Child Height and Food Consumption in Japan in the Past Century in Comparison with South Korea: Animal Proteins and Other Essential Nutrients

Dr. Sanghyo Kim[1] and Hiroshi Mori[2]

[1] Senshu University, Tokyo

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Abstract

Japan?s economy made remarkably fast progress since the mid-1950s when it recovered to its pre-war level. Accordingly, children grew appreciably taller, as the food supply and consumption (animal protein intakes for example) increased not only in quantity but also in quality. In particular, Japanese children grew sizably in height, also in pre-war years when the supply of animal proteins was virtually zero. They ceased to grow any taller in the early 1990s, when per capita consumption of animal products, milk in particular, was still increasing at high levels. Trivial question on whether the increase in animal protein intakes contributed to body height growth in Japan is naturally raised. When examining child height development throughout the past century Japan, total food calories and other essential nutrients such as vegetables and fruit should be taken into consideration. Comparison with South Korea seems to fortify this presumption.

Index terms— animal protein, children, essential nutrients, height, Japan, South Korea.

1 Introduction

apan's economy recovered to its pre-war level in the mid-1950s and made rapid and steady progress toward the end of the century. Accordingly, food consumption increased in quantity and quality, as well. Consumption of animal-sourced foods, in particular, expanded more than ten folds from the 1920s to the 1990s, e.g., per capita intake of meat +eggs was 238 kcal/day in the 1990s, compared to 13.7 kcal/day in the 1920s; per capita milk intake increased from 1.8 kcal to 139 kcal over the same period.

Children grew appreciably in height since the beginning of the century. School boys in the 6th grade in primary school, for example, grew in mean height from 129 cm in the early 1910s to 147 cm in the late 1990s, and boys in the 1st grade grew from 105.5 cm to 116 cm over the corresponding period. As far as school children are observed, they grew appreciably in height also in the pre-war years, when the net supply of animal proteins was nearly zero. On the other hand, they ceased to grow any taller in mean height in the late-1980s through the early-1990s, when per capita consumption of animal-sourced products was still gradually increasing at high levels. There exists a trivial question on whether the increase in animal protein intakes contributed to the body height development, but it may not be all for explaining changes in human height (Blum, 2013).

2 II. Growth in School Children in the

Pre-war and the Post-war Periods

Children in Japan grew in height steadily in the pre-war years. Boys in the primary-1 st grade, six years old, were 106.6 cm (in mean height) in 1907-09, and they grew to 129.2 cm in their 6 th grade 1 After the end of WW II, August 1945, Japanese children began to grow remarkably fast and steadily toward the end of the century. Boys in the 1 st grade were 108.4 cm in 1948-50 in 1912-14, by 22.6 cm. Boys in the 1 st grade were 108.7 cm in

1932-34 and grew to 132.9 in their 6 th grade in 1937-39, by 24.2 cm. With the birth cohorts explicitly considered, boys grew by (108.7-106.6) + (24.2-22.6) = 3.7 cm during 30 years from 1907-09 to 1937-39. Likewise, girls in the primary-1 st grade were 105.5 cm in 1907-09, and they grew to 128.8 cm in their 6 th grade in 1912-14, by 23.3 cm. Girls in the 1 st grade in 1932-34 were 107.5 cm, and they grew to 132.9 cm in their 6 th grade in 1937-39, by 25.4cm. In pre-war years, girls grew by (107.5-105.5) + ??25.4-23.3) =4.1 cm from 1907-09 to 1937-39.

2 1 A century ago, the rate of enrollment in middle school was quite low, regardless of sex. Those who entered middle school after graduating from primary school accounted for 12.3% in 1910 and 15.8% in 1930. Even after the end of the war, particularly girls' enrollment in high school, ages 12-17, was 38.0%, lower than 55.0% for boys in 1955, probably not high enough to represent the entire nation (Japan's Education, 1962). 2 Those primary school children in the 1 st grade in 1948-50 were born in 1942-44 and spent their "first years of life" in the severe war years ??Cole, 2003;Deaton, 2007;Prentice, 2013). Per capita caloric supply soon after the war is estimated at 1,449, 1,695, and 1,851 kcal/day respectively in 1946, 47, and 48 fiscal years (starting April). The corresponding figures for the nearest pre-war years, 1937, 38, and 39, were 2,115, 2,135, and 2.075 kcal/day, respectively (Kayo, 1977).

, and they grew to 133.5 cm in their 6 th grade in 1953-55, by 25.1 cm. Boys kept growing fast until the end of the 1990s. Boys in the 1st grade were 116.8 cm in 1993-95, and they grew to 145.3 cm in their 6 th grade in 1998-2000, by 28.5 cm. During the half century after the war, boys in primary school grew by (116.8-108.4)+(28.5-25.1)= 11.8 cm. Likewise, girls J grew to 134.3 cm in their 6 th grade in 1953-55, by 26.7 cm. Girls kept growing as fast as boys until the same peak period of the early 2000s. Girls in the 1 st grade were 116.0 cm in 1993-95, and they grew to 147.1 cm in their 6 th grade in 1998-2000, by 31.1 cm. During the halfcentury of the post-war period, Japanese girls in primary school grew by (116.0-107.6) + (31.1-26.7) = 12.8 cm.

In the pre-war years, students enrolled in middle schools should have been slightly, say 1 or 2 cm, taller in mean height than national averages for respective ages. With this reservation kept in mind, we will have a quick look at child growth from primary school 6 th grade to middle school 5 th grade. Boys in the primary-6 th grade, 11 years old, in 1907-09 were in mean height 128.5 cm, and they grew to 157.7 cm in their 5 th grade in middle school in 1912-14, by 29.2 cm. Boys in the 6 th grade in 1932-34 were 131.9 cm and they grew to 160.5 cm in their 5 th grade in middle school in 1937-39, by 28.6 cm. Boys grew by (131.9-128.5) + (28.6-29.2) = 2.8 cm during 30 years from 1907-09 to 1937-39.

In the post-war years, boys in the primary-6 th grade were 130.7 cm in 1948-50, and they grew to their 5 th grade in middle school in 1953-55, by 30.6 cm. Again, boys in the primary 6 th grade in 1993-95 were 144.8 cm, and they grew to their 5 th grade in middle school by 25.4 cm. After the end of the war, boys grew by (144.8-130.7) + (25.4-30.6) = 8.9 cm during the half-century. Refer to Tables 1 and 2, for more details in height development of school children in the past century (School Health Surveys). III. Changes in the Food Supply in the Past Century

"Stature is a net measure that captures the supply of inputs to health" (Steckel, 1995). About child height development, "inputs to health" should comprise mainly food consumption [=supply] and hygienic environments. In the early stages of economic development, worldwide, rates of infant mortality are found highly correlated negatively to child height growth (Rona, 2000; ??eidpath, 2004). It was only after the end of the 1950s in Japan that the infant mortality began to decline appreciably: i.e., the rate was a little over 60 out of 1,000 new births at the end of the 1940s and then dropped sharply below 25 in 1959 and further down below 10 in the end of the 1980s (Figure ??) (Japanese Government, Ministry of Health and Welfare, and Minister's Secretariat, 2000). These drops in infant mortality may have contributed to the positive height development of Japanese children in the post-war period, though to what extent and through what mechanism remains to be explained by future investigations.

Source: Japanese Government, Ministry of Health and Welfare, and Minister's Secretariat ??2000) Figure ??: Changes in infant mortality, 1900 to 2000 in Japan (number of deaths out of 1,000 births) Except for the decade long severe food shortage related to WW II, food supply in Japan increased steadily in the past century. Table 3 Food supply increased dramatically in both quantity and quality after the end of the war. Per capita food supply recovered to the pre-war level in 1957, when per capita caloric supply from all foods was 2,242 kcal/day, while that from animal products, meat + eggs, milk, and fish, was far larger than the pre-war years: 40.9, 25.7, and 86.6 kcal, respectively in 1957. Caloric supply from all foods further increased gradually, while animal products kept increasing rapidly to unprecedented levels: Per capita caloric supply from meat + eggs, for example, increased to nearly 200 kcal/day at the end of 1970s, more than 2.5 times higher than in the early-1960, and 6 times fold than in the mid-1930s. Increases in milk supply were more dramatic: per capita supply of milk in the turn of the 1970s was 100 kcal/day, as compared to 2.6 kcal/day in the mid-1930s (Kayo; ??AFF, 1976). Increases in the supply of animalsourced products slowed down in speed since then but per capita caloric supply from meat + eggs, milk and fish was 237.8, 162.2 and 139.8 kcal/day, respectively, at the end of 1990s (MAFF, Food Balance Sheets). 3 When mean height of boys in the primary 6th grade regressed against per capita supply of total foods and animal sourced foods (meat + eggs, milk, and fish) from 1913 to 2012: $\ln(Hp6) = 4.269 + 0.060 \ln(\text{total foods}) + 0.037 \ln(\text{animal foods})$ Adj $R^2 = 0.962$??20.2) where numbers in parentheses are t-statistics.

(2.09) ??11.78) Rapid and steady increases in animal-sourced proteins contributed to considerable growth in child height. There exists a little question about this 3 (Baten and Blum, 2014; ??eady, Hirvonen and Hoddinott, 2018).

When height growth overtime examined visually, however, straight linearity between animal protein supply and child height may require careful reservations. First, the Japanese did not consume a meaningful amount of animal-sourced foods before the war, but children had grown steadily in height. Japanese children ceased to grow in height in and around 1990, whereas the per capita supply of animal products still kept increasing considerably. Particularly, the per capita caloric supply of milk increased from 117.3 kcal/day in 1987 to 149.8 in 1992 and 162.4 kcal in 2002, respectively (Table 3). 6), 30-40% more fruit and nearly twice more vegetables (excluding potatoes) than Japanese (Table 5). On the assumption that the Japanese and the Koreans are very close in ethnical endowments in body height ??Kim, 1982), the widened differences in mean height of teens between the two nations could be attributed to differences in "inputs to health" (Steckel, 1995) observed in the recent years.

Japanese, consuming appreciably fewer total food calories with substantially less fruit and half as much vegetables than South Koreans, could be biologically shorter in height than South Koreans. One should be reminded of the statistical fact that the newer generations in Japan have increasingly steered away from fruit and vegetables since the mid-1970s (Tables 7-8), whereas their Korean peers have been consuming almost as much fruit and vegetables as the older generations (FIES; MAFF, White Paper, 1995; Park, 2018). Note: the same as Table 7.

Source: the same as Table 7.

V.

3 Conclusions

Humans do not grow appreciably taller after their mid-teens, boys at 16-17 and girls at 14-15, should they eat greater amounts of animal proteins afterword. In the society, where distinct age/cohort effects are present in food consumption, per capita consumption by age groups, in place of nation's simple per capita consumption, may require due attention to identify underlining food contributions for child growth in height over the perod or between populations (Mori, Inaba, and Dyck, 2016; Mori and Inaba, 1997;Tanaka et al., 2004;Mori, 2020).

1

Unit: centimeters

Figure 1: Table 1 :

2

Unit: centimeters

[Note: Note: p-1 and p-6 represent primary school 1st and 6th grades and m-5 middle school 5th grade. Source: Ministry of Education, School Health Surveys. Note: p-1 and p-6 represent primary school 1st and 6th grades and m-5 middle school 5th grade. Source: Ministry of Education, School Health Surveys.]

Figure 2: Table 2 :

3

		Unit: kcal/day			
Total rie	Calo-	From Meat and Egg	From Milk	From Fish	From Animal Products

Figure 3: Table 3 :

4

			Unit: centimeter				
			Japanese boys				
grades	1980	1985	1990	1995	2000	2005	2010
1st	167.0	167.5	167.9	168.4	168.6	168.4	168.3
3rd	169.6	170.2	170.5	170.9	170.9	170.8	170.7
			Korean boys				
grades	1980	1985	1990	1995	2000	2005	2010
1st	164.4	165.5	166.3	168.3	170.5	171.6	171.8
3rd	168.4	169.4	169.7	171.0	172.9	173.7	173.7
Source: Ministry of Education, School Health Surveys, various issues							

IV. Total Calories and Essential Nutrients other than Animal Proteins in Increasing Body Height

Figure 4: Table 4 :

5

Figure 5: Table 5 :

6

Unit: kcal/day

[Note: Note: numbers in this table depicts 3-year moving averages for each year, for example, the value for 1913 is average of 1912 through 1914. Source: FAOSTAT, Food Balance Sheet; MAFF for Japan and KREI for Korea]

Figure 6: Table 6 :

7

Unit: kg/year

Figure 7: Table 7 :

8

age/year	1971	1980	1985-86	1990	1995-96	2000	2010
0~9 yr	36.3	26.5	15.2	8.9	4.7	2.3	2.4
10~19	45.6	30.5	20.1	14.9	9.4	5.7	4.4
20~29	48.3	31.5	23.4	16.8	15.1	11.8	9.8
30~39	46.1	43.8	36.6	30.4	23.6	21.8	14.8
40~49	51.0	52.6	48.5	44.9	37.2	33.4	20.5
59~59	54.4	59.9	56.6	54.0	50.5	48.5	32.1
60~69	44.5	58.5	61.1	62.0	58.7	60.7	53.3
70~41.2		54.2	59.6	60.3	62.1	65.8	58.8
Average	45.6	41.6	36.4	33.8	31.5	31.1	27.7

Figure 8: Table 8 :

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.2 Conflict of Interest

The authors declare no conflict of interest.

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