

## BREAST FEEDING AND GROWTH IN A GROUP OF SELECTED 0 TO 24 MONTHS INFANTS

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### Abstract

*WHO is undertaking a combined growth study in several countries, in order to establish adequate growth curves for breast-feeding infants. Present growth charts in use, were obtained in a sample of breast and artificial feeding infants, which have overestimated the growth needs. In our country during the last two decades the number of mothers who decide to breast-feed their infants has permanently grown, due to the implementation of health care programs that promote, mother-infant interaction right after birth, in all Public Hospitals, and education programs for the mothers, during both antenatal and post natal control of mother and child. The last figures obtained in a country sample of 10000 mother-infant pair, shows that 45% of the mothers are exclusively breast-feeding their infants at 6 months of age. This figure could increase if our infants were evaluated by the adequate charts, because it is of common use that many health professionals suggest to stop breast-feeding because the infant is not growing according the charts in use.*

*The anthropometric study proposed by WHO will benefit considerably by adding determination of breast-milk intake using isotopic dilution of deuterium, a standard procedure proposed by Coward et al [6-10] and extensively used in our country [11-14]. The proposed study will also include milk composition (fat, protein and lactose) and energy density of milk to correlate energy supply, milk volume and growth.*

### General considerations

Chile is located in the southwestern part of South America, has an area of 756.626 square continental kilometres and 1.250.000 square kilometres of the Antarctic territory. The political administrative division of the country is structured in 13 regions, 51 provinces and 341 circumscriptions. The total estimated population for Chile in 1999 is 15,017,760 inhabitants 50,5% of which are women. 19,3% are under 15; 73,6% are between 15 and 64 years; 7,1% are older than 65. The annual vegetative growth rate is estimated to be 1,4%.

At present, the urban population reaches the 85,4 % concentrated mainly in the metropolitan region with 45,4%, followed by the Bio Region in the southern part of the country with 12% and the central coastal city of Valparaiso 11%.

The total students registered in 1997 in the different educational levels were 3,777,051, being 7,5% in pre-elementary level, 60,7% in primary level, 21,8% in secondary level and 10,1% in higher education. The average schooling of the population in 1997 was 9,76 years, while coverage in pre-elementary education was 29,8%, 96,05% in elementary education and 82,34% in secondary education. The literacy rate in Chile is 94,6% (Table I).

According to the Human Development Index Chile is an intermediate developed country, having a leading position in the Latin-American countries.

The United Nations information shows that the country has grown from the 38<sup>th</sup> place in 1994 to the 34<sup>th</sup> in 1999 in terms of living conditions from a total of 174 nations. Nevertheless 21,7% of the population lives in poverty and 5,6% of this segment is indigent, according to the 1998 Socio-economic Survey.

### Economy background information

The development strategy assumed by the country has achieved for the first time in the last three decades, that economic growth is greater than its inflation rate. At the international level, the Chilean economy presents the major development in Latin America during the 90s, being placed among the ten best emerging economies of the world. Per capita income increased from US\$ 3000 in

1990 to US\$ 5,105 in 1997; the minimum wage rose from US\$ 170 /month in 1997 to US\$ 176/ month in 1999.

### *Health*

Chile is facing a demographical and epidemiological transition process, presenting an important variation in the health situation of the population, due to the political, social and economic changes that have characterized the country since 1980.

This has determined a complex health situation in which coexist problems associated with underdevelopment, for example enteritis transmitted and carenial diseases, and on the other hand, those associated with life styles and economic development, such as cancer, chronic diseases, accidents and mental health problems, well known consequences of social changes as well as contamination of the environment and the working place. Classical bio-demographic indicators show a general mortality of 5,4 per 1000 inhabitants in 1997; a birth-rate of 19.3 per 1000 inhabitants and a population growth that has remained stable in the last 10 years, and fluctuates around 1.4% annually. Life expectancy is 75.2 years for those born in the five-year period 1995 –2000.

Sanitation levels in Chile are considered to be adequate in comparison to the rest of Latin America. Potable water is available in 99% of urban areas and 49% of rural areas. 80% of the urban sector has sewage system. However 80% of the sewage waters are carried away without previous treatment.

### *Mortality and Morbidity*

Chile has an infant mortality rate of 10 per 1000 live births in 1998. This is due to health care programs that give priority to the maternal infant group, also to improvement in education level of the population, basic sanitation and per-capita income. The mortality rate among pregnant women stands at 0.23 per thousand live births with complications arising from abortions being the main cause of death. Mortality rate is decreasing in all age groups, being more important in the under five years old group.

For many years the main death causes in the country correspond to pathologies strongly associated to life styles and to overall ageing of the population, such as circulatory system diseases, cancer, accidents and violence, which as a whole represents a 60% of the total deaths (Tables II, III).

Twenty five percent of the hospitalizations in the country were related to pregnancy, delivery and post partum as a result of a national policy professional care of the delivery.

### *Lactation*

Since the last decade the number of mothers who decide to breast-feed their infants has permanently grown, due to the implementation of health care.

This program that favour the mother-infant contact right after birth in all Public Hospitals, and education of the mothers during both antenatal and post natal health control of mother and child. The last figures obtained in a country sample of 10000 mother- infant pairs show that 45% of the mothers are exclusively breast-feeding their infants at 6 months of age.

### *Resources*

The Health System in Chile is composed of a public sub sector and private sub sector participating in the field of health insurance and medical care. Both sub sectors are regulated by the Ministry of Health, which supervises insurance system.

The Health activities of the public sub sector are provided by the National System of Health Services integrated by 27 Health services through out the country. Upon which depend a complex hospital network, attached out patient facilities and an also a network of primary health care centres under municipal administration.

Chile has at present an availability of 3,1 beds per 1000 inhabitants. During the last years the private sub sector has increased the offer of hospital beds, representation 26% of the total hospital beds available in the country Concerning the financing of the health sector besides the fiscal contribution, exist a compulsory premium of the 7% of the wages which goes either to the e public or

the private health insurance. The 27% of the population belong to the private insurance system (Tables IV, V, VI) [1].

## 1. INTRODUCTION

WHO is undertaking a combined growth study in several countries, in order to establish adequate growth curves for breastfeeding infants. Present growth charts in use, were obtained in a sample of breast and artificial feeding infants, which have overestimated the growth needs [2,3,4,5].

The anthropometric study proposed by WHO will benefit considerably by adding determination of breast-milk intake using isotopic dilution of deuterium, a standard procedure proposed by Coward, et al [6,7,8,9] and extensively used in our country [10,12,13,14]. The proposed study will also include milk composition (fat, protein and lactose) and energy density of milk to correlate energy supply, milk volume and growth. [15,16].

## 2. METHODOLOGY

The proposed study is part of a multicentric WHO study that combines a longitudinal design from birth to 24 months with a cross sectional study of children aged 18-71 months from the same site. The overlap between 18 and 24 months is intended to improve the merging of the two curves, and extending the upper limit to 71 months will result in improved precision of growth estimates in the fifth year of age.

### 2.1. Subjects

The study sub-population should have no socio-economic constraints on growth, low mobility, 20 % or more of the mothers following feeding recommendations and access to breast-feeding support. In our case, this WHO condition will be covered in a 100% of the mothers, considering the quality of the natal and postnatal care provided for this population.

Mothers (n=150) will be selected in the prenatal clinic at the Consultorio San Joaquin located in Santiago Metropolitan Region at 780m of altitude (Servicio de Salud Metropolitano Sur) that has a 37500 people under control of a 50000 population 50% of them being females. Last year the Clinic assisted an accumulative total of 150 women monthly in prenatal control and 230 babies were born at Maternity of the Barros Luco Troudeau joined the UNICEF and Ministry of Health program " Iniciativa Hospitales Amigos del niño y de la Madre IHANM", The results of the initiative are highly significant measured, as number of rooming in practice, in relation to number of bottles of artificial feeding provided at the maternity wards before and after this practice begun. Prevalence of exclusive breast-feeding at 6 month, increased from 47% in 1994 to 65% in 1997. These results proved that this program is highly effective (Figures 1,2,3) [17].

### 2.2. Inclusion criteria

Individual mothers selected for the study should be of middle socio-economic status willing to follow feeding recommendations, non-smoking and non-drug abuser. In the case of alcohol consumption this will be recorded, but alcoholics will not be included. Their babies should have been delivered at term and present no chronic health problems expected to influence growth. Feeding recommendations are: predominant breast-feeding that is breast-feeding alone or with non milk fluids for at least four months, introduction of appropriate complementary foods by six months and partial breast feeding for 12 months or more. As an additional request, the selection will consider:

- Those with a previous good breast-feeding experience,
- House wives (working at the house woman).
- Term and vaginal single birth deliveries without significant perinatal morbidity (a stay of 12 or more hours in the intensive care unit will inhibit the baby to be incorporated to the sample)

### 2.3. Exclusion criteria

- Lack of compliance with feeding recommendations
- Serious illness
- Voluntary exclusion
- Infants recruited into the study, whose mothers fail to comply, will continue to be followed throughout the two years so that their growth may be compared with compliers.

- Women who have followed the prenatal and feeding recommendation and are willing to keep participating in the protocol will be asked to participate in the study.

#### **2.4. Follow-up**

The mother infant dyad will be visited and controlled in the first 36 hours after delivery in the Hospital Barros Luco Troudeau that is the regional Hospital that gives attention to this population. They will be visited at home and controlled at the out patient clinic on weeks 1,2,4,6 and 8 and monthly from 3 to 12 months; in the second year visits will take place every two months.

#### **2.5. Anthropometric determinations at every visit from birth onwards**

- Weight and length
- Arm circumference
- Skin fold thickness (triceps, sub scapular, and calf) measured at every visit starting at 3 months
- Head circumference will be measured after 1 week, due to head moulding
- In the cross sectional study each child will be submitted to the above measurements once.
- Height of both parents will be measured once and the mother weighed at each visit.

#### **2.6. Socio-economic demographic and environmental characteristics, using the Alvarez test**

This test has been validated for our population since 1975 and measures: family structure, education, goods and working conditions.

#### **2.7. Measurement of breast-milk volume by deuterium dilution**

This evaluation will be determined at 1,3, 6, 12 months. To this effect, the dose-to-mother method will be used, which is able to measure maternal milk intake, as non-milk liquid ingested by the infant [6,7]. A basal sample will be collected in both infant and mother on day 0, before the administration to the mother, of a standard dose of 15 g of deuterium oxide (99.9%). Saliva samples will be collected on days 1,2,3,5,13,14 on the infant and 1,2,14 on the mother.

An additional dose of 0.2g/kg weight will be administered to the infant at the end of the dose-to-mother protocol, for the determination of total body water (TBW) in the infant.

From the 150 women recruited, it is expected to have at least 75 women-infants ending the study. The whole sample will be in exclusive lactation at 1 month (n=150) in 60% of sample by sixth month (n=90), and in partial breastfeeding, 50% of sample (n=75) by month 12th.

#### **2.8. Body composition of infant-mother dyad by deuterium dilution at 1,6,12 months**

The procedures described above, will permit the determination of body composition in the mother (dose-to mother protocol) and the infant (dose-to-infant), by establishing total body water (TBW) by the back-extrapolation procedure.

Using hydration coefficients, fat-free mass and fat mass (by difference to weight) will be established in the mother and the infant. Analysis of samples will be conducted in a HYDRA mass spectrometer, Europe Scientific, (Crewe UK) in the Mass Spectrometry Section of the Energy Metabolism and Stable Isotopes Laboratory, INTA, University of Chile.

#### **2.9. Milk composition and energy density: Fat, protein and lactose**

Milk samples will be pooled by collection of samples before and after the baby feed during the day. Milk will be stored at -20°C.

Energy content of milk will be obtained by bomb-calorimeter. Content of fat and protein will be determined by standard procedures at The Food Analyses Centre, INTA, University of Chile. Lactose will be determined by difference with energy in content of milk [15,16].

In a sub sample of 12 mothers will be chosen at random to establish lipid profile of the milk at one month of age.

Ethical considerations. The family participating will sign a written consent form (ethical approval by local and international standards).

The whole sample will be in exclusive lactation at 1 month (n=150) in 60% of sample by sixth month (n=90), and in partial breastfeeding, 50% of sample (n=75) by month 12th.

### 3. PRELIMINARY RESULTS

We have followed 35 pregnant women (mean age 26 years of age) 2 of which gave birth to two girls of 3450 and 3210 grams both are going to receive the first dose of 15 g of deuterium oxide (99.9%). Saliva samples will be collected on days 1,2,3,5,13,14 on the infant and 1,2,14 on the mother.

An additional dose of 0.2g/kg weight will be administered to the infant at the end of the dose-to-mother protocol, for the determination of total body water (TBW) in the infant.

### 4. PLANS FOR FUTURE WORK

We hope to finish with the collection of the sample by the end of August 2000 and to finish with the work in August of 2002.

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## Level of education and formal work in women of 15-49 years of age

TABLE I

years of education		women at work		
		n	%	n
none		21,513	17,77	121,031
1-3		54,034	20,88	269,023
4-6		164,495	22,27	738,556
7-8		114,858	23,57	457,278
9-10		113,444	21,26	533,495
11-12		238,922	37,93	629,862
>13		135,251	58,52	231,123
total	(1982)	842,517	27,99	3,010,008
	(1992)	1,365,437	28,06	6,084,964

**AVISA: THE FIRST 15 CAUSES OF DEATHS BOTH SEXES.  
%DISTRIBUTION AND REASON PER 1.000 INHAB. 1993**

<b>Illness</b>	<b>AVISA</b>	<b>%</b>	<b>Reason/1.000 inhab</b>
Congenital anomalies	103654	5.86	7.53
Low acute respiratory infections	73234	4.14	5.32
Heart ischemic	67534	3.82	4.90
Hipertension	60172	3.40	4.37
Cerebrovascular	57700	3.26	4.19
Asthma	55118	3.11	4.00
Trafic accidents	53692	3.03	3.90
Alcohol dependency	53498	3.02	3.88
Gallbladder disorders	53361	3.02	3.87
Depression disorders - MAD	53279	3.01	8.87
Arthrosis and similar	48452	2.74	3.52
Alzheimer	42889	2.42	3.11
Perinatal	41710	2.36	3.03
Psychosis	32474	1.84	2.36
Cirrhosis	32172	1.82	2.34
<b>Total</b>	<b>828939</b>	<b>46.85</b>	<b>65.19</b>

TABLE II

This indicator was formulated by the World Bank and the OMS, and it was published in the Report no W.D.1993

## TEN MAIN CAUSES OF DEATH IN CHILE 1997

	N° of Deaths	%	Rate per 100,000 inhabitants
Circulatory System	20.733	26.42	141.8
Malignant Tumors	17.000	21.66	116.3
Respiratory System	9.987	12.73	68.3
Traumatism and Poisoning	8.280	10.55	56.6
Digestive System	5.858	7.47	40.1
Signs, Symptoms and not defined	3.718	4.74	25.4
Endocrinology Nutrition			
Metabolic problems	2.567	3.27	17.6
Infectious and Parasitical	2.465	3.14	16.9
Genitourinary System	1.703	2.17	11.6
Mental problems	1.584	2.04	10.8
Other groups	4.577	5.83	31.3
Total	78.472	100.00	536.7

Source: Ministry of Health

TABLE III

## ESTABLISHMENTS OF THE PUBLIC HEALTH SUBSYSTEM NET, 1998

TABLE IV

Hospital	Number
Hospital type 1	20
Hospital type 2	32
Hospital type 3	23
Hospital type 4	107
Diagnostic and Terapeutical Center	3
Health Reference Center	2
Geriatric Centers	2
Delegated Hospitals	14
Additional Clinics	120
General Urban y Rural Clinics	406
Emergency Clinics and Medical rural stations	1.840

This type corresponds to *Medium Complexity Hospital*

**NUMBER OF HOSPITAL BEDS ACCORDING TO THE CHILEAN  
HEALTH SUBSYSTEM. 1985-1997**

Year	Publics Subsystem	Private Subsystem
1985	33.435	8.789
1986	33.103	9.185
1987	32.594	8.233
1988	32.580	10.199
1989	32.818	10.366
1990	32.515	10.499
1991	32.295	10.600
1992	32.176	10.985
1993	31.989	10.918
1994	31.804	11.208
1995	31.579	11.549
1996	31.353	11.419
1997	30.956	11.065

Source: Minsal, Ministry of Health

TABLE V

## RESULT INDICATORS IN THE CHILEAN HEALTH CARE SYSTEM. 1998

Indicator	
Coverage in infant vaccination (third dose/born alive Dept) %	95.28
Coverage in infant vaccination (third dose/born alive Polio) %	95.36
% of Professional care at childbirth	99.60
% Low weight at child birth	5.1
General mortality rate (per one thousand inhabitants)	5.4
Infant mortality rate (per one thousand born alive)	10.0
Neonatal mortality rate (per one thousand born alive)	5.7
Late infant mortality rate	4.3
Precocious neonatal mortality rate (per one thousand born alive)	4.5
Mortality rate from 1 to 4 years of age (per 1.000 inhabitants from 1 to 4 years old)	0.5
Maternal mortality rate (per one thousand born alive) 0.30	0.2

Source: Minsal, Ministry of Health

# Art feeding in newborns BLT Hospital 1992-1993

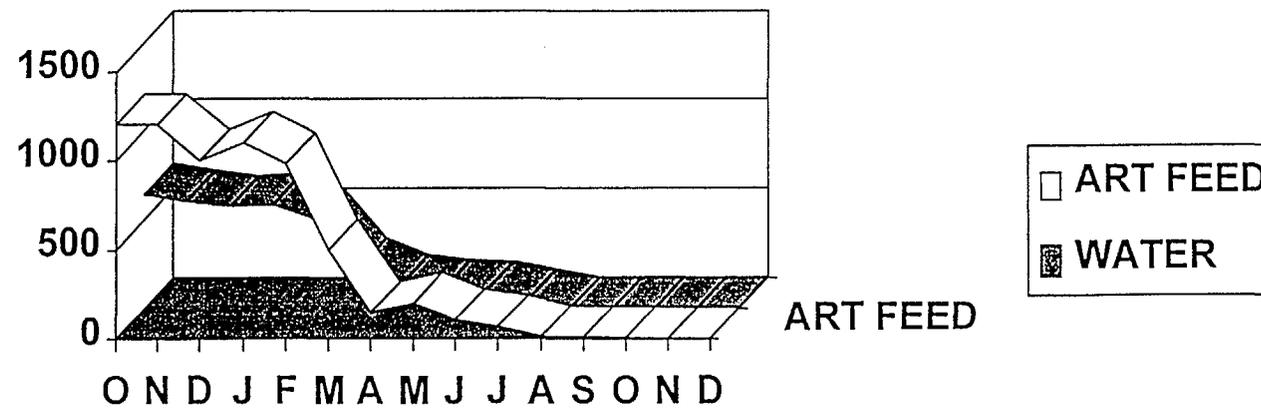


Figure 1

# Mother-infant bonding at BLT Hospital 1993

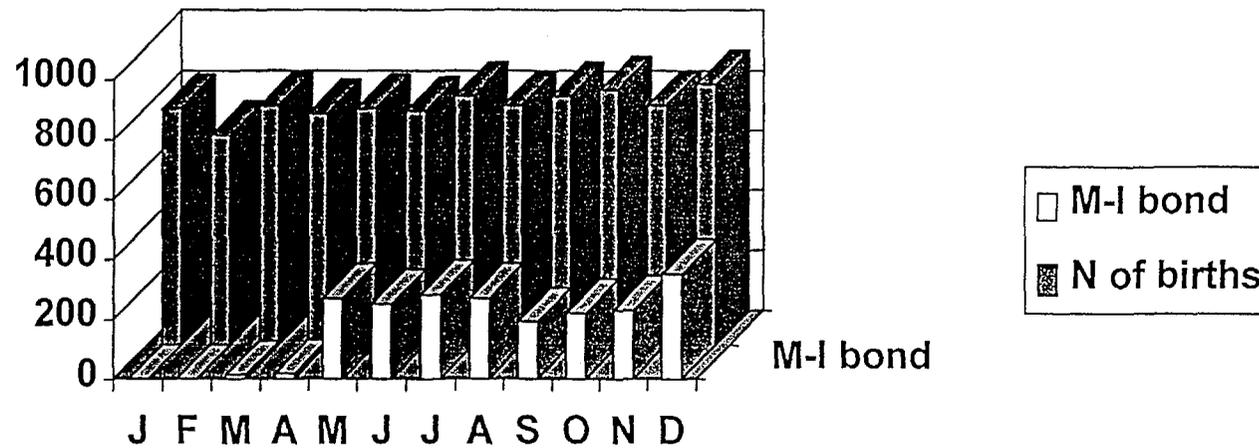


Figure 2

## % of breast feeding at Santiago South health area 1993 -1996

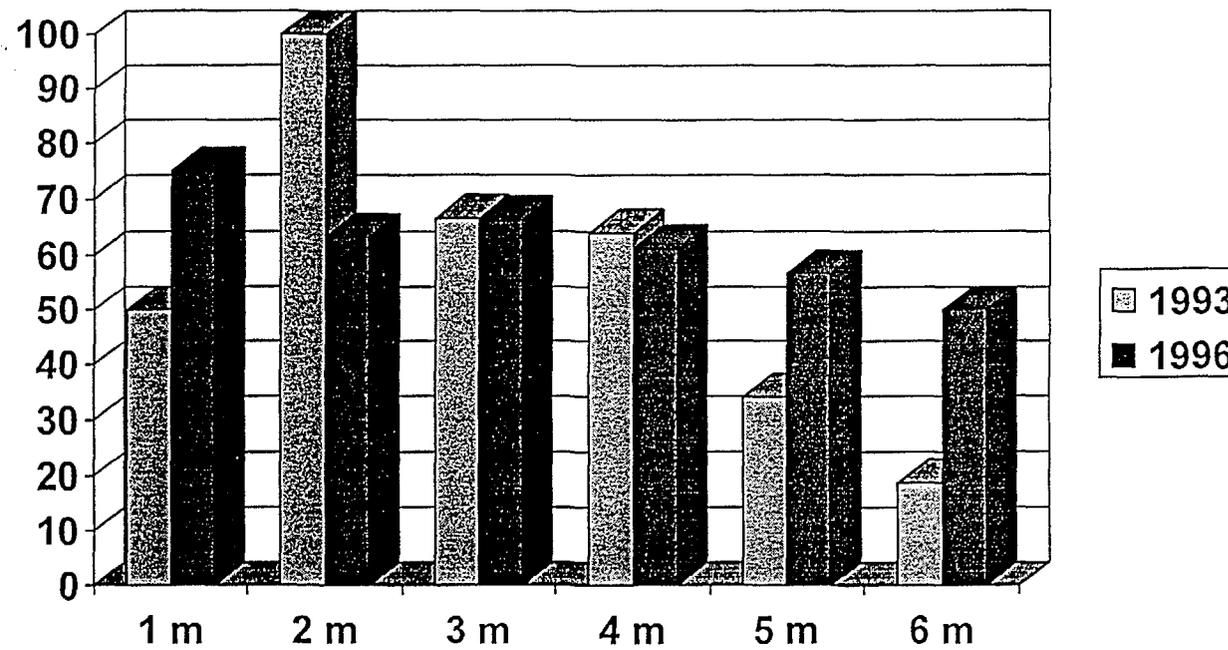


Figure 3