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Medical Genetics in Latin America

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Abstract

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This special issue of *Community Genetics* reviews some of the most important developments in medical genetics in key countries of Latin America. Contributions to this issue were prepared for a special consultation of the World Health Organization held in Porto Alegre, Brazil, on June 19, 2003. Latin America is a region of medium- to low-income countries characterized by socioeconomic problems, with large segments of the population living in poverty and extreme disparities in the distribution of wealth. A rise in chronic diseases typical of the processes of industrialization and urbanization coexists with the persistence of nutritional and infectious diseases characteristic of poverty and underdevelopment. Over the last 2 decades of the 20th century, birth defects and genetic disorders have increased their share of morbidity and mortality, and tertiary-care-based genetic services have developed in urban areas. Although privatization of health care is eroding the public sector, the public institutions continue to be the main providers of genetic services for the bulk of the population and the leaders in research. The development of clinical genetics in the region is concentrated in tertiary-care centers in large cities, although a recent trend began extending genetic services to the community.

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Introduction

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This special issue of *Community Genetics* on 'Medical Genetics in Latin America' developed out of the Consultation on Community Genetic Services in Latin America and Regional Networks on Medical Genetics organized by the Human Genetics Program of the World Health Organization in Porto Alegre, Brazil, on June 19, 2003. The purpose of the meeting was to assess the status of genetic services in the region and to devise mechanisms of cooperation to further their development, including issues of genetic research, training and education [1]. Twenty internationally recognized experts in medical genetics from Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Mexico, Paraguay and Peru were invited to the Consultation [names of participants are listed in ref. 2].

113 Demographic Indicators

115 Latin America comprises the region of the American
116 continent which runs from the Rio Grande that borders
117 Mexico with the United States, through the southern tip
118 of Argentina. This area of the world was inhabited for the
119 past several thousand years by a diversity of indigenous
120 populations, and was conquered and colonized in the
121 16th century primarily by the Spanish and Portuguese.
122 Today, its population numbers 524 million people [3] and
- 123 is characterized by an extensive ethnic and cultural diver-
- 124 sity, determined by their demographic history and the dif-
125 ferent degrees of admixture of the original indigenous
126 population with the Spanish and Portuguese colons, the
127 Africans brought as slaves in the 17th and 18th centuries,
128 and the extensive European immigration of the 19th and
- 129 20th centuries. Most Latin American countries have me-
130 dium-low annual gross national income (regional average
131 USD 3,580 per capita, compared to USD 26,510 of high-
132 income countries). Industrialization and urbanization is
133 occurring at a fast pace, although with marked disparities
134 between and within countries. By 2025 it is estimated that
135 84.6% of the population will live in urban areas [3]. The
136 degree of socioeconomic inequality in the region is one of
- 137 the highest in the world: in Brazil, for example, the per-
- 138 centage share of income by the lowest 10% of the popula-
139 tion is only 0.5%, compared with 47% for those in the
140 highest 10% of income. In 2001 over half the population
141 was living in poverty, and 27.6% was earning less than
142 USD 2 per day [3].

145 General Health Indicators

147 The following figures for 2001 give an idea of some
148 average health and demographic indicators in the region
- 149 [3, 4]. Being averages, they hide wide variations by coun-
150 try and by social class. Fertility rate declined from 4.1 in
151 1980 to 2.6 in 2001 (comparable figures in high-income
- 152 countries are 1.9 and 1.7). Adolescent (ages 15–19) fertili-
153 ty rate is 72 per 1,000 (compared to 24 in high-income
- 154 countries). Between 1980 and 2001, life expectancy in-
155 creased from 65 to 71 years, while infant mortality rate
156 fell from 61 to 28 per 1,000, the latter showing extreme
157 variations, both between countries and between social
158 classes in each country. An epidemiological transition
- 159 based on urbanization and modernization, lack of physi-
- 160 cal activity, unhealthy diets and increased stress is deter-
161 mining an increased morbidity and mortality due to birth
162 defects, genetic diseases and common chronic conditions
163 associated with genetic predisposition [4]. For example,
- 164 in 1990 the percentage of deaths from cardiovascular dis-
165 eases in Latin America ranged from 20 to 46% (compared

with 54% in the United States of America) and the percentage from malignancies ranged from 8 to 25% (compared with 23% in the United States of America) [4]. Similarly, congenital anomalies are now high in the rank of causes of infant mortality, while birth defects and genetic conditions account for 10–25% of pediatric admissions in large cities [4].

The average proportion of births at maternal ages over 35 is 13.5% and ranges from 4.3% in Cuba to 22.5% in Peru [4]. Access to family planning services and reversible contraceptives is limited, and maternal mortality is still unacceptably high (average: 190 per 100,000, compared to 20 in high-income countries) [5]. As noted in most papers in this issue, elective abortion in Latin America is largely illegal. However, induced abortions occur at a very high rate (50 per 1,000 women of reproductive age, compared to 10–20 in high-income countries), implying a ratio of at least 1 abortion for every 2 or 3 births [6]. Sadly, 75% of induced abortions are performed under unsanitary conditions and are associated with a death rate >100 times higher than in developed countries (119 per 100,000 procedures, compared with less than 1 per 100,000 in high-income countries) and with 25% of all maternal deaths [6]. This state of affairs is slowly changing, as a number of countries are passing less restrictive abortion laws. As reported in this issue, abortion has been legal in Cuba for the past 40 years, and Mexico City has recently legalized abortion, while in most countries enforcement of legal prohibition is virtually non-existent. Furthermore, many countries with restrictive abortion laws are beginning to allow exceptions for severe fetal anomalies.

The average annual per capita health expenditure in Latin America in 2001 was only USD 262, compared with USD 2,736 in industrialized countries [3]. Health resources are unequally distributed, favoring excessive specialization and high-technology medicine in tertiary centers rather than cost effective primary-care-centered medicine. The recent trend toward privatization of health care is increasing barriers in the access to adequate health care.

Prevalence of Birth Defects and Genetic Disorders

The studies in this issue show that the prevalence of birth defects and genetic diseases in Latin America is similar to other regions of the world, something that several studies over the past 2 decades had consistently shown [7–9]. Hemoglobinopathies, particularly sickle cell anemia, are a significant public health problem in the Caribbean and Brazil [8, 9]. The relatively high proportion of pregnancies at advanced maternal age determines an excess of births with chromosome anomalies, particularly in rural areas. Conditions of genetic susceptibility, such as

5

- 239 diabetes, cancer, coronary disease, mental illness and oth-
- 240 ers, have similar frequencies as in industrialized countries
- 241 [8, 9].

244 **Genetic Services**

- 246 The status of genetic services in Latin America was dis-
- 247 cussed in 1996 in Rio de Janeiro, Brazil, at a satellite
- 248 meeting on the occasion of the 8th International Congress
- 249 of Human Genetics [10]. A recent review summarized the
- 250 major characteristics of the development of medical ge-
- 251 netics and genetic services in Latin America [11].

- 252 Genetic services, defined as health services for the
- 253 diagnosis, treatment, follow-up and counseling of patients
- 254 affected or at risk for genetic conditions and their fami-
- 255 lies, have had an incipient and fragmentary development
- 256 in Latin America. The studies in this issue show that the
- 257 development of medical genetics has been uneven within
- 258 and between countries, being more developed in wealth-
- 259 ier, urbanized areas, and less developed in poorer and
- 260 rural areas. Services tend to be concentrated in large cities
- 261 and to have a limited scope, determined largely by the
- 262 interest of individual clinicians and researchers and the
- 263 limitation in resources. While the public sector continues
- 264 to be the largest provider of genetic services in the region,
- 265 under-financing and poor planning conspire against qual-
- 266 ity, equity and efficiency. The private sector has devel-
- 267 oped selected services for commercially profitable appli-
- 268 cations, such as chromosome analysis, prenatal diagnosis
- 269 and DNA paternity testing, accessible only to a wealthy
- 270 minority.

- 271 A common theme found in this issue is the shortage of
- 272 trained clinical geneticists and of hospital positions for
- 273 those with training. In some countries of the region there
- 274 have been difficulties in the recognition of clinical genet-
- 275 ics as a medical specialty.

- 276 Reasons for the slow development of genetic services
- 277 in the region include the following [11]. (a) There is still a
- 278 load of unmet needs in other areas of health care, such as
- 279 infectious diseases, malnutrition, and prenatal, labor/
- 280 delivery and newborn care. (b) Genetic conditions are not
- 281 considered priorities by the medical professionals and
- 282 public health officials. (c) Genetic services are misper-
- 283 ceived as expensive and dealing only with rare diseases.
- 284 (d) Their preventive value is erroneously associated with
- 285 the interruption of affected pregnancies, which is opposed
- 286 by traditional sectors. (e) The public is largely unaware
- 287 about genetic risks and the possibilities of prevention.

As pointed out iteratively by authors in this issue, departments of health at city, provincial and national levels usually do not have explicit policies or programs in genetic health care, except for newborn screening for phenylketonuria and congenital hypothyroidism, which tend to be mandated by law. Even so, the coverage rarely surpasses 30–50% of births in a few major cities of the region. Furthermore, the programs tend to lack financial resources and organization for follow-up and treatment of affected infants. Food fortification with folic acid as an explicit government policy is slowly taking ground in some Latin American countries, most notably Chile.

Most studies in this issue note that induced abortion is prohibited, except in Cuba and selected jurisdictions, such as Mexico City and others. Allowed exceptions include pregnancies resulting from rape, when the life of the mother is at risk and, increasingly, the presence of fetal anomalies. Legal prohibition, however, does not prevent abortions, as there is little or no government enforcement: 95% of the 4.5 million induced abortions that take place yearly in Latin America are illegal, largely performed in unsafe conditions, particularly for low-income women. The consequence is that 25% of the high maternal mortality of the region (190 per 100,000) is caused by unsafe abortions [6]. In this context, while prenatal diagnosis is an accepted and demanded service by those with higher educational and socioeconomic status (irrespective of religious affiliations), it counts virtually with no public funding, resulting in socioeconomic barriers to its access, distortions in its rational utilization, service fragmentation and lack of quality control.

Medical Genetic Workforce

The studies in this issue reveal that clinical and laboratory geneticists are very active in the region. It is estimated that there are approximately 500 trained clinical geneticists in the region, providing an array of medical genetic services. Genetic counseling is considered a medical function and is performed by clinical geneticists and other trained physicians.

The specialty of medical genetics has been recognized in Mexico, Cuba, Brazil and Argentina. Virtually all countries count with professional and scientific societies of human or medical genetics. Recently, a Latin-American Network of Human Genetics (acronym in Spanish and Portuguese: RELAGH) has been constituted as a loose federation of human genetic societies of Latin America, and is the official representative in the Steering Committee of the International Federation of Human Genetic Societies [12].

360 Training and Education in Medical Genetics

362 Genetic education of health professionals is clearly
363 deficient both at undergraduate and postgraduate levels.
364 While basic genetics is generally taught in most medical
365 schools, this is not the case with clinical and community
366 genetics. Most papers stress the need of teaching medical
367 genetics in the clinical years of undergraduate education
368 of medical students and nurses. Some countries have
- 369 postgraduate training programs for physicians and scien-
370 tists, leading to master and doctorate degrees. Residence
371 training programs in clinics are scarce. Almost no country
- 372 in the region trains non-physician-allied health profes-
373 sionals to perform genetic counseling, which remains a
374 practice restricted to physicians.

377 Research in Medical Genetics

379 The paucity of government support for biomedical and
380 epidemiological research has prevented genetic research
381 in Latin America to achieve a level commensurate with
- 382 the talents, abilities and ingenuity of the biomedical scien-
383 tists of the region. Several important exceptions are noted
384 in the papers in this issue, such as the first rate program
385 for the monitoring of congenital malformations [13], the
386 cloning of the genome of the bacterium *Xylella fastidiosa*
387 in Brazil, a pathogen of citrus crops responsible for great
388 economic losses [14], and a number of other genomic
389 research projects [15, 16].

392 Ethical, Legal and Social Issues

- 394 The common ethical, legal and social themes in medi-
395 cal genetics emerging from the studies in this issue are:

396 Inequities in access to genetic services, as a result of
397 underfunding in the public sector and poor coverage by
398 private health insurance.

399 Since prenatal diagnosis is usually not provided in the
- 400 public sector, its access is limited to those with good eco-
401 nomic resources. Unfortunately, the legal restrictions on
402 abortion apply de facto only to the poor, as the rich can
- 403 access safe pregnancy termination without fear of prose-
404 cution.

414 There are no regulations to enforce privacy of genetic
415 information.

-416 People with disabilities and patients with genetic con-
-417 ditions suffer overt or covert discrimination and stigmati-
418 zation.

-419 Lack of governmental regulation of genetic tests, re-
-420 sulting in the noncritical introduction of predictive genet-
-421 ic testing induced by commercial interests without clini-
422 cal validation or genetic counseling.

423 Genetic research conducted by international scientists
424 with funding from developed countries generally lacks
425 proper ethical safeguards and concerns for technology
426 transfer and capacity building.

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Conclusions

431 In spite of the problems mentioned above, the studies
432 in this issue show that medical genetics in Latin America
-433 has come a long way over the past 2 decades. Most coun-
434 tries are endowed with centers of excellence in clinical
-435 genetics, cytogenetics and prenatal diagnosis. Some coun-
436 tries with high prevalence of hemoglobinopathies have
437 good centers for their management. Molecular diagnosis
-438 is slowly becoming available for a limited number of con-
439 ditions, and genetic services are slowly becoming more
440 organized and efficient, expanding their activities and
-441 coverage to primary care settings in the community. The
-442 expert geneticists who met in Porto Alegre for the Consul-
443 tation of the World Health Organization have put forth a
-444 series of recommendations for the continuing develop-
445 ment of medical genetics in the region [2], including (a)
446 the need for government funding for services, research
-447 and education in medical genetics; (b) the conduct of epi-
448 demiological research on the prevalence and types of birth
449 defects, genetic disorders and genetic predispositions to
-450 common diseases; (c) the education of health profession-
451 als in genetics; (d) the education of genetic professionals
452 in community health and public health genetics; (e) the
-453 fostering of interactions between clinical geneticists, pub-
454 lic health personnel, primary health care workers and
455 community organizations, and (f) a better planning of
-456 regionalized services to avoid duplication and ineffi-
457 ciency.

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References

- 1 Boulyjenkov V: The Role of the World Health Organization in Promoting Medical Genetics in Latin America. *Community Genet* 2004; ■■■■.
- 2 Kofman-Alfaro S, Penchaszadeh VB: Community Genetic Services in Latin America and Regional Network of Medical Genetics. Recommendations of a World Health Organization Consultation. *Community Genet* 2004; ■■■■.
- 3 World Development Indicators. Washington, World Bank, 2003.
- 4 Pan American Health Organization: Health Conditions in the Americas. Washington, Pan American Health Organization, 2002.
- 5 Maternal mortality in 2000: Estimates developed by WHO, UNICEF and UNFPA. Geneva, World Health Organization, 2003. www.who.int/reproductive-health/publications/maternal_mortality_2000/maternal_mortality_2000.
- 6 Alan Guttmacher Institute: Sharing Responsibility. Women, Society and Abortion Worldwide. New York, Alan Guttmacher Institute, 1999.
- 7 World Atlas of Birth Defects. Rome & Geneva, International Center for Birth Defects and World Health Organization, 1998.
- 8 World Health Organization: Services for the Prevention and Management of Genetic Disorders and Birth Defects in Developing Countries. A Joint WHO/WAOPBD Meeting. The Hague, 5-7 January 1999. WHO/HGN/GL/WAOPBD 1999.
- 9 Penchaszadeh VB, Christianson AL, Giugliani R, Boulyjenkov V, Katz M: Services for the prevention and management of genetic disorders and birth defects in developing countries. *Community Genet* 1999;2:196-201.
- 10 Penchaszadeh VB, Beiguelman B: Medical genetic services in Latin America. Report of a meeting of experts. *Rev Panam Salud Publica* 1998;3:409-420.
- 11 Penchaszadeh VB: Community genetic services in Latin America. Challenges and perspectives. *Community Genet* 2000;3:124-127.
- 12 Giugliani R, da-Silveira-Matte U: The Latin American network of human genetics. *Community Genet* 2004;■■■■.
- 13 Castilla EE, Orioli IM: ECLAMC: The Latin American Collaborative Study of Congenital Malformations. *Community Genet* 2004; ■■■■.
- 14 Brazilian National Genome Project Consortium: The genome sequence of the plant pathogen *Xylella fastidiosa*. The *Xylella fastidiosa* Consortium of the Organization for Nucleotide Sequencing and Analysis. *Nature* 2000;406:151-157.
- 15 Camargo AA, Samaia HP, Dias-Neto E, et al: The contribution of 700,000 ORF sequence tags to the definition of the human transcriptome. *Proc Natl Acad Sci USA* 2001;8:12103-12108.
- 16 Orioli IM, Vieira AR, Castilla EE, Ming JE, Muenke M: Mutational analysis of the *Sonic hedgehog* gene in 220 newborns with oral clefts in a South American (ECLAMC) population. *Am J Med Genet* 2002;108:12-15.

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