Maternal Leisure-time Physical Activities are not Determinant Risk Factors of Low Birthweight Babies: A Cross-sectional Study of 1,714 Pregnant Women

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Abstract

There is a general recognition of the role of low birthweight (LBW) as a major determinant of infant mortality rates. Since the rate of LBW has been increasing over the past fifteen years in Japan, we decided to ascertain the risk factors related to it, and also to verify whether or not maternal leisure-time physical activities including sports activities, before pregnancy and during gestation, affected the rate of LBW babies. In our study of the 2,682 questionnaires delivered within a year to the Municipal Health Centers of the three cities chosen for this study, 1,714 questionnaires were analyzed. The results in a univariate analysis showed that maternal height, pre-pregnancy weight, length of gestation, smoking, hospitalization before the 37th week of gestation, a history of LBW, and occupational activities were significantly associated with LBW. In logistic regression analyses, mothers of smaller stature, less pre-pregnancy weight, less length of gestation and mothers who were, furthermore, hospitalized before the 37th week of gestation, smoked, had previously delivered a LBW baby or had experienced stressful events during pregnancy were more likely to have LBW babies. The results showed that maternal leisure-time physical activities before and/or during pregnancy had no bearing on the delivery of a LBW baby.

Key words: maternal leisure-time physical activities, low birthweight, risk factors, maternal history of physical activities, pregnancy.

Introduction

The causal relationship of 75% of poor perinatal outcomes to low birthweight (LBW) among infants⁽¹⁾ is still a major health problem in both developing and developed countries, largely due to the fact that LBW is a very important determinant of infant mortality⁽²⁻⁶⁾. New technological devices and up-to-date clinical approaches have been used during the antenatal period to prevent adverse pregnancy outcomes. Also, professionals involved in public health are emphasizing the need to educate mothers better about conception and pregnancy, and about complications and hazardous habits that can endanger both mothers and fetuses, as well as about how to maintain healthy habits during pregnancy.

Some studies have reported that the prevalence of LBW in developed countries such as Canada is 5 per cent⁽⁷⁾, in the U.S.A around 7 per cent⁽⁸⁾ and in Japan close to 8 per cent⁽⁹⁾; while in such Latin American countries as Argentina, Chile, Brazil,

Colombia and Cuba the prevalence is around 10 per cent⁽¹⁰⁾. Touching especially on Japan, where this study was conducted, the rate of LBW babies has been increasing over the past fifteen years as is shown in Figure 1.

Although socioeconomic factors, work-related characteristics, psychosocial stress and gestational factors have been investigated and their possible relation to the weight of newborn babies determined, the rate of LBW has failed to decrease in many countries, partly because to a large extent the causes of LBW still remain unexplained. In determining the risk factors related to LBW it is, also, possible to define better public health interventions aiming at the improvement of health conditions of mothers and fetuses, and consequently enlarging birth weight distribution⁽¹¹⁾.

Physical exercise has been recommended by the American College of Obstetricians and Gynecologists (ACOG) to healthy pregnant women without medical or obstetric complications in order to maintain and/or improve cardiorespiratory and muscular fitness, thus helping them to have better control over their bodies at a time of physiological and psychological processes of adjustment of mothers' bodies toward an optimal environment for their fetuses^(12, 13). The Melpomene Institute has encouraged

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Fig. 1 Percentage of single low birthweight in Japan, 1968 through 1997.

pregnant women to undergo regular exercise sessions especially for the psychological effects in enhancing their positive self-image¹⁴⁾. The Japanese Association of Obstetricians and Gynecologists for Maternity Safekeeping has recommended physical activities during pregnancy and plans to spread word of the benefits of such activities amongst obstetricians, gynecologists and professionals concerned with the well-being of pregnant women¹⁵⁾. The effects of physical activities during pregnancy on the birth weight of infants have been reported under different aspects, some investigators mentioning an increase in^{16, 17)}, others a reduction of^{18, 19)} and some no effect on birth weight²⁰⁻²²⁾. The main purpose of this study was to determine a possible relationship between maternal leisure-time physical activities and/or sports activities and LBW, and to evaluate whether present maternal leisure-time physical activities are inappropriate from the point of view of contributing to the pregnancy outcome, of LBW. The relationship between leisure-time physical activities and/or sport activities and pregnancy outcome requires an investigation since an increasing number of Japanese mothers-to-be have engaged in some sort of physical activity during pregnancy in the last decade²³⁾. Also, we decided to ascertain the risk factors for LBW babies searching for reasons to explain why 8 per cent of the babies in Japan are still born below a desirable weight.

Method

This study was conducted in the cities of Kariya, Hekinan and Takahama in Aichi prefecture, which is located in the central part of Japan.

In Japan all babies three or four months after birth must be brought by their mothers to the Municipal Health Center to verify their health and physical condition. For the purposes of this study, a questionnaire with a letter explaining the purpose of our study and requesting the mothers' cooperation in answering our questions, were delivered with a stamped envelope to all who

had given birth to a single live child. Multiple births were not included in this study. The questionnaire was to be filled out by the mothers and mailed to us at Chukyo University.

The questionnaires were handed out from July, 1997 to June, 1998 in Kariya and from October, 1997 to September, 1998 in Hekinan and Takahama. A total of 2,682 questionnaires were delivered to mothers or their relatives in the Health Centers of the three cities included in this research over a period of 12 months. The distribution by city was as follows: Kariya 1,576 questionnaires, Hekinan 674 and Takahama 432. Of the 2,682 questionnaires, 1,732 (64.6%) were returned to us, i.e. from Kariya 67.4 %, from Hekinan 60.1% and from Takahama 61.3%; 18 of the total had not been completed. We believed that the questionnaires returned uncompleted were those handed to non-Japanese mothers who probably could not understand it as it was written in Japanese. Therefore, 1,714 questionnaires were analyzed in this research. Postcards were sent in the last six months to all mothers who had previously received a questionnaire in order to avoid a low response rate, requesting the mothers to return their questionnaires in case that they had not yet done so. After we started mailing the supplementary postcards to the mothers, the response rate increased by about 10 per cent.

The questionnaire consisted basically of the following: mother's and baby's physical and demographic characteristics such as her height, weight and age, and the baby's height, weight, head circumference and sex; gestational factors such as length of gestation, mother's smoking and drinking habits, passive smoking, mother's occupational activities outside the home and the execution of household chores at home, mother's leisure-time physical activities and/or sports activities, mother's medical health condition and also an evaluation of mother's psychological stress; mother's prior pregnancy characteristics and habits such as her medical history and previous delivery experiences and mother's leisure-time physical activities and/or sports activities during elementary, junior high and after junior high school.

In our questionnaire we sought information about the

mother's possible stressful experiences during pregnancy including a question about maternal psychological stress. Examples are as follows: retirement, unemployment or change of the workplace of the householder; mother's employment status; involvement in work or family related problems; going through a difficult financial situation; death of a close relative; health problems within the family; and change of residence.

In a question regarding maternal sickness, we asked mothers to indicate whether they had been sick or not during pregnancy. Those who gave positive answers were asked to answer a supplementary question to determine the nature of the sickness as follows: toxemia of pregnancy, phlebitis, hypertension, edema, anemia, diabetes mellitus, severe nausea or vomiting, imminent miscarriage, imminent premature delivery, abdominal pain, abnormal fatigue, any abnormal discharge from the vagina, and others.

We also included in our questionnaire a question about medical advice while pregnant. The aim was to determine whether mothers had, during pregnancy, received any advice from doctors or midwives concerning either the quality or quantity of food intake; stopping occupational activities; stopping leisure-time physical activities; taking more rest; exercising more; and so forth.

Then, in a question bearing on the mother's leisure-time physical activities and/or sports activities before pregnancy, we asked if the mothers had experienced any kind of physical activities, other than those of physical education classes at school, more than once a week, during their school days, and after junior high school. We further asked if they had performed any leisure-time physical activities and/or sports activities during pregnancy.

Questions concerning a mother's educational level and family income were excluded from the questionnaire as they are regarded as intrusive questions by Japanese society. Taking into consideration cultural aspects and a concern for a low response rate, we decided to exclude from the questionnaire any questions that would clash with Japanese social attitudes. Since in our study we found that 99.3% of the mothers were Japanese we did not include a maternal race variable in our analysis.

We conducted our analyses using SPSS 8.0 for the WINDOWS system. First, the results were analyzed with the chi-square test for differences between prevalence rates of LBW in each variable using an univariate analysis. Then, to examine the risk factors of LBW and to evaluate the relationship of physical activities to LBW, the logistic regression analyses including all variables were performed. At first, crude odds ratios and 95 per cent confidence intervals (CI) were calculated for all cases. Furthermore, in examining whether the determinant risk factors of LBW differed between nulliparous mothers and multiparous

mothers, we calculated in a logistic regression analysis the odds ratios and 95 per cent confidence intervals for all nulliparous mothers and later, in a separate analysis, all multiparous mothers.

Results

In our sample, as shown in Table 1, women who exercised during pregnancy were similar to those who did not in terms of age, pre-pregnancy weight, height, drinking habits and experience of having a very low birthweight baby. Those exercisers who were more often nulliparous, nonsmoking, were less hospitalized before the 37th week, had less illness during gestation and had fewer previous LBW babies. Concerning leisure-time physical activities and/or sports activities during pregnancy, the rate of LBW babies was a little higher among mothers who did not exercise (7.4%) than mothers who were engaged in leisure-time physical activities and/or sport activities (5.5%), but was not statistically significant.

The risk factor determinants of low birthweight in univariate analysis are shown in Table 2. Babies who were born premature (< 37 weeks) had greater association with LBW (43%) than those delivered at term (4.8 %). There were significant trends towards an increasing risk of bearing LBW babies with the decrease of pre-pregnancy weight and among mothers of smaller stature. Mothers in our study who had previously given birth to a LBW infant; were hospitalized before the 37th week of gestation; had many illnesses during gestation; were engaged in work related activities during gestation; or who smoked during pregnancy were at a higher risk of having LBW babies. Mothers who were engaged in leisure-time physical activities and/or sport activities during elementary, junior high and after junior high school had almost the same risks of having LBW babies as mothers who were not engaged in any physical activities. Thus maternal leisure-time physical activities and/or sport activities before and during pregnancy were not significantly associated with LBW.

We also examined the data through a logistic regression analysis utilizing the same variables we had employed in Table 2. The results of this analysis, which are given in Table 3, included the odds ratios and 95 per cent confidence intervals for the significantly associated variables with LBW and for maternal leisure-time physical activities. Maternal hospitalization and smoking habits during pregnancy had highly significant associations with LBW babies. Also, maternal height, maternal pre-pregnancy weight and length of gestation were significantly associated with LBW. The risk of having LBW babies decreased as maternal pre-pregnancy weight and maternal height increased. The risk also decreased if infants were born at term. Once again, maternal leisure-time physical activities and/or sport activities

Table 1 Characteristics of the sample of Kariya, Hekinan and Takahama cases by exercise status.

	Age, year (mean $\pm$ SD)	Pre-pregnant weight, kg (mean $\pm$ SD)	Height, cm (mean $\pm$ SD)	Parity (%)			Prior LBWB (%)	Rate of LBWB (%)	Rate of VLWB (%)
				0	1	≥ 2			
Non-exercisers	29.44 $\pm$ 3.85	51.42 $\pm$ 7.44	157.31 $\pm$ 5.16	44.4	39.4	16.2	7.7	7.4	0.10
Exercisers	28.52 $\pm$ 3.58	51.18 $\pm$ 6.60	157.86 $\pm$ 5.08	61.6	31.8	6.6	3.4	5.5	0.15

	Drinking habits (%)			Smoking habits (%)		Maternal hospitalization		Maternal sickness during	
	None	Seldom drank	Sometimes	None	Yes	before the 37th week (%)	No	Yes	pregnancy (%)
Non-exercisers	47.6	31.9	20.5	88.4	11.6	86.2	26.0	74.0	
Exercisers	46.2	34.6	19.2	90.8	9.2	88.6	27.3	72.7	

1) SD denotes standard deviation; 2) LBWB denotes low birthweight babies; 3) VLWB denotes very low birthweight babies.

Table 2 Univariate analysis of the risk factors of low birthweight babies (LBWB)

Risk factor	n	LBWB (+) n (%)	LBWB (-) n	X ²
Baby's sex				
Male	846	52 (6.1)	794	NS
Female	849	63 (7.4)	786	
Maternal age (years)				
< 30	1012	73 (7.2)	939	NS
- 35	563	32 (5.7)	531	
35 ≤	96	6 (6.3)	90	
Maternal height (cm)				
< 150	78	10 (12.8)	68	P<0.01
- 155	411	34 (8.3)	377	
- 160	595	42 (7.1)	553	
- 165	471	28 (5.9)	443	
165 ≤	150	1 (0.7)	149	
Maternal pre-pregnancy weight (kg)				
< 45	248	27 (10.9)	221	P<0.01
- 50	504	38 (7.5)	466	
- 55	507	35 (6.9)	472	
55 ≤	450	15 (3.3)	435	
Length of gestation (weeks)				
< 37	86	37 (43.0)	49	P<0.01
- 38	474	50 (10.5)	424	
39 ≤	1137	28 (2.5)	1109	
Birth order				
First	874	70 (8.0)	804	NS
Second	621	35 (5.6)	586	
Third or more	213	10 (4.7)	203	
History of low birthweight baby				
Yes	59	14 (23.7)	45	P<0.01
No	893	34 (3.8)	859	
Maternal smoking during pregnancy				
Didn't smoke	1528	96 (6.3)	1432	P<0.05
Smoked	183	19 (10.4)	164	
Maternal alcohol habits				
Didn't drink	803	62 (7.7)	741	NS
Seldom drank	565	30 (5.3)	535	
Sometimes or more times	341	23 (6.7)	318	
Passive smoking				
No	595	37 (6.2)	558	NS
Yes	1115	78 (7.0)	1037	
Maternal psychological stress during pregnancy				
No	892	51 (5.7)	841	NS
Yes	806	64 (7.9)	742	
Maternal hospitalization before the 37th week of gestation				
No	1466	75 (5.1)	1391	P<0.01
Yes	215	39 (18.1)	176	
Maternal sickness during pregnancy				
No	449	25 (5.6)	424	NS
Yes	1239	89 (7.2)	1150	
Number of maternal sickness during pregnancy				
None	449	25 (5.6)	424	P<0.01
1	545	31 (5.7)	514	
2	361	23 (6.4)	338	
3	181	14 (7.7)	167	
4 or more	150	21 (14.0)	129	
Medical advice during pregnancy				
No	286	22 (7.7)	264	NS
Yes	1409	93 (6.6)	1316	
Number of medical advice during pregnancy				
None	285	22 (7.7)	263	NS
1	577	30 (5.2)	547	
2	439	26 (5.9)	413	
3	259	26 (10.0)	233	
4 or more	135	11 (8.1)	124	
Maternal occupational activity during pregnancy				
No	897	41 (4.6)	856	P<0.01
Yes	811	74 (9.1)	737	
Maternal activity at home (household chores)				
Did all of them	837	49 (5.9)	788	NS
Did almost all of them	688	51 (7.4)	637	
Did half or less of them	183	15 (8.2)	168	
Maternal leisure-time physical activity during pregnancy				
Non-exercised	1034	77 (7.4)	957	NS
Exercised	670	37 (5.5)	633	
Physical activity during elementary school				
Non-exercised	902	62 (6.9)	840	NS
Exercised	760	48 (6.3)	712	
Physical activity during junior high school				
Non-exercised	465	29 (6.2)	436	NS
Exercised	1234	85 (6.9)	1149	
Physical activity after junior high school				
Non-exercised	732	41 (5.6)	691	NS
Exercised	950	71 (7.5)	879	

1) NS denotes not significant; 2) n denotes number of cases; 3) Missing cases were not included in the analysis.

Table 3 Logistic regression analysis of the risk factors of LBW babies among all subjects.

Variable	Category	Odds Ratio	95% Confidence Interval
Maternal height (cm)	< 150	1.00	
	~ 155	0.51	0.21-1.23
	~ 160	0.56	0.23-1.33
	~ 165	0.50	0.19-1.26
	165 ≤	0.05	0.00-0.43
Maternal pre-pregnancy weight (kg)	< 45	1.00	
	~ 50	0.92	0.47-1.76
	~ 55	0.77	0.38-1.55
	55 ≤	0.33	0.14-0.79
Length of gestation (weeks)	< 37	1.00	
	~ 38	0.15	0.07-0.28
	39 ≤	0.03	0.01-0.07
Maternal hospitalization before the 37th week of gestation	No	1.00	
	Yes	2.47	1.36-4.48
Maternal smoking	Didn't smoke	1.00	
	Smoked	2.42	1.24-4.70
Maternal leisure-time physical activity during pregnancy	Non-exercised	1.00	
	Exercised	1.05	0.64-1.73
Physical activity during elementary school	Non-exercised	1.00	
	Exercised	0.71	0.42-1.16
Physical activity during junior high school	Non-exercised	1.00	
	Exercised	1.02	0.60-1.78
Physical activity after junior high school	Non-exercised	1.00	
	Exercised	1.38	0.83-2.29

during pregnancy were not associated with LBW babies. Also, we could not find any relationship between fit women during their school years and LBW. Maternal occupational activity, was no longer a determinant of LBW in this analysis.

In Table 4 we can see the results of a logistic regression analysis for the determinant risk factors of LBW among nulliparous mothers. Mothers who were hospitalized before the 37th week of gestation were at a higher risk of delivering LBW babies. Mothers who weighed ≥ 55 kg and were ≥ 165 cm, also, babies who were born at term, were significantly less associated with LBW. Maternal leisure-time physical activities and/or sport activities during school years and during pregnancy were not significantly associated with LBW babies.

Table 5 shows the determinant risk factors of LBW among multiparous mothers in a logistic regression analysis. Mothers who had had a previous LBW delivery were at a greater risk of having another LBW baby. Also, there was a strong relationship between smoking during pregnancy and delivering LBW babies. Babies born at term were significantly less associated with LBW. For the first time in this analysis mothers who experienced stressful situations during gestation were more likely to have LBW babies. In this analysis, maternal leisure-time physical activities and/or sports activities during school years and during pregnancy were not significantly associated with LBW babies.

Excluding the selection bias, we analyzed mothers who had had no medical history or obstetrical history of LBW and/or preterm delivery before the present pregnancy. We found that

healthy mothers who exercised during pregnancy showed no incidence of delivering a LBW baby, to a statistically significant degree ($P < 0.01$).

Discussion

Some limitations may have affected the results of the present study. Firstly, according to the Japanese government statistics²⁴⁾, the rate of LBW in the cities wherein we conducted our study was almost 3 % higher than we found. We assumed that some cases with severe complications postpartum were not submitted to the medical check when we handed out our questionnaire because they were still hospitalized or under close observation by the hospital. So, our sample was less likely to have included very low birthweight cases (< 1500 g). The official vital statistics reveal that 0.5 % of the babies were born with a very low birthweight whereas our survey accounted for just 0.1 % of them²⁵⁾. Secondly, the response rate of 65 to 70 % was rather low. It was probable that mothers subject to any risk factor had a lower response rate than those free of such factors. Finally, the survey was conducted after delivery, i.e. retrospectively. Although mothers usually clearly well recall their pregnancy experiences, it was inevitable that some misclassifications would arise.

In this retrospective study, maternal leisure-time physical activities prior to or during pregnancy did not seem to demonstrate negative effects on fetal growth, LBW^{13, 26, 27)}. The risk of having LBW babies fell among mothers of taller stature^{28,}

Table 4 Logistic regression analysis of the risk factors of LBW babies among nulliparous mothers.

Variable	Category	Odds Ratio	95% Confidence Interval
Maternal height (cm)	< 150	1.00	
	~ 155	0.50	0.15-1.57
	~ 160	0.28	0.08-0.92
	~ 165	0.52	0.15-1.78
	165 ≤	0.05	0.00-0.60
Maternal pre-pregnancy weight (kg)	< 45	1.00	
	~ 50	0.90	0.37-2.14
	~ 55	0.75	0.29-1.88
	55 ≤	0.12	0.02-0.50
Length of gestation (weeks)	< 37	1.00	
	~ 38	0.09	0.03-0.24
	39 ≤	0.03	0.01-0.08
Maternal hospitalization before the 37th week of gestation	No	1.00	
	Yes	3.57	1.62-7.84
Maternal leisure-time physical activity during pregnancy	Non-exercised	1.00	
	Exercised	1.16	0.59-2.23
Physical activity during elementary school	Non-exercised	1.00	
	Exercised	0.77	0.38-1.52
Physical activity during junior high school	Non-exercised	1.00	
	Exercised	0.92	0.42-1.96
Physical activity after junior high school	Non-exercised	1.00	
	Exercised	0.98	0.49-1.93

Table 5 Logistic regression analysis of the risk factors of LBW babies among multiparous mothers.

Variable	Category	Odds Ratio	95% Confidence Interval
Length of gestation (weeks)	< 37	1.00	
	~ 38	0.20	0.06-0.63
	39 ≤	0.02	0.00-0.09
History of low birthweight baby	No	1.0	
	Yes	17.34	5.30-56.81
Maternal smoking	Didn't smoke	1.00	
	Smoked	6.35	2.04-19.76
Maternal psychological stress during pregnancy	No	1.00	
	Yes	3.12	1.16-8.33
Maternal leisure-time physical activity during pregnancy	Non-exercised	1.00	
	Exercised	0.56	0.18-1.69
Physical activity during elementary school	Non-exercised	1.00	
	Exercised	0.49	0.18-1.32
Physical activity during junior high school	Non-exercised	1.00	
	Exercised	1.00	0.35-2.87
Physical activity after junior high school	Non-exercised	1.00	
	Exercised	1.92	0.73-4.97

²⁹⁾ and higher pre-pregnancy weight ^{8, 17, 29)} and, also, if the infant was born at term ¹⁷⁾. However the risk increased among preterm delivery ²⁹⁾, mothers who smoked during pregnancy ^{8, 17, 28, 29, 30-34)}, were hospitalized before the 37th week of gestation, had previously delivered a LBW baby ^{8, 17)} or had experienced stressful events during gestation ^{35, 36)}. No relationship with LBW was found in the matters of infant sex and maternal age ²⁸⁾. Maternal occupational activity was significant in univariate analysis, but the relationship was not significant after the adjustment of other factors ¹⁷⁾.

This study demonstrated that LBW babies in Japan have a higher tendency towards preterm delivery. It serves to confirm the results of Kramer ²⁹⁾ when he reported that it appears that in developed countries most LBW babies may be attributed to premature delivery rather than intrauterine growth retardation.

Psychological stress bore a significant relationship to LBW among multiparous mothers in this study after controlling the variables in a logistic regression analysis. In an interesting investigation of work-related psychosocial stress conducted by Homer et al ³⁵⁾, it was found that mothers who had experienced stressful events at the workplace due to a lack of control over undesirable situations delivered lighter babies. In the Newton and Hunt study ³⁶⁾ the effect of stressful events was directly related to birth weight, that is the more stressful the events mothers had experienced during gestation, the lower the birth weight was likely to be. However, in a study conducted by Brooke et al ²⁸⁾, psychosocial stress appeared to have little relation to birth weight and this effect became insignificant after controlling for smoking. In our study, psychological stress and smoking habits were closely related to LBW among multiparous mothers.

Smoking has been indicated as having a detrimental effect on birthweight for years. In our study the percentage of mothers who smoked during pregnancy (10.7%) was markedly low when compared to other countries (30); however, the rate of LBW amongst mothers who smoke is higher than amongst non-smokers (10.4% vs. 6.3%). Smoking during gestation has a dose-response effect ^{28, 31)}. However, Wilcox et al ³²⁾ in their studies on the effect of social deprivation on birthweight in the United Kingdom, concluded that there was a reduction in birthweight associated with an increase in the number of cigarettes smoked per day, though the relationship was not linear. They expressed the importance of advising mothers not just to reduce but to stop smoking during pregnancy. According to a study conducted by Oakley in England ³³⁾, the cessation of smoking is a very relevant matter of concern, though it is important to find a suitable social and medical intervention programme readily acceptable to mothers who smoke. It is advisable that the nature of the intervention be informative, giving practical guidance and behavioral strategies to the mothers, rather than creating maternal stress through arousing feelings of guilt because they had failed to stop smoking. In Sweden ³⁴⁾, research was conducted to investigate whether smoking-prevention programmes were effective in decreasing the number of cases of fetal growth retardation in the period from 1983 to 1992. They determined that smoking-prevention programmes played a meaningful part in reducing the rate of low birthweight babies.

We particularly agree that smoking intervention programmes during pregnancy are extremely important in the short-term prevention of LBW infants in that they give better information to mothers-to-be about the effects of smoking on birth weight. Attention should be given to mothers in their 20's and 30's, since

the rate of smoking among Japanese women in these age groups has been increasing in the last 30 years ³⁷⁾ and the majority of births are from mothers in this age range ³⁸⁾.

In this study passive smoking was not significantly related to LBW babies, in accordance with the findings of Brooke et al ²⁸⁾. Inhalation of environmental tobacco smoke had no substantial effect on LBW, but, time and quantity of exposure to smoke should be better investigated to determine whether passive smoking is related or not to an increased risk of having LBW babies.

In our findings maternal occupational activities were significantly associated with LBW babies in univariate analysis, but proved no longer significant in the following logistic regression analyses ¹⁷⁾. In a study of maternal working conducted by Naeye and Peters ³⁹⁾, mothers working during the last trimester of pregnancy had delivered lower birth weight babies than mothers who did not work outside the home. However, it seems that not just maternal work affects uterine growth; for it is indicated in Naeye and Peter's study that mothers who were hypertensive, were underweight pregravid, and/or had children at home to care for after work had more risk of delivering a growth retarded infant. Regarding maternal activities at home, mothers who did all the household chores were at less risk of having LBW babies than mothers who did half of them or less (5.9% vs. 8.2%), although it was not significantly associated to LBW babies. Probably some mothers who could not do all of their household chores had not been in the best of health during pregnancy.

Maternal physical activities have been investigated in many studies. According to our investigation maternal leisure-time physical activities prior to and/or during pregnancy were not associated with the risk of delivering a LBW baby, either in a univariate analysis or after adjustment for other variables. In research conducted by Collings and Curet it was reported that aerobic exercise performed at 65 to 70% of maximum maternal heart rate capacity during pregnancy showed neither a beneficial nor detrimental effect on fetal growth ²⁰⁾. It is worth to mentioning here, a study conducted by Hatch et al ¹⁷⁾ wherein infants of fit mothers who exercised during pregnancy had mean birth weights higher than those of mothers in a non-exercising group. The authors hypothesized that maternal physical conditioning might be important in avoiding an adverse outcome of pregnancy, since in their study mothers who were sedentary in early pregnancy but engaged in a heavy exercise programme in the 3rd trimester were associated with a reduction of 220g in birth weight. Also they stated that mean birth weight increased with gestational age, maternal pre-pregnant weight, pregnancy weight gain, and parity, but decreased with a history of low birth weight infants and with maternal smoking. However, in a study by Clapp and Dickstein, opposite findings were observed when mothers who continued endurance exercise, limited to running, aerobic dance and cross-country skiing, into the 3rd trimester of gestation delivered infants 500g less than those mothers who stopped exercising prior to the 28th week ¹⁸⁾. Lokey et al ⁴⁰⁾ conducted a meta-analysis on the effects of physical exercise on pregnancy outcome. In their overall results they suggested that pregnant woman can exercise at a moderate level without it being harmful for the mother and fetus. In Lokey's study was expressed the idea of Lotgering et al, when they put it that exercise per se cannot be denominated as a cause in variation of outcome in pregnancy. Factors such as socioeconomic, environmental,

nutritional and genetic must be included and analyzed in a well-controlled epidemiological study. Also Mittelmarm et al.⁴¹⁾ emphasized the difficulties of investigating maternal exercise effects on pregnancy outcome due a lack of uniformity both in the level of fitness and in objective quantification of the different exercises routines of the subjects enrolled in the studies; lack of appropriate analysis; lack of randomization and few control groups to compare with active groups. Our present investigation is an observational study and for this reason lacks uniformity on the level of physical activities and randomization; however we could control the main confounding factors in the analysis.

In conclusion, leisure-time physical activities of the study population have no effect on LBW. The important risk factors for LBW are short stature, a lower pre-pregnancy weight, short length of gestation, maternal hospitalization before the 37th week of gestation, history of LBW and maternal smoking. Professionals involved with pregnant women should be aware that nulliparous mothers who were hospitalized before the 37th week of gestation (odds ratio 3.57, CI 1.62-7.84), as well as, multiparous mothers with a history of LBW babies (odds ratio 17.34, CI 5.30-56.81)

were at a greater risk of delivering a LBW baby. In these cases, mothers should be considered as liable to high risk pregnancies and their health condition must be monitored with increased alertness by the responsible professionals⁴²⁾. In addition, it is extremely important that mothers be advised of their delicate health condition.

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