4,132; the Federal Republic of Germany, 1/3,827; Greece, 1/3,314; Hungary, 1/5,632; Israel, 1/3,152; Italy, 1/3,150; the Netherlands, 1/3,723; Norway, 1/3,069; Portugal, 1/3,139; Spain, 1/3,216; Switzer-

land, 1/3,913; the U.K., 1/3,398, and Turkey, 1/2,943. In the U.S. had 1/4,119 live newborns[28]. Thus, data from the Vela-Amieva et al. study on CH prevalence in Mexico showed a high prevalence of 1/2,380, a scenario comparable to that of Turkey in the XX Century.

In conclusions, no data on universal END prevalence in Mexico have been investigated, except for CH. Mexico needs more research to determine basic epidemiologic data focused on designing actions to prevent, treat, and rehabilitate END.

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