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# Have Japanese and South Koreans Depleted The Reserve Gene Potentials For Body Height?

**Hiroshi Mori***

*Professor Emeritus, Senshu University, Tokyo, Japan.*

***Correspondence:**
Hiroshi Mori, Professor Emeritus, Senshu University, Tokyo, Japan.

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## ABSTRACT

*As food consumption increased in quality and quantity after WWII, children in Japan and South Korea grew in height at unprecedented speed, with South Korea some two decades behind Japan due to the Korean War (1950-53). Children in the younger ages ceased to grow taller in Japan shortly before the economy plunged into stagnation in the early-1990s. Children in South Korea kept increasing in height to catch-up with Japanese peers in the mid-1990s and overtook them by 3-5 cm in height in the mid-2000s and then plateaued in the expanding economy toward the end of the 2010s. Have Japanese and Koreans depleted respective gene potentials in height? Children in Japan started to turn away from fruit in the late-1970s and ate far less than one-tenth the volume eaten by older adults in their 50s-60s in 2010. Children in South Korea started to steer away from vegetables in the early-1990s and ate less than one-tenth the volume eaten by older adults in their 50s-60s in the end of the 2010s. Unhealthy diets, with so little fruit/vegetables, likely caused plateauing of children's height in both Japan and South Korea. It is premature to assume that genetic potential for adult height has been reached.*

## Keywords

Height, Children, Growth-patterns, Japan, South Korea, Fruit/Vegetables.

## Introduction

Japan' economy recovered in the 10 years after WWII to its pre-war level and made fast and steady progress toward the end of the century. Its population and the young in particular, leaned to eat animal products, meat, milk and eggs, in their everyday diet. Accordingly, children started to grow appreciably in height and at unprecedent speed of 2.5 cm per decade. They ceased to grow taller in the early 1990s. In comparison, South Korea was two decades behind Japan in economic development due to the Korean War (1950-53) but children grew in height faster than Japanese peers to catch-up with them in the early 1990s and overtook their Japanese peers at all ages by 3-5 cm in the mid-2000s and have plateaued since then.

At the beginning of the 1990s, the "bubble" burst in the economy of Japan and was followed by a decade long stagnation. People familiar with Japan's economy attribute the failure in children' growth in height to "the lost 10-20 years". Was this related to diet? In respect of per capita supply (=consumption) of animal products, however, Japan was 618 kcal/day in 1990[*1], nearly twice as large in South Korea and 578 kcal/day in 2005, more than 20% larger than in South Korea (Table 1a,b), at a time when Korean children were appreciably taller than Japanese peers at all ages. In fact, teens in 1990, for example, were born in the mid-1970s and thus grew up with an increasing supply of animal products in an expanding economy in Japan. The food supply in 1991, when the bubble burst, has nothing to do with the mean height of teens in the same year. The Korean economy kept expanding vigorously and the supply of animal products increased a further 30% from 2010 to 2020. The height of teens in Korea has plateaued in the mid-2000s (Table 1; Figure 2).

**Table 1a:** Secular changes in per capita caloric supply from animal products in Japan and S. Korea.

| | 1985~2017 | | | | | | (Kcal/day) | |
|---|---|---|---|---|---|---|---|---|
| | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2017 |
| Japan | 463 | 508 | 546 | 541 | 528 | 503 | 508 | 522 |
| S. Korea | 260 | 335 | 399 | 428 | 446 | 475 | 512 | 530 |

Sources: Food Balan Sheets: Respecctive countries.
Notes: 3 year moving averages.

**Table 1b:** Per capita protein supply.

| from animal products | | (gr/day) |
|---|---|---|
| Fiscal Yr | Jp,gr/day | Kr,gr/day |
| 1965 | 28.6 | 6.9 |
| 1970 | 36.3 | 8.6 |
| 1975 | 41.6 | 14.6 |
| 1980 | 46.9 | 18.5 |
| 1985 | 50.9 | 23.0 |
| 1990 | 55.2 | 26.6 |
| 1995 | 56.1 | 33.8 |
| 2000 | 55.0 | 36.8 |
| 2005 | 51.3 | 39.0 |
| 2010 | 48.6 | 44.0 |

Sources: FAOSTAT, Food Balance Sheeets, Old methodologies.

A noted biological historian strongly concludes that both Japanese and Koreans have depleted their reserve gene potential for height in the mid-1990s and the mid-2000s, respectively [1].

Shohei Otani, the 2021 MVP in the US Baseball League, is 193 cm in height, exceptionally tall as a native Japanese. His father is 182 cm and mother 170 cm, respectively, 15 cm taller than their contemporaries. His elder brother is 183 cm and elder sister is 168 cm, respectively. No one denies the importance of genetics in determining adults' height. The author was 165 cm, when young. His two sons are 175 cm and one grand- son is 181 cm tall. "Inputs to health", healthy diets, at the right time, should also play an important role in determining one's height.

Figure 1 displays that Norwegian young adults were 2-3 cm taller than their Dutch counterparts for 100 years up to the 1960s but this was reversed after the 1960s (birth years). Genetics/ethnicity cannot explain this. Inputs to health must have played an important role.

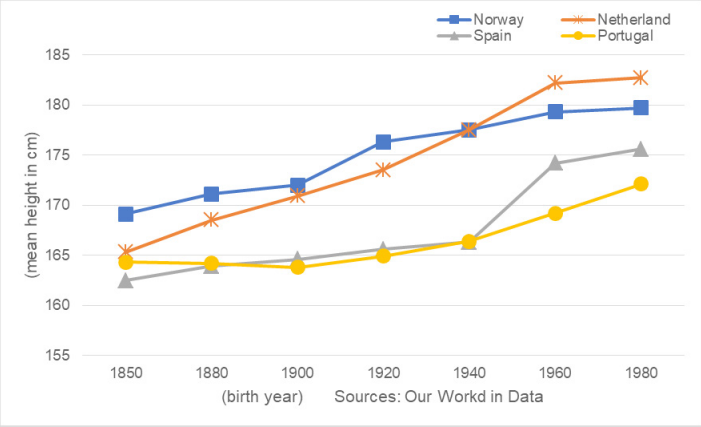


**Figure 1:** Secular changes in young men's mean height in selected countries in Europe, by birth yaers, 1850 to 1980.

## Data

Japanese government, Ministry of Health and Welfare initiated nationwide nutrition survey in 1946 at the order of the occupation forces and added heath items, such as stature and blood pressure, eyesight etc. in next year and started to classify food consumption by age groups of survey subjects in 1996. Republic Korea, Center for Disease Control and Prevention, initiated comprehensive nationwide *Health and Nutrition Examination Survey* in 1998, followed by the second survey in 2001, and the third one in 2005.

Japanese government has been conducting large scale nationwide school health surveys since 1900 and the survey results, such as stature, eyesight, decayed teeth, are published in *National School Health Statistical Surveys* every year. In human biology, the importance of "early years of life", the first 1,000 days, including pregnancy is emphasized [2-4]. Cole and Mori, based on the analyses of children's height in Japan and South Korea in the past 50 years, state "most of the height increment seen in adults had already accrued by age of 1.5 years" [5]. *School Surveys* cover the ages of 6 (1st grade of primary school) to 17 (3rd grade of high school) and hence the first years of life, 0 to 5 years of age are not covered. *National School Health Surveys* have been conducted by Department of Education in South Korea exactly in the same format as in Japan, in the first month of school year, March in S. Korea and April in Japan.

As published mean height by school grades fluctuates from year to year, 3 year moving averages are employed throughout this analysis: $H_{1980}$ = average ($H_{1979}$:$H_{1981}$).

The author intends to explain secular changes in children's height in relation to "the supply of inputs to health", mostly food consumption. The United Nations, FAOSTAT, food balance sheets, provide per capita supply consumption of various food products, by major categories, such as animal products and vegetal products and specific products such as meat, milk and vegetables in terms of kg/year and kcal/day by counties from 1961 to 2018. This paper is to cover the period from 1965 to 2017.

## Secular Changes in Children's Mean Height by Age in Japan and South Korea

Figure 2 depicts secular trends of children's height, 6 years of age, 1st grade of primary school and 17 years of age, 3rd grade of high school in cm, respectively, in Japan and South Korea from 1965 to 2017.

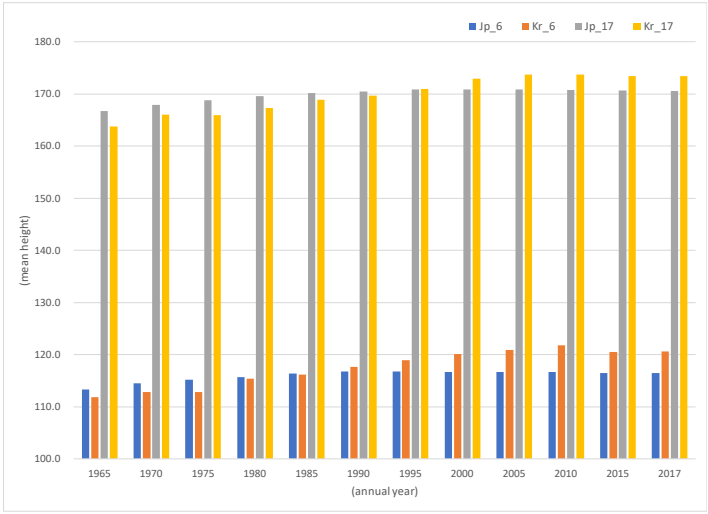


**Figure 2:** Secular trends of mean height of school boys at 6 and 17, Japan and South Korea, 1965 to 2017.

Before the mid-1980s, Japanese children were a few cm taller than Korean peers, who caught-up with Japanese peers in the 1980s at the younger age, 6 and clearly overtook their Japanese peers by 5.0 cm in the 2000s.

Korean children in the older age bracket, high school children caught up with Japanese peers in the mid-1990s, overtook them after the late-1990s, and kept constantly taller by 3.0 cm than Japanese peers toward the end of the 2010s. Throughout the entire period, from the 1960s to the mid-2010s, Japan was greater than South Korea in respect of per capita GDP (Table 2: International Monetary Fund data account). Koreans should be taller than Japanese in gene potentials and Japanese should have depleted their height gene potentials a decade or so earlier than Koreans [1].

**Table 2:** Per capita GDP, Japan, Sputh Korea and Taiwan, 1980 to 2018. in current US ($)

| | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| Japan | 9,659 | 11,816 | 25,896 | 44,210 | 39,173 | 37,819 | 45,136 | 35,006 | 39,850 |
| S. Korea | 1,715 | 2,482 | 6,610 | 12,565 | 12,263 | 19,398 | 23,077 | 28,737 | 33,447 |
| Taiwan Province of China | 2,367 | 3,294 | 8,167 | 13,066 | 14,844 | 16,427 | 19,181 | 22,753 | 25,826 |

Sources: IMF, per capita GDP, in current US $.

School Health Ex amination carries 12 age classes: 6 ages from 1st grade to 6th grade in primary school, 3 ages from 1st grades to 3rd grade in junior high school and 3 ages from 1st grade to 3rd grade in high school. The author examined changes in growth velocities of schoolchildren in the two countries by periods, to obtain significant discoveries in relation to changes in food intakes by age [5,6]. In this paper, the author will examine changes in growth patterns of school children, divided into two age groups: young children, 1st to 6th grades in primary school and 1st grade*2 in junior high school to 3rd grade in high school.

School children in Japan grew in mean height approximately (to be omitted hereafter) by 34 cm from age 6 in 1965 to age 12 in 1971 and 36cm from age 6 in 1995 to age 12 in 2001 and levelled off afterwards, whereas Korean school children grew by 31cm from age 6 in 1970 to age 12 in1976 and 38 cm from age 6 in 2000 to age 12 in 2006 and then the growth speed fell to 35 cm, 1.0 cm less in Japan toward the mid-2010s (Figure 3).

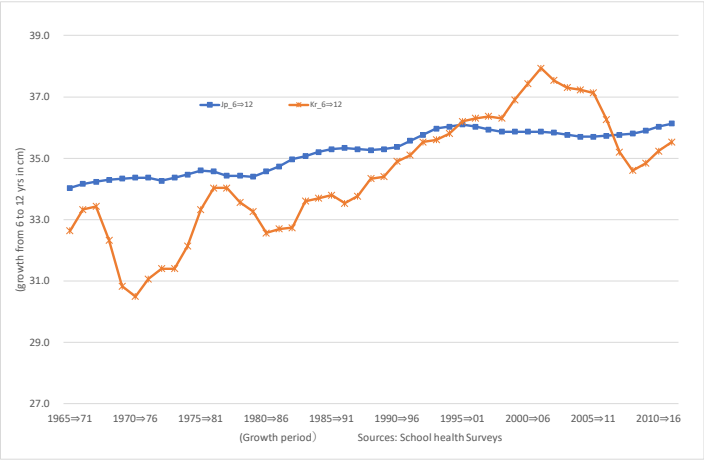


**Figure 3:** Growth in mean height from 6 to 12 yrs, school boys, Japan and South Korea, 1965 to 2016.

School children in Japan grew by 21cm from age 12 in 1975 to age 17 in 1980 and gradually slowed down in growth speed to18 cm in the end of the 1990s and levelled off afterwards, whereas Korean children grew much faster by 23-24 cm from age 12 in 1975 to age 17 in 1980 and started to slowdown in growth speed persistently to 15 cm after the mid-2000s, nearly 3.0 cm slower than in Japan.

It is not easy for the author to generalize the picture. On surface, children in Korea grew much faster than Japanese peers, which plateaued in height at all ages in the mid-1990s (Figure 2). Growth patterns of Korean teens examined in details; one may detect negative signs for their future height development.

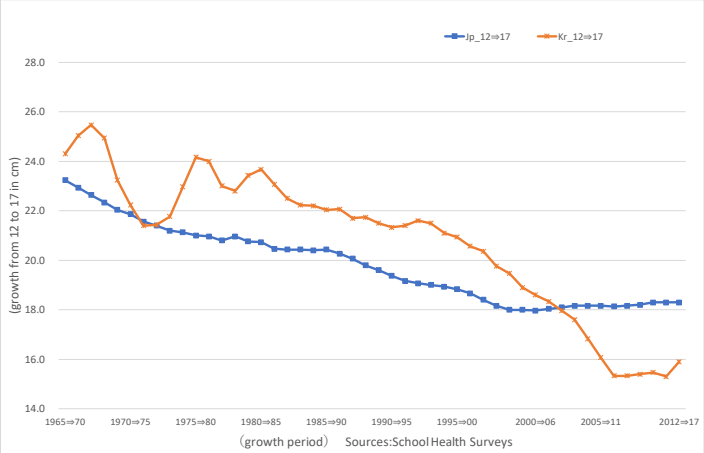


**Figure 4:** Growth in mean height from 12 to 17 yrs, school boys, Japan and South Korea, 1965 to 2017.

*2The survey takes place in the first month of school year. Mean height of 1st graders in junior high school should be very close to that of 6th graders in primary school in the end of school year.

## Why Korean children ceased to grow taller in height in the mid-2000s?

Japanese government, Ministry of Agriculture, *White Paper on Agriculture1994* called for public attention to "wakamono no kudamono-banare" (steering away from fruit by the young). As clearly shown by the author's estimation derived from *Family Income and Expenditure*, classified by age groups of household head, Table 3, children in Japan started to turn away from fruit drastically in the late 1970s, when Japan was in the midst of booming economy. Unlike rice and potatoes, fruit is not inferior goods [7].

Blum [8] states that a high consumption of animal protein alone does not result in increasing body height, if the overall consumption of calories and other essential nutrients is insufficient. Unbelievably drastic reduction in fruit consumption by children in growing ages in Japan (Table 3) could have caused plateauing of children's height in the 1990s and on.

**Table 3:** Secular changes in individual at-home consumption of fruit by age groups, 1971~2010.

(kg/year)

| Age/year | 1971 | 1980 | 1985-86 | 1990 | 1995-96 | 2000 | 2010 |
|---|---|---|---|---|---|---|---|
| 0~9 yo | 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 |
| 50~59 | 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 |
| Grand Ave | 45.6 | 41.6 | 36.4 | 33.8 | 31.5 | 31.1 | 27.7 |

As mentioned earlier, *Korea Nutrition Examination Survey*, which reports intakes of food products by age groups was initiated in 1998, followed by the second one in 2001 and the third one in 2005. *Household Income and Expenditure Surveys are classified by age groups of household head*. The author derived per capita household expenditures on various food items, grain, meats, vegetables, etc. by age groups of household members, 0~9, 10~14, 15~19, 20~24, ---, by means of Mori and Inaba [9] and TMI. Table 4 presents changes in individual consumption of vegetables (processed vegetables included) by household members by age groups, 0~9, 10~14, 15~19, 20~29, --in South Korea from 1990-91 to 2017-19. Children in growing ages decreased individual at-home vegetable consumption by 90% over the two decades from the early-1990s to the end of 2010s. In 2017-19, children aged 0~9 to 10~14 ate 10% of vegetables consumed by the older adults in their 50s and 60s.

Children in South Korea have steered away from vegetables, almost exactly as their Japanese peers turned away from fruit four decades ago (Table 3).

| Age/year | 1990-91 | 1995-96 | 2000-01 | 2005-06 | 2010-11 | 2014-15 | 2017-19 |
|---|---|---|---|---|---|---|---|
| 0-9 | 17857 | 12261 | 7352 | 4505 | 2519 | 2847 | 1856 |
| 10~14 | 18593 | 13452 | 8233 | 6884 | 3070 | 2861 | 2210 |
| 15~19 | 18504 | 13693 | 8805 | 7927 | 3789 | 3168 | 2828 |
| 20-29 | 19801 | 16414 | 10563 | 10568 | 5558 | 4823 | 4915 |
| 30-39 | 26309 | 25237 | 15037 | 16541 | 9680 | 9486 | 9998 |
| 40-49 | 34428 | 34267 | 20639 | 23888 | 14560 | 13838 | 14925 |
| 50-59 | 35876 | 39010 | 24140 | 30639 | 20062 | 18889 | 21914 |
| 60~ | 34134 | 38357 | 25114 | 32786 | 23314 | 22884 | 28603 |

**Table 4:** Secular changes in real monthly expenditures on vegetables, 1990 ~2017-19, S. Korea.

Sources: Household Income and Expenditure Surveys, classified by age groups of household head.

Estimated by the author by means of TMI model.

Only a few days ago, the author came across an article, secular growth trends among children in Beijing [10], EHB, 21,2016, which presents that school boys at age 17 in Beijing increased in mean height from 173.4 cm in 1995 to 175.4 cm in 2010, while per capita consumption of cereals and animal products decreased by 15.4% and 27.6%, without reducing consumption of legumes, vegetable and fruit [11] (Supplementary Table). This information may fortify the author's contention that fruit/vegetables may contain "essential nutrients" [8].

## Brief Conclusions

Japan made fast and steady economic developments after WWII, with South Korea some two decades behind Japan, due to the Korean War (1950-53). Food consumption increased in quantity and quality as well. As a result, children grew in height at unprecedented speed in both countries. Children in Japan ceased to grow taller in height in the end of the 1980s, when the economy was booming. Children in South Korea have kept growing in height to catch up with Japanese peers in the mid-1990s and overtook them at all ages by 3-5 cm in the mid-2000s and then plateaued, when the economy was prosperous. Have Japanese and Koreans depleted respective gene potentials in height? The author does not share the view. Most children in Japan have quit eating fruit and children in South Korea seem to have turned away from Kimchi in recent years. Why? The author has no confident answers, because he has not met with objective investigations, with social psychologists involved.

The author has heard "Peeling skin off is a nuisance"; "Household labor carries explicit costs by now", etc. at the seminars on declining fruit consumption. These comments are true but no remedies.

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**Supplemental Table:** Secular changes in per capita supply of vegetabls, fruit, meat, eggs, milk in China, 1965~2010.

**(kg/year)**

| | vegetabls | fruit | meat | eggs | milk |
|---|---|---|---|---|---|
| 1965 | 58.3 | 4.6 | 9.2 | 2.0 | 2.4 |
| 1970 | 45.4 | 5.1 | 9.1 | 2.1 | 2.2 |
| 1980 | 50.4 | 7.3 | 14.6 | 2.6 | 3.0 |
| 1990 | 99.3 | 16.0 | 24.8 | 6.3 | 5.8 |
| 2000 | 240.3 | 43.7 | 45.1 | 15.4 | 9.5 |
| 2010 | 327.3 | 77.8 | 57.7 | 18.3 | 31.0 |

**Sources:** FAOSTAT, *Food Balance Sheets*.