EFFECTS OF THE CONDITIONS OF NURSING ON THE DEVELOPMENT OF INFANT HIP-BONES*

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In Japan the physical development of infants, especially in early infancy, has shown marked improvement in recent years[1], and this has been attributed to advances in methods of rearing, rationalization of the environment and diffusion of the knowledges of nuring-care.

The fact that the physical development of infants is dependent on methods of rearing, socio-economic status and the customs of their families, has been gradually brought to light.

Some[2)3)] reported on the relation of infant mortality or premature birth to socio-economic factors and others[4)~7)] the effects on the physical development, especially weight growth, of the parents' occupation.

At our department of public health, the development of infant hip-bones has been repeatedly[8)~14)] studied from the stand point of relative growth, based on a hypothesis established by Mizuno[15] that the ratio of the measurement-values of any two parts of the developing body selected at will would change continuously and a defenite normal form could not be settled.

Mizuno[15] emphasized that the pattern of the normal hip-joint, generally described in textbooks of orthopedics, is not of the early infant but of older ones, and this has often caused errors in diagnosis of dislocation, and hence, the need of clarifying the normal form of the infant hip-bones was acquired. Even in the normal roentgenogram of the early infant, the hip-bones show a picture which has been considered to be characteristic of dislocation of the hip-joint. Consequently there is need to know the relative position of the femur to the ilium as it changes with advance in age.

From these points of view, many studies[16)~21)] have helped to clarify the closely relation between dislocation of the hip and the development of the hip-bones.

Needless to say the development of infant hip-bones, as a part of body, will be affected by nursing-conditions as well as the general physical development.

The conditions may be roughly divided into biological, natural and social (or socio-economic) factors.

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Developmental changes in infant hip-bones affected by biological factors such as sex and month-age have already been studied by Kuroda,[13] Mizuno[12] and Morita[10] of our department.

Nagura[22], Imada[23], Ueda[24], Tanaka[25] and R. G. Record[26] have previously reported on the great influence of the natural environment upon development of hip-bones.

They reported that the occurence of dislocation of the hip-joint is closely related to such natural factors as sun-beam, birth-season, living-location and climate.

Tanaka[25] reported that a higher incidence of dislocation of the hip was observed in infants living under poor conditions, of housing, humidity, sun-beam, drainage and home economic status.

Watanabe[27] pointed out that developmental formation of the hip was affected by the way of holding or shouldering babies.

Iino[28] emphasized on secondary factors after birth affecting greatly the formation of infant hip-bones, and Akabayashi[29] pointed out that the physical development and nutritional condition after birth were most important.

On the other hand, Tsuchiya[30] and Klopfer[31] asserted that both genetic back ground and environments after birth must be simultaneously taken count of.

Nomura[32] of our department made an experimental survey on methods in rearing infants that affect the development of hip-bones.

He compared two groups, one instructed in rearing method such as nutrition, sun-bathing, exercise of lower extremities, massage, sleeping-posture and sitting-posture favorable to the development of hip-bones, and another without instruction, and found that the horizontal growth of the hip-joint was greater in the former group than in the latter and that the influences were more obvious in females than in males.

Another investigation[33] made at our department has proved that Vitamin-D intake, exercise of lower extremities and sitting-posture with the lower extremities extended favorably affect the development of the upper structures of the hip-joint.

Difficulties, however, lie in examining the social factors affecting the development of hip-bones as pointed out by Tanaka,[25] especially in analysing the data obtained. The experimental plans for such a purpose should be carefully designed.

The author attempted to solve these problems with samples of infants taking into account, such social and natural factors as parents' occupations, utilization of the Health Center Clinic, characteristics of the areas where they live, home-environments, and birth-season, that could be practically and distinctly classified.

The author belives that such a survey will contribute further to studies on maternal-child health of public health activities, and also to methods of community-diagnosis which is receiving increasing interest[34], and its need recognized widely.

The author presents this study as an attempt at community-diagnosis, as

well as the first step in solving the problems underlying the analysis of nursing-conditions influencing the development of infant hip-bones.

MATERIALS AND METHODS

A. Materials

1) Materials for the study of influences in the social environments that affect the development of the infant hip-bones

The infants, classified systematically by month-age and sex, were selected from the service-area of a Health Center in Aichi Prefecture and were asked to visit the clinic of the Health Center for one year, from April 1959 to March 1960.

873 infants (male 439, female 434), as shown in Table-1, were measured for their weights and heights and the X-ray photographs of the hip-joint were taken ventrodorsally.

TABLE 1. Number of Infants by Sex and Month-Age

Sex → / Month-Age ↓	Male	Female	Total
1	34	33	67
2	29	27	56
3	30	29	59
4	53	44	97
5	46	45	91
6	42	44	86
7	50	45	95
8	40	46	86
9	43	41	84
10	34	43	77
11	38	37	75
Total	439	434	873

Then their mothers were interviewed as regards their nursing-methods and the environments under which the infants nursed daily.

As the objective recognition of facts is very difficult by the question-answer method, some items supposed to be more correctly obtainable by question-answer method were selected among the nursing-conditions.

Two persons were selected as interviewers, throughout the entire period.

The items of the questionairs were as follows

1. Breadearners' (mostly fathers) occupations

This item was subdivided into 4 groups, of agriculture, clerical, laboring and other occupations.

2. Utilization of the clinic of Health Center

Whether the mothers utilized the clinic of the Health Center or not for nursing their babies.

3. Location of the infants' homes

Two cities and three villages were selected from the service-area of the Health Center, and they were grouped into 3 areas.

city.....a middle sized and small city
3 villages...farm area

4. Existence of Grandparents

The aim was to know if the infants live with their grandparents or not, and was grouped into 4.

with grandparents
with grandfather but not grandmother
with grandmother but not grandfather
neither grandfather nor grandmother

5. Occupation of Mothers

This item was grouped into 5.

no occuption
agriculture
agriculture and sericulture
agriculture and miscellaneous affairs
other occupations except the above

In these areas of this survey, sericulture has been conducted since old times as subsidiary to agriculture, in between periods of agricultural work.

2) Materials for the study on influences of the birth-season, as a natural environment, on the development of the infant hip-bones

The influences of the birth-season as a natural environment on the development of infant hip-bones was studied as shown in Table-2,

TABLE 2. Number of Infants by Sex, Birth-Season and Month-Age

Sex	Birth-Season→ Month-Age ↓	Spring–Summer	Autumn-Winter
Male	1	8	13
	2	18	17
	3	14	20
	4	13	23
	5	11	18
	6	11	24
	7	16	12
	8	14	6
Female	1	12	15
	2	19	18
	3	17	18
	4	8	16
	5	15	20
	6	8	22
	7	13	6
	8	8	9

577 infants were selected so that an analysis of variance by sex, month-age and birth-season could be made. These infants were groups visiting the clinic of a Health Center in Nagoya city and its suburbs.

B. Method of taking roentgenogram of the infant hip

Roentgenograms were taken with the infants laid in the dorsal position

with the legs stretched parallel and with the distance between the X-ray tube and the focus at one meter.

The X-ray was focused at the central point of a triangle joining the two anterior spines of the ilium and the symphysis pubis.

The pictures were taken under the conditions shown in Table-3, dorso-ventrally. From these pictures, those with the form and size of the foramen obturatorium of the pelvis of both sides alike and with the median of the sacral bone and the extension line from the apex of the coccyx running exactly through the middle of the pubic cartilage were chosen, and biometry was conducted by the follwoing method (Fig-1).

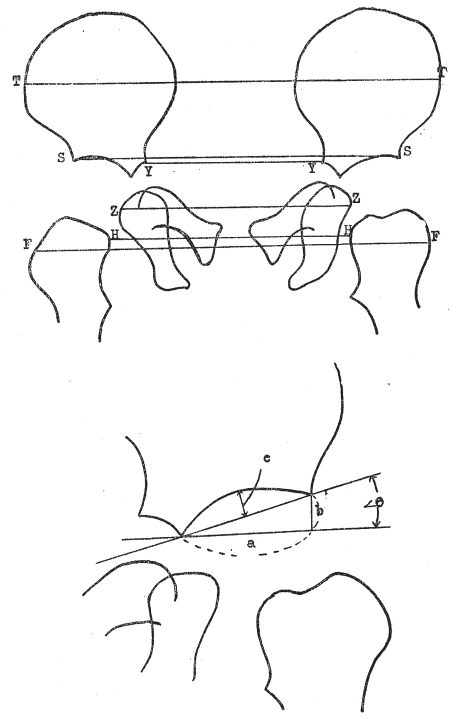

FIG. 1

(1) The distance between the apices of both acetabular roofs (S-S)

(2) The distance between the most lateral parts of both Ilia (T-T)

(3) The distance of Wollenberg's Y-Cartilage Line (Y-Y)

(4) The distance between the most lateral margins of both Ischia (Z-Z)

(5) The distance between the Lingulae of both Femur-Necks (H-H)

(6) The distance between the lateral margins of both Femur-Metaphysis (F-F)

(7) Horizontal distance of Acetabulm (a)

(8) Vertical distance of Acetabulum (b)

(9) The depth of Acetabulum (c)

(10) The steepness of Acetabulum ($\angle\theta$)

TABLE 3. Condition of Roentgenography of Hip-Bones

Thickness (cm)	Primary voltage (V) (Ms)	(Fs)	Seconpary voltage (KV)	mA	Time (sec)	Distance (m)
6.0	76	79	42–43	50	1/20	1
6.5	79	82	43–45	〃	〃	〃
7.0	80	85	44–46	〃	〃	〃
7.5	82	86	〃	〃	〃	〃
8.0	82	89	〃	〃	〃	〃
8.5	84	94	〃	〃	〃	〃
9.0	87	95	〃	〃	〃	〃
9·5	92	97	〃	〃	〃	〃
10.0	96	99	〃	〃	〃	〃
10.5	96	100	49–50	〃	〃	〃
11.0	87	103	49–51	〃	〃	〃
11.5	100	106	50–55	〃	〃	〃
12.0	103	110	50–56	〃	〃	〃

C. The method of statistical analysis

1. The method of statistical analysis for the study on influences of social environments

Measurement was carried out at all 10 parts of the hip to estimate the development and formation of hip-bones.

All values obtained by measurement were arranged by code-number to facilitate calculation, and the minimum value was arranged into code-number I.

T–T, S–S, Y–Y, Z–Z and H–H were arranged at 0.2 cm and likewise F–F at 0.4 cm, a and b at 0.1 cm, c at 0.05 cm and $\angle\theta$ at 1 degree.

Some samples (number of samples different according to factors) were extracted by sex, month-age and nursing-environment to examine the development and formation of the hip by analysis[35] of variance.

The calculation of mean and analysis of variance were all carried out by code-numbers.

2. The method of statistical analysis for the study on influences of birth-season as a natural environment

Measurement was made with 7 parts of hip-bones on roentgenogram. These 7 parts were H–H, Z–Z, Y–Y, S–S, a, c and $\angle\theta$. And 3 samples were selected by sex, month-age and birth-season to examine for development of hip-bones by analysis of variance.

The values obtained by measurement were grouped into 2, one of infants born in the warm season (spring and summer) and another in the cold season (autumn and winter).

The mean of each part was calculated by month-age group, sex and two seasons of birth.

RESULT

A. Influences of social environments on the development of the infant hip-bones

1) Influences of breadearners' occupation on the development of infant hip-bones

Breadearners' occupation was classified into 4 groups, of agricultural, clerical, labouring and other occupations.

The infants classified according to the above, excepting the last, were compared for development of the hip-bones by month-age groups of 2–3, 4–5, 6–7, 8–9 and 10–11 months.

1. Tables 4–1 and 5–1 show the means and the standard deveations of Y–Y and Z–Z in the infant hip-bones classified by breadearners' occupations, month-age and sex.

From these tables, the developments of Y–Y and Z–Z in infant hip-bones of clerical occupations were considered to be greater than those of the other two occupations.

10 samples each were selected by occupation, month-age and sex to examine the difference statically, and significant differences were noted in Y–Y at 1% level of confidence and in Z–Z at 5%, by the analysis of variance (Tables 4–2, 4–3 and 5–2, 5–3).

TABLE 4-1. Breadearners' Occupation (Y-Y) (mm)

Sex	Month-age	Occupation (1)			(2)			(3)		
		N	$\bar{x}$	s	N	$\bar{x}$	s	N	$\bar{x}$	s
Male	2- 3	15	2.8	1.3	22	3.4	1.4	12	3.2	1.5
	4- 5	10	4.8	1.7	22	4.7	1.2	11	4.9	1.3
	6- 7	18	5.9	1.6	19	6.0	1.4	11	6.4	1.8
	8- 9	19	6.6	1.7	19	7.1	1.2	12	6.0	1.7
	10-11	18	7.5	1.9	11	7.4	0.8	10	6.9	2.1
Female	2- 3	17	2.5	1.1	20	2.7	1.3	13	2.5	0.9
	4- 5	18	3.8	1.5	21	4.7	1.6	10	4.3	1.0
	6- 7	21	5.4	2.0	19	5.9	1.4	12	5.4	1.8
	8- 9	19	6.8	1.9	16	7.0	1.3	19	6.5	1.3
	10-11	16	7.1	1.2	24	7.7	2.0	14	7.9	1.8

N ····number of samples
$\bar{x}$ ····mean
s ····standard deviation
(1) ····agricultural, (2)····clerical, (3)····labouring

TABLE 4-2. Breadearners' Occupation (Y-Y)

Sex	Month-age→ Occupation ↓	2-3	4-5	6-7	8-9	10-11	Total
Male	(1)	36	50	63	62	67	278
	(2)	39	51	63	73	73	299
	(3)	28	49	56	68	73	274
Total		103	150	182	203	213	851
Female	(1)	26	45	51	57	82	261
	(2)	29	45	59	73	71	277
	(3)	28	37	55	66	73	259
Total		83	127	165	196	226	797

(1)····agricultural, (2)····clerical, (3)····labouring

TABLE 4-3. (Y-Y)

Factor	SS	DF	Ms	
Sex (S)	97.20	2− 1= 1	97.20	**
Month-age (M)	6745.84	5− 1= 4	1686.46	**
Occupation (O)	107.48	3− 1= 2	53.74	**
S ×M	142.18	1× 4= 4	35.55	*
S ×O	3.60	1× 2= 2	1.80	
M×O	180.50	4× 2= 8	22.56	**
R	26.62	29−21= 8	3.37	
Total	7445.88	30− 1=29		

** significant level at 1%
* 〃 at 5%

TABLE 5-1. Breadearners' Occupation (Z-Z) (mm)

Sex	Month-age	Occupation (1)			(2)			(3)		
		N	$\bar{x}$	s	N	$\bar{x}$	s	N	$\bar{x}$	s
Male	2- 3	15	6.7	1.8	22	7.5	2.4	12	7.3	2.2
	4- 5	10	9.3	2.3	22	9.5	2.1	11	9.2	1.5
	6- 7	18	11.0	1.7	19	11.5	1.8	11	11.3	2.4
	8- 9	19	11.8	1.0	19	12.5	1.3	12	11.3	1.9
	10-11	18	13.7	2.2	11	13.0	1.8	10	12.8	2.3
Female	2- 3	17	7.0	1.8	20	7.0	2.0	13	6.6	1.2
	4- 5	18	8.5	2.0	21	9.3	2.7	10	8.9	1.7
	6- 7	21	10.8	2.3	19	11.3	1.7	12	10.7	2.8
	8- 9	19	12.6	2.4	16	12.4	2.0	19	11.9	2.2
	10-11	16	13.5	1.5	24	13.9	2.9	14	13.4	2.4

N····number of samples

$\bar{x}$····mean

s····standard deviation

(1)····agricultural, (2)····clerical, (3)····labouring

TABLE 5-2. Breadearners' Occupation (Z-Z)

Sex	Month-age→ Occupation ↓	2-3	4-5	6-7	8-9	10-11	Total
Male	(1)	77	94	108	114	125	518
	(2)	75	104	118	129	128	554
	(3)	64	94	111	125	131	525
Total		216	292	337	368	381	1597
Female	(1)	65	89	107	116	139	516
	(2)	72	93	117	127	129	535
	(3)	71	89	109	122	137	528
Total		208	271	333	362	405	1579

(1)····agricultural, (2)····clerical, (3)····labouring

TABLE 5-3. (Z-Z)

Factor	SS	DF	Ms	
Sex (S)	7.96	2− 1= 1	7.96	
Month-age (M)	13928.33	5− 1= 4	3482.08	**
Occupation (O)	153.27	3− 1= 2	76.64	*
S × M	172.38	1× 4= 4	43.10	
S × O	29.44	1× 2= 2	14.72	
M × O	244.07	4× 2= 8	30.51	
R	115.22	29−21= 8	14.40	
Total	14650.97	30− 1=29		

** significant level at 1%

* 〃 5%

$$Y\text{-}Y\cdots Fs=15.95>F_8^2(0.01)=8.65$$
$$Z\text{-}Z\cdots Fs=\ 5.32>F_8^2(0.05)=4.46$$

Each of the parts in infants of "clerical" occupation were, on the average, greater than in other occupations.

2. The developments of H-H, F-F and S-S were also observed to be the same as above, but no significant difference could be proved statistically (Tables 6-1, 6-2, 7-1, 7-2 and 8-1, 8-2).

TABLE 6-1. Breadearners' Occupation (H-H)

Sex	Month-age→ Occupation ↓	2-3	4-5	6-7	8-9	10-11	Total
Male	(1)	58	62	85	80	91	376
	(2)	61	77	85	93	86	402
	(3)	43	70	93	88	88	382
Total		162	209	263	261	265	1160
Female	(1)	42	60	67	85	105	359
	(2)	49	66	80	89	96	380
	(3)	48	60	82	89	106	385
Total		139	186	229	263	307	1124

(1)····agricultural, (2)····clerical, (3)····labouring

TABLE 6-2. (H-H)

Factor	SS	DF	Ms	
Sex (S)	43.19	2− 1= 1	43.19	
Month-age (M)	7853.06	5− 1= 4	1963.27	**
Occupation (O)	115.27	3− 1= 2	57.64	
S ×M	620.55	1× 4= 4	155.14	**
S ×O	121.39	1× 2= 2	60.70	
M×O	354.14	4× 2= 8	44.27	
R	105.87	29−21= 8	13.23	
Total	9213.47	30− 1=29		

** significant level at 1%

TABLE 7-1. Breadearners' Occupation (F-F)

Sex	Month-age→ Occupation ↓	2-3	4-5	6-7	8-9	10-11	Total
Male	(1)	70	79	92	96	105	442
	(2)	61	84	101	102	108	456
	(3)	56	82	86	99	110	433
Total		187	245	279	297	323	1331
Female	(1)	55	69	91	95	121	341
	(2)	58	73	89	110	98	428
	(3)	53	71	82	99	119	424
Total		166	213	262	304	338	1283

(1)····agricultural, (2)····clerical, (3)····labouring

TABLE 7-2. (F-F)

Factor	SS	DF	Ms	
Sex (S)	76.78	2− 1= 1	76.78	
Month-age (M)	9762.71	5− 1= 4	2440.67	**
Occupation (O)	36.87	3− 1= 2	18.44	
S ×M	261.29	1× 4= 4	65.32	
S ×O	22.22	1× 2= 2	11.11	
M×O	44.59	4× 2= 8	5.57	
R	665.01	29−21= 8	83.13	
Total	10869.47	30− 1=29		

** significant level at 1%

TABLE 8-1. Breadearners' Occupation (S-S)

Sex	Month-age→ Occupation ↓	2–3	4–5	6–7	8–9	10–11	Total
Male	(1)	96	126	160	162	168	712
	(2)	98	130	156	175	175	734
	(3)	82	133	152	169	167	703
Total		276	389	468	506	510	2149
Female	(1)	75	120	133	148	196	672
	(2)	83	120	150	173	175	703
	(3)	74	108	125	168	181	656
Total		232	348	408	491	552	2031

(1)····agricultural, (2)····clerical, (3)····labouring

TABLE 8-2. (S–S)

Factor	SS	DF	Ms	
Sex (S)	464.14	2− 1= 1	464.14	*
Month-age (A)	32663.67	5− 1= 4	8165.92	**
Occupation (O)	317.27	3− 1= 2	158.64	
S ×H	1070.19	1× 4= 4	267.55	*
S ×O	12.86	1× 2= 2	6.43	
M×O	564.73	4× 2= 8	70.59	
R	533.81	29−21= 8	66.73	
Total	35626.67	30− 1=29		

** significant level at 1%
* 〃 5%

3. The developments of T–T, a, b, c and $\angle\theta$ were observed to show no trend described above.

2) Utilization of the Health Center Clinic

All infants were classified into 2 groups, one of infants whose mothers utilized the clinic of Health Center, and the another who did not. The infants of these 2 groups were compared for their developments of hip-bones by sex and month-age groups of 3 to 11 months.

1. Tables 9-1, 10-1 and 11-1 show the means and the standard deviations of T-T, S-S and H-H by sex, month-age and utilization of Health Center.

The developments of T-T, S-S and H-H in infant hip-bones were considered to be greater in infants of the utilization-group than those of the non-utilization group.

8 infants each were sampled by sex, month-age and the group classified by the utilization of Health Center to examine for the difference between the 2 groups statistically, and significant differences were noted in T-T, S-S and H-H at 5% level of confidence by the analysis of variance (Tables 9-2, 9-3, 10-2, 10-3 and 11-2, 11-3).

TABLE 9-1. Utilization of Health Center (T-T) (mm)

Sex	Month-age	(1)			(2)		
		N	$\bar{x}$	s	N	$\bar{x}$	s
Male	3	13	6.2	1.0	15	7.7	2.6
	4	11	9.6	2.9	13	8.9	2.2
	5	15	11.9	3.1	9	12.4	2.2
	6	19	15.3	1.1	8	13.7	2.5
	7	18	13.8	3.9	13	14.4	3.1
	8	15	16.2	2.1	14	13.6	3.2
	9	16	16.4	3.5	9	15.4	3.8
	10	16	18.4	3.6	8	16.1	3.1
	11	13	17.8	0.8	11	16.1	4.0
Female	3	12	5.1	1.9	14	5.6	2.3
	4	17	7.9	2.7	17	8.4	2.9
	5	16	9.4	1.2	9	8.7	3.0
	6	20	11.1	1.0	10	9.7	2.3
	7	22	13.8	2.6	15	11.8	2.7
	8	16	14.2	2.9	13	13.9	2.9
	9	22	15.5	2.0	14	15.7	3.1
	10	17	16.5	2.5	16	15.3	4.3
	11	22	17.8	3.6	9	16.9	4.3

(1)····utilization group, (2)····non-utilization group
N····number of samples
$\bar{x}$····mean
s····standard deviation

TABLE 9-2. Utilization of Health Center (T-T)

Sex	Month-age→ Utilization ↓	3	4	5	6	7	8	9	10	11	Total
Male	(1)	52	74	99	129	103	125	126	139	144	991
	(2)	66	75	97	111	112	114	125	134	126	960
Total		118	149	196	240	215	239	251	273	270	1951
Female	(1)	44	60	78	88	124	113	133	128	146	914
	(2)	45	65	69	75	99	107	114	110	144	828
Total		89	125	147	163	223	220	247	238	290	1742

(1)····utilization group, (2)····non-utilization group

TABLE 9-3. (T-T)

Factor	SS	DF	Ms	
Sex (S)	1213.34	2− 1= 1	1213.34	**
Month-age (M)	26967.95	9− 1= 8	3373.49	**
Utilization (U)	380.23	2− 1= 1	380.23	*
S ×M	1739.91	1× 8= 8	217.49	*
S ×U	83.54	1× 1= 1	83.54	
M×U	424.02	8× 1= 8	53.00	
R	463.71	35−27= 8	57.96	
Total	29921.20	36− 1=35		

** significant level at 1%
* " 5%

TABLE 10-1. Utilization of Health Center (S-S) (mm)

Sex	Month-age	(1)			(2)		
		N	$\bar{x}$	s	N	$\bar{x}$	s
Male	3	13	9.7	1.2	15	9.9	1.1
	4	11	12.5	2.6	13	12.5	2.3
	5	15	13.7	1.8	9	13.3	3.3
	6	19	15.8	2.8	8	15.0	2.9
	7	18	15.6	2.7	13	15.6	2.1
	8	15	17.0	1.7	14	15.6	3.3
	9	16	17.0	2.5	9	16.7	2.8
	10	16	18.3	3.3	8	18.3	3.9
	11	13	17.8	3.3	11	17.2	3.8
Female	3	12	8.5	1.2	14	8.7	3.0
	4	17	11.3	2.1	17	11.4	2.3
	5	16	13.2	2.4	9	11.1	1.9
	6	20	14.3	1.5	10	11.8	1.6
	7	22	15.0	1.8	15	14.3	1.9
	8	16	15.7	1.9	13	15.6	3.0
	9	22	16.4	2.7	14	16.8	1.7
	10	17	17.9	2.5	16	17.7	3.7
	11	22	19.1	2.4	9	17.9	4.0

(1)····utilization group, (2)····non-utilization group
N····number of samples
$\bar{x}$····mean
s····standard deviation

TABLE 10-2. Utilization of Health Center (S-S)

Sex	Month-age→ Utilization ↓	3	4	5	6	7	8	9	10	11	Total
Male	(1)	83	100	109	130	121	134	130	138	139	1084
	(2)	88	105	102	120	128	130	138	146	134	1091
Total		171	205	211	250	249	264	268	284	273	2175
Female	(1)	72	89	104	100	121	131	133	130	162	1042
	(2)	76	90	87	91	115	120	132	129	151	991
Total		148	179	191	191	236	251	265	259	313	2033

(1)····utilization group, (2)····non-utilization group

TABLE 10-3. (S-S)

Factor	SS	DF	Ms	
Sex (S)	560.11	2− 1= 1	560.11	**
Month-age (M)	15152.66	9− 1= 8	1894.08	**
Utilization (U)	53.78	2− 1= 1	53.78	*
S ×M	1354.72	1× 8= 8	169.34	**
S ×U	92.56	1× 1= 1	92.56	**
M×U	354.72	8× 1= 8	44.34	**
R	40.94	35−27= 8	5.12	
Total	17609.16	36− 1=35		

** significant level at 1%
* 〃 5%

TABLE 11-1. Utilization of Health Center (H-H) (mm)

Sex	Month-age	(1)			(2)		
		N	$\bar{x}$	s	N	$\bar{x}$	s
Male	3	13	5.2	1.6	15	5.9	2.4
	4	11	6.5	1.9	13	6.5	1.5
	5	15	6.8	1.8	9	7.0	1.0
	6	19	7.9	1.5	8	8.0	2.2
	7	18	8.6	2.0	13	8.1	2.1
	8	15	8.5	1.4	14	7.9	2.3
	9	16	8.8	1.6	9	8.8	1.9
	10	16	10.2	2.1	8	8.7	1.4
	11	13	9.4	1.4	11	8.7	2.0
Female	3	12	5.9	1.4	14	5.1	1.2
	4	17	6.1	1.4	17	6.4	1.4
	5	16	7.4	1.6	9	5.6	1.9
	6	20	8.2	2.2	10	6.6	1.0
	7	22	8.0	2.0	15	8.1	1.4
	8	16	9.0	1.0	13	8.2	2.3
	9	22	9.0	1.0	14	9.8	1.9
	10	17	9.8	1.5	16	9.4	2.1
	11	22	11.1	1.8	9	8.5	3.1

(1)····utilization group, (2)····non-utilization group
N····number of samples
$\bar{x}$····mean
s····standard deviation

TABLE 11-2. Utilization of Health Center (H-H)

Sex	Month-age→ Utilization↓	3	4	5	6	7	8	9	10	11	Total
Male	(1)	43	57	54	62	61	65	70	68	77	557
	(2)	53	50	57	64	71	63	74	73	65	570
Total		96	107	111	126	132	128	144	141	142	1127
Female	(1)	51	54	58	61	65	75	75	77	94	610
	(2)	41	50	44	52	66	61	77	71	80	542
Total		92	104	102	113	131	136	152	148	174	1152

(1)····utilization group, (2)····non-utilization group

TABLE 11-3. (H-H)

Factor	SS	DF	Ms	
Sex (S)	17.35	2− 1= 1	17.35	
Month-age (M)	3779.77	9− 1= 8	33.92	**
Utilization (U)	84.02	2− 1= 1	84.02	*
S ×M	351.90	1× 8= 8	43.99	
S ×U	182.02	1× 1= 1	182.02	**
M×U	261.03	8× 1= 8	32.63	
R	111.43	35−27= 8	13.93	
Total	4787.52	36− 1=35		

** significant level at 1%
* 〃 5%

$$T\text{-}T\cdots Fs = 6.65 > F_8^1(0.05) = 5.32$$
$$S\text{-}S\cdots Fs = 10.50 > F_8^1(0.05) = 5.32$$
$$H\text{-}H\cdots Fs = 6.03 > F_8^1(0.05) = 5.32$$

The same tendency as the above was also observed in all parts of the hip-bones and was more distinct as the month-age advanced.

2. The developments of Y-Y, Z-Z and F-F were also observed to be greater in infants of the utilization than those of the non-utilization group, but no significant difference could be observed statistically (Tables 12-1, 12-2, 13-1, 13-2 and 14-1, 14-2).

TABLE 12-1. Utilization of Health Center (Y-Y)

Sex	Month-age→ Utilization ↓	3	4	5	6	7	8	9	10	11	Total
Male	(1)	29	39	42	50	47	50	51	55	58	421
	(2)	35	37	39	67	51	51	59	58	52	449
Total		64	76	81	117	98	101	110	113	110	870
Female	(1)	24	30	43	39	51	56	54	52	70	419
	(2)	25	32	32	34	45	50	55	53	59	385
Total		49	62	75	73	96	106	109	105	129	804

(1)····utilization group, (2)····non-utilization group

TABLE 12-2. (Y-Y)

Factor	SS	DF	Ms	
Sex (S)	121.00	2− 1= 1	121.00	*
Month-age (M)	3493.94	9− 1= 8	436.74	**
Utilization (U)	1.00	2− 1= 1	1.00	
S ×M	591.00	1× 8= 8	73.88	**
S ×U	106.64	1× 1= 1	106.64	*
M×U	200.00	8× 1= 8	25.00	
R	97.36	35−27= 8	12.17	
Total	4610.94	36− 1=35		

** significant level at 1%
* 〃 5%

TABLE 13-1. Utilization of Health Center (Z–Z)

Sex	Month-age→ Utilization ↓	3	4	5	6	7	8	9	10	11	Total
Male	(1)	63	69	77	86	92	94	96	106	107	790
	(2)	71	71	79	83	90	94	104	106	101	799
Total		134	140	156	169	182	188	200	212	208	1589
Female	(1)	68	71	84	83	86	96	100	103	117	808
	(2)	56	72	67	75	95	91	102	101	106	765
Total		124	143	151	158	181	187	202	204	223	1573

(1)····utilization group, (2)····non-utilization group

TABLE 13-2. (Z–Z)

Factor	SS	DF	Ms	
Sex (S)	7.11	2− 1= 1	7.11	
Month-age (M)	7432.28	9− 1= 8	929.04	**
Utilization (U)	32.11	2− 1= 1	32.11	
S ×M	130.39	1× 8= 8	16.30	
S ×U	74.62	1× 1= 1	74.62	
M×U	177.36	8× 1= 8	22.17	
R	174.88	35−27= 8	21.86	
Total	8028.78	36− 1=35		

** significant level at 1%

TABLE 14-1. Utilization of Health Center (F–F)

Sex	Month-age→ Utilization ↓	3	4	5	6	7	8	9	10	11	Total
Male	(1)	51	64	65	75	77	80	79	88	96	675
	(2)	56	63	70	70	77	72	87	85	83	663
Total		107	127	135	145	154	152	166	173	179	1338
Female	(1)	52	57	65	73	70	89	83	80	94	663
	(2)	49	57	52	57	74	75	82	80	95	621
Total		101	114	117	130	144	164	165	160	189	1284

(1)····utilization group, (2)····non-utilization group

TABLE 14-2. (F–F)

Factor	SS	DF	Ms	
Sex (S)	81.00	2− 1= 1	81.00	
Month-age (M)	5282.85	9− 1= 8	660.36	**
Utilization (U)	81.00	2− 1= 1	81.00	
S ×M	236.00	1× 8= 8	29.50	
S ×U	24.66	1× 1= 1	24.66	
M×U	222.00	8× 1= 8	27.75	
R	187.34	35−27= 8	23.42	
Total	6114.85	36− 1=35		

** significant level at 1%

3. No significant difference could be observed in the developments of a, b, c and $\angle\theta$ statistically.

3) Location of the infants' homes

Living-location were divided into 3 areas—a middle sized city, a small sized city and farm area, for the samples were selected from two cities and three villages.

Month-age groups were defined as 3-4, 5-6, 7-8 and 9-10 months. 10 infants each were selected at random by sex, month-age and living-location, and the development of hip-bones was investigated by the method of analysis of variance.

The developments of T-T, S-S, Y-Y, Z-Z, H-H and F-F were observed to be greater in infants living in the middle sized city than in the other two areas, and this tendency became more distinct as the month-age advanced, and in females than in males. But no significant difference could be proved statistically (Tables 15-1, 15-2, 16-1, 16-2, 17-1, 17-2, 18-1, 18-2, 19-1, 19-2 and 20-1, 20-2).

4) Existence of grandparents

All infants were divided into 4 groups as stated in the chapter on materials and methods.

TABLE 15-1. Location (T-T)

Sex	Month-age→ Location ↓	3-4	5-6	7-8	9-10	Total
Male	(1)	81	134	149	154	518
	(2)	77	112	139	180	508
	(3)	87	139	137	175	538
Total		245	385	425	509	1564
Female	(1)	75	107	142	152	476
	(2)	67	84	142	153	446
	(3)	53	103	132	159	447
Total		195	294	416	464	1369

(1)····a middle sized city, (2)····a small sized city, (3)····farm area

TABLE 15-2. (T-T)

Factor	SS	DF	Ms	
Sex (S)	1583.94	2− 1= 1	1583.94	**
Month-age (M)	26338.60	4− 1= 3	8779.53	**
Location (L)	109.80	3− 1= 2	54.90	
S ×M	563.09	1× 3= 3	187.70	
S ×L	152.18	1× 2= 2	76.09	
M×L	1022.77	3× 2= 6	170.46	
R	287.29	23−17= 6	47.88	
Total	30057.67	24− 1=23		

** significant level at 1%

TABLE 16-1. Location (S-S)

Sex	Month-age→ Location ↓	3-4	5-6	7-8	9-11	Total
Male	(1)	109	152	168	173	602
	(2)	106	127	162	182	577
	(3)	114	155	154	178	601
Total		329	434	484	533	1780
Female	(1)	114	142	163	169	588
	(2)	101	126	158	163	548
	(3)	85	133	144	171	533
Total		300	401	465	503	1699

(1)····a middle sized city, (2)····a small sized city, (3)····farm area

TABLE 16-2. (S-S)

Factor	SS	DF	Ms	
Sex (S)	512.78	2− 1= 1	512.78	*
Month-age (M)	15477.75	4− 1= 3	5159.25	**
Location (L)	309.69	3− 1= 2	154.85	
S ×M	17.52	1× 3= 3	5.84	
S ×L	194.73	1× 2= 2	97.37	
M×L	623.65	3× 2= 6	103.94	
R	296.47	23−17= 6	49.41	
Total	17432.56	24− 1=23		

** significant level at 1%, * significante level at 5%

TABLE 17-1. Location (Y-Y)

Sex	Month-age→ Location ↓	3-4	5-6	7-8	9-10	Total
Male	(1)	49	56	64	69	238
	(2)	37	49	61	74	221
	(3)	45	63	62	72	242
Total		131	168	187	215	701
Female	(1)	43	55	66	63	277
	(2)	34	57	70	67	228
	(3)	27	51	56	68	202
Total		104	163	192	198	657

(1)····a middle sized city, (2)····a small sized city, (3)····farm area

TABLE 17-2. (Y-Y)

Factor	SS	DF	Ms	
Sex (S)	80.57	2− 1= 1	80.57	
Month-age (M)	2992.60	4− 1= 3	997.53	**
Location (L)	30.02	3− 1= 2	15.01	
S ×M	97.33	1× 3= 3	32.44	
S ×L	140.68	1× 2= 2	70.34	*
M×L	203.15	3× 2= 6	33.86	
R	81.49	23−17= 6	13.58	
Total	3625.77	24− 1=23		

** significant level at 1%, * significant level at 5%

TABLE 18-1. Location (Z-Z)

Sex	Month-age→ Location ↓	3-4	5-6	7-8	9-10	Total
Male	(1)	87	101	120	125	433
	(2)	79	89	119	127	414
	(3)	89	111	109	131	440
Total		255	301	348	383	1287
Female	(1)	92	115	122	126	455
	(2)	82	102	124	130	438
	(3)	73	102	106	130	411
Total		247	319	352	386	1304

(1)····a middle sized city, (2)····a small sized city, (3)····farm area

TABLE 18-2. (Z-Z)

Factor	SS	DF	Ms	
Sex (S)	29.32	2− 1= 1	29.32	
Month-age (M)	6592.09	4− 1= 3	2197.36	**
Location (L)	127.35	3− 1= 2	63.68	
S ×M	38.65	1× 3= 3	12.88	
S ×L	209.43	1× 2= 2	104.72	*
M×L	438.41	3× 2= 6	73.07	
R	114.50	23−17= 6	19.08	
Total	7550.25	24− 1=23		

** significant level at 1%, * significant level at 5%

TABLE 19-1. Location (H-H)

Sex	Month-age→ Location ↓	3-4	5-6	7-8	9-10	Total
Male	(1)	66	72	85	91	314
	(2)	60	61	84	86	291
	(3)	62	82	82	95	321
Total		188	215	251	272	926
Female	(1)	63	79	88	89	319
	(2)	61	71	93	97	322
	(3)	52	72	77	86	287
Total		176	222	258	272	928

(1)····a middle sized city, (2)····a small sized city, (3)····farm area

TABLE 19-2. (H-H)

Factor	SS	DF	Ms	
Sex (S)	0.0	2− 1= 1	0.0	
Month-age (M)	3192.35	4− 1= 3	1064.12	**
Location (L)	43.64	3− 1= 2	21.82	
S ×M	39.89	1× 3= 3	13.30	
S ×L	267.75	1× 2= 2	133.88	**
M×L	246.40	3× 2= 6	41.07	
R	32.36	23−17= 6	5.39	
Total	3822.39	24− 1=23		

** significant level at 1%

TABLE 20-1. Location (F-F)

Sex	Month-age→ Location ↓	3-4	5-6	7-8	9-10	Total
Male	(1)	75	89	101	105	370
	(2)	68	79	97	110	354
	(3)	72	94	93	114	373
Total		215	262	291	329	1097
Female	(1)	70	88	96	107	361
	(2)	66	79	98	105	348
	(3)	57	78	89	103	327
Total		193	245	283	315	1036

(1)····a middle sized city, (2)····a small sized city, (3)····farm area

TABLE 20-2. (F-F)

Factor	SS	DF	Ms	
Sex (S)	154.81	2− 1= 1	154.81	**
Month-age (M)	5050.69	4− 1= 3	1683.56	**
Location (L)	75.10	3− 1= 2	37.10	
S ×M	16.78	1× 3= 3	5.59	
S ×L	124.31	1× 2= 2	62.16	*
M×L	161.18	3× 2= 6	26.86	
R	55.60	23−17= 6	9.27	
Total	5638.47	24− 1=23		

** significant level at 1%
* " 5%

Of these 4 groups, the groups living with their grandparents and those not living with grandparents, were selected to compare the developments of the infant hip-bones by samples of 7 each and classified by sex and month-age groups, of from 2 to 11 months.

But no parts of the hip-bone showed significant difference statistically.

5) Mothers' Occupation

All mothers were divided into 5 groups according to their occupations as stated in the chapter on materials and methods, and the developments of infant hip-bones of these groups except the last one were compared by the method of analysis of variance.

6 infants each were sampled by sex, month-age (3, 6 and 9 months) and groups of mothers' occupation for this analysis.

No parts of the hip-bone showed different development.

B. Influence of birth-season as a natural environment on the development of the infant hip-bones

1) Tables 21-1, 22-1, 23-1, 24-1 and 25-1 show the means and the standard deviations of Y-Y, S-S, a, c and $\angle\theta$ classified by sex, month-age and birth-season groups.

TABLE 21-1. (Y–Y) (mm)

Sex	Birth-season→ / Month-age ↓	Spring–Summer			Autumn–Winter		
		N	$\bar{x}$	s	N	$\bar{x}$	s
Male	1	8	41.3	2.28	13	39.6	3.63
	2	18	42.0	2.42	17	42.6	3.06
	3	14	44.4	2.49	20	43.6	2.30
	4	13	45.5	1.29	23	46.3	2.96
	5	11	46.5	2.82	20	46.5	2.07
	6	11	48.7	2.78	24	48.2	3.29
	7	16	49.4	1.23	12	50.3	3.04
	8	14	47.1	4.24	6	49.0	3.18
Female	1	12	39.0	1.53	15	39.4	2.58
	2	19	41.0	3.35	18	40.8	3.95
	3	17	42.5	2.79	18	42.7	4.67
	4	7	44.0	1.85	16	44.5	3.07
	5	15	48.0	3.41	20	46.4	2.49
	6	8	47.8	4.51	22	47.5	4.12
	7	13	48.1	1.95	6	47.5	1.50
	8	8	49.9	2.61	9	49.7	3.18

N ····number of samples

$\bar{x}$ ····mean

s ····standard deviation

TABLE 21-2. (Y–Y)

Sex→ / Birth-season→ / Month-age ↓	Male				Female				Total
	Spring	Summer	Antumn	Winter	Spring	Summer	Autumn	Winter	
1	127	123	120	127	117	116	118	115	963
2	128	129	125	126	131	123	124	127	1013
3	131	138	131	132	124	127	133	125	1041
4	138	142	132	130	134	136	134	130	1076
5	136	145	141	134	142	146	136	138	1118
6	140	148	136	140	148	134	136	137	1119
7	152	154	147	146	135	149	144	135	1162
8	149	155	157	150	141	145	149	148	1194
Total	1101	1134	1089	1085	1072	1076	1074	1055	8686

TABLE 21-3. (Y–Y)

Factor	SS	DF	Ms	
Sex (S)	272.25	2− 1= 1	272.25	**
Month-age (M)	5266.94	8− 1= 7	752.42	**
Birth-season (B)	159.32	4− 1= 3	53.11	*
S ×M	197.75	1× 7= 7	28.25	
S ×B	60.87	1× 3= 3	20.29	
M×B	369.68	7× 3=21	17.60	
R	292.13	63−42=21	13.91	
Total	6618.94	64− 1=63		

** Significant level at 1%

* 〃 5%

TABLE 22-1. (S-S) (mm)

Sex	Birth-season→ / Month-age↓	Spring-Summer			Autumn-Winter		
		N	$\bar{x}$	s	N	$\bar{x}$	s
Male	1	8	71.8	4.19	13	67.4	6.30
	2	18	72.3	5.19	16	74.0	2.19
	3	14	78.8	3.11	20	73.1	5.58
	4	13	84.0	5.37	23	84.1	2.29
	5	11	77.7	2.48	20	84.6	5.17
	9	12	88.8	4.13	24	88.5	5.06
	7	16	90.0	5.00	12	91.7	5.58
	8	14	91.9	4.31	6	92.6	7.10
Female	1	12	66.3	4.01	15	65.5	4.89
	2	19	71.5	5.23	18	70.0	2.90
	3	17	76.4	3.74	18	75.1	6.23
	4	7	81.7	5.99	16	81.2	4.01
	5	15	87.1	4.69	19	84.5	5.03
	6	8	87.8	4.52	22	86.1	4.69
	7	13	88.3	4.79	6	87.2	4.17
	8	8	92.1	6.18	9	91.8	5.25

N ····number of samples

$\bar{x}$ ····mean

s ····standard deviation

TABLE 22-2. (S-S)

Sex→ / Birth-season→ / Month-age↓	Male				Female				Total
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	
1	218	220	214	192	196	196	192	192	1620
2	218	226	213	214	206	212	212	210	1711
3	234	248	228	238	219	232	232	220	1849
4	242	256	248	237	248	250	248	232	1961
5	251	258	250	254	246	266	250	238	2013
6	252	260	246	253	252	271	264	246	2044
7	273	280	267	259	231	275	263	237	2085
8	269	280	282	261	270	286	276	264	2188
Total	1957	2028	1948	1908	1865	1988	1937	1839	15470

TABLE 22-3. (S-S)

Factor	SS	DF	Ms	
Sex (S)	702.25	2− 1= 1	702.25	**
Month-age (M)	32763.44	8− 1= 7	4680.49	**
Birth-season (B)	2434.32	4− 1= 3	811.44	**
S ×M	1036.75	1× 7= 7	148.11	**
S ×B	231.87	1× 3= 3	77.29	
M×B	759.18	7× 3=21	36.15	
R	1094.13	63−42=21	52.10	
Total	39021.94	64− 1=63		

** Significant level at 1%

TABLE 23-1. (a) (mm)

Sex	Birth-season→ / Month-age ↓	Spring-Summer			Autumn-Winter		
		N	$\bar{x}$	s	N	$\bar{x}$	s
Male	1	6	9.1	0.43	9	10.3	1.16
	2	14	10.2	2.97	14	9.7	1.43
	3	12	10.9	1.56	13	12.2	1.68
	4	10	12.8	1.47	18	13.2	1.69
	5	6	14.0	1.00	18	14.6	2.11
	6	9	14.1	1.62	23	14.2	1.60
	7	14	14.7	2.02	7	15.2	1.67
	8	14	14.9	1.07	6	15.0	2.31
Female	1	10	9.7	1.27	12	9.1	0.66
	2	14	10.0	1.25	15	10.0	1.26
	3	14	11.5	1.29	14	10.9	1.50
	4	6	13.0	0.71	13	12.3	0.74
	5	12	13.4	2.92	17	13.3	2.61
	6	6	13.5	0.50	18	13.3	2.03
	7	13	14.6	1.54	6	12.1	0.70
	8	7	15.1	2.07	6	15.3	1.06

N ····number of samples

$\bar{x}$ ····mean

s ····standard deviation

TABLE 23-2. (a)

Sex→	Male				Female				Total
Birth-season→ Month-age ↓	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	
1	28.5	29.0	30.5	27.0	29.0	28.0	27.5	26.5	226.0
2	31.5	34.5	29.0	32.5	29.5	33.0	28.0	28.0	246.0
3	34.5	39.5	38.5	32.5	31.5	39.0	34.0	29.5	279.0
4	40.0	43.0	39.5	35.3	34.5	38.5	37.0	35.5	303.3
5	44.5	44.0	44.0	39.0	38.0	41.0	38.0	37.0	326.0
6	43.0	47.0	41.5	43.0	39.0	42.5	39.5	39.5	336.0
7	43.5	45.0	44.0	43.0	43.0	44.5	39.5	39.5	342.0
8	43.5	48.5	45.5	45.0	45.0	48.5	37.0	46.5	359.5
Total	309.0	330.5	312.5	297.0	289.5	315.0	280.5	283.0	2417.8

TABLE 23-3. (a)

Factor	SS	DF	Ms	
Sex (S)	104.55	2− 1= 1	104.55	**
Month-age (M)	2110.07	8− 1= 7	287.24	**
Birth-season (B)	150.68	4− 1= 3	50.23	**
S×M	17.11	1× 7= 7	2.44	
S×B	11.93	1× 3= 3	3.98	
M×B	104.12	7× 3=21	4.96	
R	57.93	63−42=21	2.76	
Total	2456.39	64− 1=63		

** Significant level at 1%

TABLE 24-1. (c) (mm)

Sex	Birth-season→ / Month-age↓	Spring–Summer			Autumn–Winter		
		N	$\bar{x}$	s	N	$\bar{x}$	s
Male	1	6	4.2	4.45	9	4.6	6.20
	2	14	5.1	4.42	14	4.1	4.40
	3	12	7.1	6.01	16	6.6	5.06
	4	10	8.3	3.87	19	8.9	8.20
	5	6	9.1	4.83	17	9.0	5.85
	6	9	8.5	2.95	23	10.7	6.00
	7	14	13.6	2.09	9	16.8	5.21
	8	12	11.1	4.18	6	17.6	5.15
Female	1	10	3.9	3.59	12	2.7	3.10
	2	14	5.2	6.40	15	3.5	3.62
	3	14	4.9	3.65	14	5.7	5.65
	4	6	8.7	2.35	13	7.1	4.33
	5	12	11.1	4.13	17	9.7	4.88
	6	6	11.3	4.14	18	8.2	4.34
	7	13	11.3	6.71	6	9.0	3.54
	8	7	15.2	3.81	6	9.8	3.87

N ····number of samples

$\bar{x}$ ····mean

s ····standard deviation

TABLE 24-2. (c)

Sex→ / Birth-season→ / Month-age↓	Male				Female				Total
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	
1	2.5	0.0	2.8	0.0	1.3	1.1	0.5	0.2	8.4
2	1.5	2.3	2.0	0.0	1.2	2.0	1.3	0.8	11.1
3	1.5	3.5	2.9	1.0	1.2	2.0	1.3	0.8	14.1
4	2.0	3.0	2.8	1.5	1.7	2.0	1.7	1.0	15.7
5	3.5	3.5	2.5	2.8	2.3	3.5	2.8	2.2	23.1
6	3.9	4.9	3.1	3.7	1.8	3.4	1.3	2.5	24.6
7	4.0	3.8	4.2	3.5	2.7	3.3	3.3	3.3	28.1
8	3.3	4.8	4.5	3.5	3.0	4.5	2.3	3.8	29.7
Total	22.2	25.8	24.8	16.0	15.2	21.8	14.7	14.3	154.8

TABLE 24-3. (c)

Factor	SS	DF	Ms	
Sex (S)	8.13	2− 1= 1	8.13	**
Month-age (M)	56.77	8− 1= 7	8.11	**
Birth-season (B)	8.51	4− 1= 3	2.84	**
S ×M	2.83	1× 7= 7	0.40	
S ×B	3.48	1× 3= 3	1.16	**
M×B	13.62	7× 3=21	0.65	
R	4.01	63−42=21	0.19	
Total	97.36	64− 1=63		

** Significant level at 1%

TABLE 25-1 ($\angle\theta$) (degree)

Sex	Birth-season→ / Month-age↓	Spring-Summer			Autumn-Winter		
		N	$\bar{x}$	s	N	$\bar{x}$	s
Male	1	8	24.1	3.95	13	25.0	3.35
	2	18	22.3	4.84	17	26.9	4.43
	3	14	24.3	3.10	20	24.2	3.65
	4	13	23.4	3.87	23	23.0	3.96
	5	11	18.4	4.48	20	21.5	4.08
	6	12	21.1	3.99	24	21.2	3.76
	7	16	20.3	4.46	12	20.2	4.75
	8	14	20.6	5.04	6	22.3	3.27
Female	1	12	28.5	5.31	15	28.8	4.11
	2	19	25.9	3.14	18	27.9	3.65
	3	16	25.5	2.65	18	27.3	5.06
	4	7	25.1	4.03	16	27.6	4.32
	5	15	21.9	4.07	20	24.8	4.36
	6	8	23.8	5.67	22	23.9	3.81
	7	13	23.1	4.55	6	25.0	1.22
	8	8	21.7	4.59	9	21.8	4.00

N ····number of samples

$\bar{x}$ ····mean

s ····standard deviation

TABLE 25-2. ($\angle\theta$)

Sex→	Male				Femal				Total
Birth-season→ Month-age↓	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	
1	66	60	86	80	80	82	80	68	629
2	75	64	89	78	74	80	81	85	625
3	76	68	61	73	90	67	80	95	640
4	69	59	71	71	71	71	86	86	584
5	50	48	54	68	70	66	71	83	510
6	72	62	67	74	76	72	74	73	570
7	61	51	68	67	69	71	72	77	536
8	59	61	68	64	60	57	75	72	516
Total	558	473	564	575	599	566	619	657	4611

TABLE 25-3. ($\angle\theta$)

Factor	SS	DF	Ms	
Sex (S)	1147.52	2− 1= 1	1147.52	**
Month-age (M)	2382.59	8− 1= 7	340.36	**
Birth-season (B)	1259.49	4− 1= 3	419.83	**
S ×M	345.10	1× 7= 7	49.30	
S ×B	107.48	1× 3= 3	35.83	
M×B	1436.38	4× 3=21	68.40	
R	1034.36	63−42=21	49.26	
Total	7712.86	64− 1=63		

** Significant level at 1%

The developments of Y-Y, S-S, a, c and $\angle\theta$ of infants born in the warm season were considered to be greater than those of infants born in the cold season.

3 infants each were sampled by sex, month-ages of 1 to 8, and birth-season —spring, summer, autumn and winter, and the developments of the hip-bones were compared by the method of analysis of variance.

Significant differences were found between the birth-season groups, statistically (Tables 21-2, 21-3, 22-2, 22-3, 23-2, 23-3, 24-2, 24-3 and 25-2, 25-3).

$$\begin{aligned}
&\text{Y-Y}\cdots\text{Fs}= 3.13>F^{3}_{21}(0.05)=3.07\\
&\text{S-S}\cdots\text{Fs}=15.57>F^{3}_{21}(0.01)=4.37\\
&\text{a}\ \cdots\text{Fs}=18.20>F^{3}_{21}(0.01)=4.37\\
&\text{c}\ \cdots\text{Fs}=14.95>F^{3}_{21}(0.01)=4.37\\
&\angle\theta\ \cdots\text{Fs}= 8.52>F^{3}_{21}(0.01)=4.37
\end{aligned}$$

The infants born in the warm season showed significantly better development than those born in the cold season.

The influences of birth-season were clearly seen in the horizontal growth of the upper structure of the infant hip-bone, and the acetabular depth of infants born in the warm season was deeper and its steepness was milder than those born in the cold season.

2) The developments of H-H and Z-Z, *i.e.* of the lower structures of the hip-bone, showed no significant difference statistically (Tables 26-1, 26-2 and 27-1, 27-2).

TABLE 26-1. Birth-Season (H-H)

Sex→ / Birth-season→ / Month-age↓	Male				Female				Total
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	
1	182	172	169	162	170	168	171	162	1356
2	180	182	178	175	171	173	179	177	1415
3	188	196	189	175	179	161	181	180	1449
4	187	197	191	195	191	194	195	191	1541
5	192	198	195	185	207	210	195	191	1573
6	198	203	197	193	204	210	205	196	1607
7	210	207	208	201	198	209	204	196	1633
8	199	214	212	169	209	211	216	205	1665
Total	1536	1569	1539	1485	1529	1536	1547	1498	12239

TABLE 26-2. (H-H)

Factor	SS	DF	Ms	
Sex (S)	5.56	2− 1= 1	5.56	
Month-age (M)	10849.36	8− 1= 7	1549.91	**
Birth-season (B)	54.09	4− 1= 3	18.02	
S×M	618.73	1× 7= 7	88.39	**
S×B	566.89	1× 3= 3	188.96	**
M×B	1021.53	7× 3=21	48.64	**
R	165.24	63−42=21	7.87	
Total	13281.48	64− 1=63		

** Significant level at 1%

TABLE 27-1. Birth-Season (Z-Z)

Sex→ / Birth-season→ / Month-age↓	Male				Female				Total
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	
1	151	144	134	152	148	150	143	146	1168
2	157	162	165	168	159	161	157	158	1287
3	169	175	170	163	187	158	179	168	1369
4	174	178	167	180	177	176	185	178	1415
5	182	187	184	180	184	192	185	183	1475
6	184	189	183	186	183	182	196	185	1488
7	190	197	198	189	189	200	189	186	1538
8	184	201	199	187	189	197	201	186	1544
Total	1391	1433	1400	1405	1416	1414	1435	1390	11284

TABLE 27-2. (Z-Z)

Factor	SS	DF	Ms	
Sex (S)	10.56	2− 1= 1	10.56	
Month-age (M)	15005.75	8− 1= 7	2143.68	**
Birth-season (S)	109.00	4− 1= 3	36.33	
S×M	119.44	1× 7= 7	17.06	
S×B	141.69	1× 3= 3	47.23	
M×B	885.00	7× 3=21	42.14	
R	618.31	63−42=21	29.44	
Total	16889.75	64− 1=63		

** Significant level at 1%

DISCUSSION

Six items were considered to find the influences of the nursing-conditions, natural and social, on the development of infant hip-bones.

A. Influences of the social environment on the development of infant hip-bones

1) Influences of breadearners' occupation

The breadearners' occupations were classified into 3 groups, clerical, labour and agricultural.

The reason why the breadearners' occupation was selected is that it might to a great extent explain the income and living-mode of the homes.

As Tanaka[25] stated, the income and living-mode influence greatly the formation of the infant hip-bone. And further studies[36)~40)] have reported how the income of the home influences much the physical development of infants and children in general.

There is, however. another important problem in farm-homes in Japan. The compound house-hold[41) 42)] is basic to the japanese farm-home and all of the family must be engaged in agricultural work. Consequently, the mothers in these homes must work hard not only in agricultural work but in house-holding, and so have not enough time to nurse their babies.

Under the circumstances, it can be said that the infants of farmers are in disadvantageous conditions all the more when their mothers are engaged in

agricultural work.

On the other hand, the breadearners who are engaged in clerical occupation belong mostly to the intelligentia group and they are interested in better nursing of their babies. Besides, most of the mothers in these homes have no occupation and they have more time to nurse their babies.

And so, infants of the clerical class are in a more advantageous conditions and the development of the hip-bone was found to be better. But in parts of the acetabular roof represented by a, b, c, and $\angle\theta$, no marked difference according to breadearners' occupations could be observed. This may be considered to show that parts forming the hip-joint with the head of the Femur and the formation of the acetabular roof are more affected by other factors.

2) Utilization of the Health Center Clinic

Utilization of the Health Center Clinic explain to some extent the attitude toward reasonable nursing, and the babies whose mothers utilize such a clinic can be considered to be under more appropriate guardianship.

It is fundamentally necessary to have reasonable knowledge of nursing for the better development of infants.

Watanabe[43] has recently reported on the relation between the breadearners' occupation and utilization of the clinic and described that the Health Center Clinic is utitilized more by infants or babies of breadeaners' occupations in the tertiary industry than those of the primary. And so, it may be deducted that poor utilization of the clinic and insufficient knowledges of proper nursing are seen in farmers and their babies will be under poorer nursing-conditions

Nagano[44] reported on the physical development of infants and stated that the more mothers utilized the Health Center Clinic the better was the development of infants. And so, utilization of such a clinic will explain the parents' attitude toward nursing and their proper knowledge of nursing. Mothers who often utilize the clinic will make try to improve both methods and environments of nursing.

Thus the development of the hip-bone of infants whose mothers often utilize the clinic are better when compared with the developments of the non-utilization group. And this was revealed by the better development of hip-bone represented by T–T, S–S and H–H in infants of the utilization-group than of the non-utilization group. But no marked difference was observed in the development of the acetabulum according to the breadearners' occupation.

Hence, other special factors must be considered to explain the formation of acetabular roof.

3) Influences of location where the infants live

It has been often reported that the area where the infants live will influence the development of the infant hip-bones.

Nagura[22] reported that the frequency of dislocation of the infant hip-joint differs according to the living-location of the infants.

R. G. Record[26] also stated that "There is a marked geographical variation in incidence." Also in Japan, Ueda[24] reported that infants with abnormal find-

ings in their hip-bones were found more in cold mountainous areas, based on an epidemiological survey on dislocation of the infant hip.

Watanabe[27] also reported that infants with abnormal findings in their hip-bones were found more frequently in mountainous areas than in the planes or coast.

Le Damany[45] recognized that the frequency of dislocation of the infant hip-joint differs according to the living-location and explain it to be native or racial.

But recent reports attribute the difference in frequency to difference in climate of the location or area where the infants live.

And so, the development of the infant hip-bones is believed to be disturbed by coldness and the shortage of sun-rays in that location.

In my survey, however, two cities and three villages in the same province were examined, and so the difference due to climate can not be considered. Though no significant difference was proved, infants living in a middle sized city showed better development than in the other two areas.

The breadearners who were engaged in the secondary or tertiary industries were more numerous in a middle sized city than in a small city or farm area.

Consequently, breadearners engaged in clerical work live more in a middle sized city than in the other 2 areas, and the location of the infants as natural or geographical environment were not considered in this survey, but the social factors due to difference in occupation in these areas played the greater role.

4) Influences of the existence of grandparents and the mothers' occupation on the development of the infant hip-bones

No part of the hip-bone showed different development due to these influences, and no marked trend was observed in any part of the infant hip-bones.

The reason why the existence of grandparents was studied was that nursing is sometimes laid in thair hands when they live together, especially in cases where the mothers are engaged in some occupation and have not enough time for nursing. Grandparents often interfere in nursing-affairs in Japan[46], and nursing by them is almost always conservative, and most of them make no effort to learn modern nursing or improve nursing methods and environment. And this means less utilization of the Clinic of Health Centers.

As Nakamura[47] emphasized, the role of grandparents in nursing babies is very great in Japanese farm-homes.

But these problems are very complex and interrelated with the breadearners' occupation and utilization of the clinic.

The author is now studing the method of analysing these complex factors influencing nursing by another experimental design, based on the method of multivariate analysis[48][49] and a part of it will be reported.

B. Influences of birth-season as a natural environment

The development of the upper structure of the infant hip-joint represented by S–S and Y–Y, especially the formation of the acetabular roof of infants born in the cold season is inferior to that of infants born in the warm.

This tendency is more marked in females, but a difference by birth-season

was not observed in the development of the lower structure of hip-joint represented by H–H and Z–Z. Consequently the acetabular roof of infants born in the cold season is smaller and steeper than of infants born in the warm season.

Dislocation of the infant hip-joint can be considered to occur more easily in infants born in the cold than warm season, if a certain external force is loaded on the head of femur in the direction to dislocation.

Watanabe[27] reported that there is a custom in nursing babies to wind a small blanket round the lower extremities covering the diaper-cover in the cold provinces in Japan. As the result of this custom, there is a tendency to limit free movement and exercise of the lower extremities.

Besides, it is considered that babies born in the cold season can not move their bodies freely and have less opportunities of sun-bathing due to heavy clothing.

These babies are also considered to lack those conditions that accelerate the development of the infant hip-bone advocated by Mizuno.[21] Hence the movement and exercise of the lower extremities as freely as possible must be considered to play an important role in the formation of the acetabular roof. Namely, these could be the direct stimulus accelerating the formation of the acetabulum.

"Wuchtum-Reiz" stated by Klopfer[31] is also considered to be the stimulus forming the acetabular roof by the movement and exercise of the lower extremities concretely.

Recently Mittelmeier[50] advocated functional therapy of dislocations of the infant hip-joint. This treatment is also considered to be based on the reason that positive exercise and movement of the lower extremities would accelerate acetabular formation. Consequently, cold season or cold location would act adversely on the development of the acetabulum by limiting free movement and exercise of the lower extremities in babies.

SUMMARY AND CONCLUSION

Influences of the nursing-conditions upon the development of the infant hip-bones were investigated with X-ray photographs, sampled at random by several environmental factors.

The data were statically analysed and the results obtained were as follows.

A. Influences of the social environment on the development of the infant hip-bones

1) Breadearners' Occupation

The development of the infant hip-bones is generally better in infants whose breadearners' occupation are clerical than agricultural or labouring. Especially the developments of Y–Y and Z–Z were observed to be greater in the former at confidence levels of 1% or 5%. H–H, F–F and S–S were also observed to be greater in the former but a significant difference could not be proved statistically.

The developments of T–T, a, b, c and $\angle\theta$ showed no tendency as above.

It was concluded that the breadearners' occupation would affect the whole development of hip-bones, and that not only the upper structure but also the lower of the hip-joint would develop better in infants of parents engaged in clerical work than in those engaged in the other two.

Acetabular formation, however, dose not seem to be affected obviously by the breadearners' occupation.

2) Utilization of the Health Center Clinic

Babies whose mothers utilize the clinic of Health Centers showed better development of hip-bones, especially of T-T, S-S and H-H at a confidence levels of 5%.

The same tendency was also observed in the developments of Y-Y, Z-Z and F-F, but a significant difference could not be found statistically. Also no significant difference could be found in the development of the acetabulum represented by a, b, c and $\angle\theta$.

3) Lilving-location of the infants

No difference in the development of the infant hip-bones could be observed statistically due to this factor.

Infants, however, who lived in urbanized areas showed slightly better development of the hip-bones than those in rural areas, especially as regards the developments of T-T, S-S, Y-Y, Z-Z, H-H, F-F, but no difference could be observed in the development of the acetabulum represented by a, b, c and $\angle\theta$.

4) Existence of grandparents and mothers' occupation

No significant difference could be proved due to these factors, namely no influence on the development of hip-bones was seen whether the infants co-dwell with their grandparents or not and whether the mothers were engaged in work or not.

B. Influence of birth-season as a natural environment on the development of the infant hip-bones

The development of the lower structure of the infant hip-joint represented by H-H and Z-Z showed no difference. Namely, this part was observed to develop regularly regardless of birth-season.

As the upper structures of the infant hip-joint represented by Y-Y, S-S, a, c and $\angle\theta$ showed different development by birth-season, *i.e.* these parts in infants born in the warm season showed better growth than in infants born in the cold season, the upper structures are likely to be more unstable and easily affected than the lower structures.

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REFERENCES

1. *Kōseinoshihyō*. Tokyo, *Kōseitōkeikyōkai*, 1961.
2. USUI, J. The 17th Annual Meeting of the Japanese Society of Public Health, 1961.
3. ISHIBASHI, M. *Nihonkōshūeiseizasshi* (Japanese Journal of Public Health) 8: 205, 1961 (Japanese).
4. HOTTA, I. The 17th Annual Meeting of the Japanese Society of Public Health, 1961.

5. SAITO, K. *Shonihokenkenkyu* (The Journal of Child Health) **18**: 104, 1959 (Japanese).
6. KADOKAKE, S. *Shonihokenkenkyu* (The Journal of Child Health) **18**: 104, 1959 (Japanese).
7. TAKUMA, T. *et al. Report on the Weaning in Japan*, Tokyo: Morinaga-Hōshikai, 1958 (Japanese).
8. MIZUNO, H. The 33th Annual Meeting of the Japanese Orthopedic Surgical Society, 1960.
9. TACHINO, M. (J. Nagoya med. Ass.) **68**: 833, 1959 (Japanese).
10. MORITA, J. *ibid.* **80**: 1394, 1959 (Japanese).
11. HIBINO, S. *ibid.* **80**: 1459, 1959 (Japanese).
12. MIZUNO, T. *ibid.* 1366, 1959 (Japanese).
13. KURODA, E. *ibid.* 1342, 1959 (Japanese).
14. ISHIKAWA, M. *ibid.* 1424, 1959 (Japanese).
15. MIZUNO, H. The 3rd Annual Meeting of the Japanese School Hygiene, 1956.
16. MIZUNO, H. *et al. Nihonrinsho* **16**: 2041, 1958 (Japanese).
17. HOTTA, I. *et al.* (J. Nagoya med. Ass.) **84**, 632, 1961 (Japanese).
18. MIZUNO, H. The 4th Annual Meeting of the Japanese Society of Public Health, 1950.
19. MIZUNO, H. *Nihongakujitsushinkōkai-Gakujitsugeppō* **21**: 181, 1951.
20. MIZUNO, H. *ibid.* **32**: 233, 1953.
21. MIZUNO, H. *Shōnikarinsho* **10**: 272, 1957 (Japanese).
22. NAGURA, S. *Sentensei-Kokansetsudakkyū*, Tokyo: Nihon-Isho, 1950 (Japanese).
23. IMADA, T. *Nippon Seikeigekagakkai Zasshi* (The Journal of Japanese Orthopedic Surgical Society) **32**: 255, 1958 (Japanese).
24. UEDA, F. *ibid.* **23**: 29, 1949 (Japanese).
25. TANAKA, K. *ibid.* **34**: 297, 1960 (Japanese).
26. RECORD, R. G. AND EDWARDS, J. H. *Brit. J. Preventive Medicine* **12**: 8, 1958.
27. WATANABE, S. (J. Nagoya med. Ass.) **71**: 502, 1956.
28. IINO, S. *Tokyo Ijishinshi* **70**: 533, 1953 (Japanese).
29. AKABAYASHI, J. *Nippon Seikeigekagakkai Zasshi* (The Journal of Japanese Orthopedic Surgical Society) **32**: 9, 1958 (Japanese).
30. TSUCHIYA, K. *ibid.* **31**: 405, 1957 (Japanese).
31. KLOPFER, K. *Z. Orthop.* **79**: 1, 1949.
32. NOMURA, S. *et al.* (J. Nagoya med. Ass.) **84**: 621, 1961 (Japanese).
33. HOTTA, I. *et al.* The 16th Annual Meeting of the Japanese Society of Public Health, 1966.
34. MIYASAKA, T. *et al.* The 17th Annual Meeting of the Japanese Society of Public Health, 1961.
35. TAKAHASHI, M. *et al. Suikeigaku-Nyūmon*, Tokyo: Igaku-Shoin, 1953 (Japanese).
36. ASAKIMORI, T. *Graduation Thesis in Nihon-Hukushi Daigaku* (Japan Social Welfare College), 1962 (Japanese).
37. TAKIGUCHI, R. *Minzoku-Eisei* (Race Hygiene) **61**: 484, 1944 (Japanese).
38. HURUSE, Y. *Jido-Kenkyu* **16**: 259, 1912 (Japanese).
39. KONDŌ, S. *et al. Tohoku-Igakuzasshi* **25**: 339, 1939 (Japanese).
40. HOWARD, V. MEREDITH, A. *J. of Disease of Children* **82**: 702, 1959.
41. ŌHASHI, K. *Rōdōkagaku* **27**: 613, 1961 (Japanese).
42. NAKAMURA, K. *ibid.* **32**: 463, 1956 (Japanese).
43. WATANABE, T. *Nihonkōshūeisei-zasshi* (Japanese Journal of Public Health) **6**: 12, 1961 (Japanese).
44. NAGANO, R. The 17th Annual Meeting of the Japanese Society of Public Health, 1961.
45. LE DAMANY. *Z. Orthop.* **21**: 129, 1908.
46. KOYAMA, T. *Boshihokensōsho*, Boshieisei-Kenkyūkai, 1961 (Japanese).
47. NAKAMURA, F. The 17th Annual Meeting of the Japanese Society of Public Health, 1961.
48. GUTTMAN, L. Annals of the Japan Statistical Association, 1959.
49. HAYASHI, C. Proceedings of the Japan Statistical Association, 1959.
50. MITTELMEIER, H. *Arch. Orthop. u. Unfall-Chir.* **52**: 465, 1961.