ある．中高年者の体重当たりの脚筋力（伸展パワー）は加齢とともに低下する．特に女性の40代の脚筋力は男性の70代とほぼ同等であり，筋力を保持することは女性において，より重要だと考えられる．しかし，運動習慣の割合は20代から40代の女性で20%前後と低い（平成12年度国民栄養調査）．仕事，育児，家事などで余暇時間が少ないことが影響していると考えられるが，今後女性の要介護期間を減らす意味でも，女性の運動習慣が増えるような社会的支援が必要である．

また，藤原らの研究によれば[8]，一般地域住民においてIADLの低下に先駆けて，知的能動性や社会活動が低下する．知的関心の低下や社会参加が減ることは社会適応を低下させ，閉じこもりの原因となると考えられる．高齢者の社会参加を増やし，高齢者の生き甲斐を創世するような社会基盤の整備が，将来の要介護人口を減らし，より健康的な高齢社会を形成するために必要である．

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Abstract

Strategies to reduce bed-ridden or house-bound elderly people in Japan

Fujiko Ando

Preventive medicine is supposed to be important for reducing bed-ridden ('netakiri', in Japanese) or frail elderly people. Previous studies showed that only about 30% of the bed-ridden elderly had decreased their ADL levels directly due to diseases, such as cerebrovascular disease or hip fracture. One of the other important causes of 'Netakiri' is disused syndrome. A few weeks after staying in bed, not only muscle power but also bone mineral density and intellectual interest often decrease in the elderly. Rehabilitation in daily life is expected to prevent disused syndrome. House-bound ('tojikomori', in Japanese) is supposed to be another cause of reduction of ADL. There are miscellaneous causes of tojikomori. Aging is one of the most important factors, but cannot be modified. Physical, mental, social or environmental factors are also important. Participation in social activity, improvement of intellectual interest and habitual physical excise, as well as prevention of diseases, is expected to be useful for preventing 'tojikomori' and 'netakiri' in the elderly.

Key words: *House-bound, Bed-ridden, Frail elderly, Preventive medicine*
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Osteoporosis Japan

成長期の骨評価値とPeak Height Velosityに関する検討

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はじめに

成長期は身体などのbody compositionの発達にとって非常に重要な時期であることはいうまでもない。なかでも骨量が一生の中で最も増加，蓄積される時期でもあり，成長期の骨量増加ならびに蓄積は最大骨量(peak bone mass)に関与するとされ，その重要性が示唆されている。そこで成長期の骨評価値およびその増加の関連要因として，身長の最大年間成長率 (peak height velosity：PHV)・初経・運動習慣について検討をする。

1 対象と方法

対象は6～18歳の男子2065名，女子2166名(表1)についてAloka社製AOS-100を用いて，踵骨超音波法による骨評価値の測定を行った。また，測定に際しては足のサイズに合わせて，25cm以上・22～25cm・22cm未満は小児用アダプター[1)]の3種類のアダプターを使用して，より適切なROIのpositioningをこころがけ，右足の踵骨部分の測定をした。また，身長・運動習慣・初経について調査を行い，音速SOS (speed of sound：m/sec)，透過指標TI (transmission index)，音響的骨評価値OSI (osteo sono-assessment index)の増加との関連について検討した。統計解析はstudent *t*-検定で比較検討した。

2 結 果

1) 骨評価値の年齢別推移

各骨評価値の年齢別推移は，男子SOSは8歳・9歳で減少を認め，その後年齢とともに上昇し，16歳で最も増加を認めた。女子は8歳・9歳で減少を認め，12歳で最も増加を認めた。男子TIは8歳で減少を認め，その後年齢とともに上昇し，16歳で最も増加を認めた。女子は年齢とともに上昇し，13歳で最も増加を認めた。男子OSIは8歳，9歳で減少を認め，その後年齢とともに上昇し，16歳で最も増加を認めた。女子は9歳で

表1 年齢別対象者数年齢

年齢（歳）	6	7	8	9	10	11	12	13	14	15	16	17	18	計
男子	30	142	135	143	156	163	161	231	215	278	161	158	92	2065
女子	27	161	145	166	167	138	144	215	228	249	190	191	145	2166

Analysis of Association between Bone Mass and Peak Height Velosity in Japanese Children

Yukio Kurosawa：Tokyo Health Service Association, *et al.*

Key words：Growing period, Bone mass, Peak height velosity

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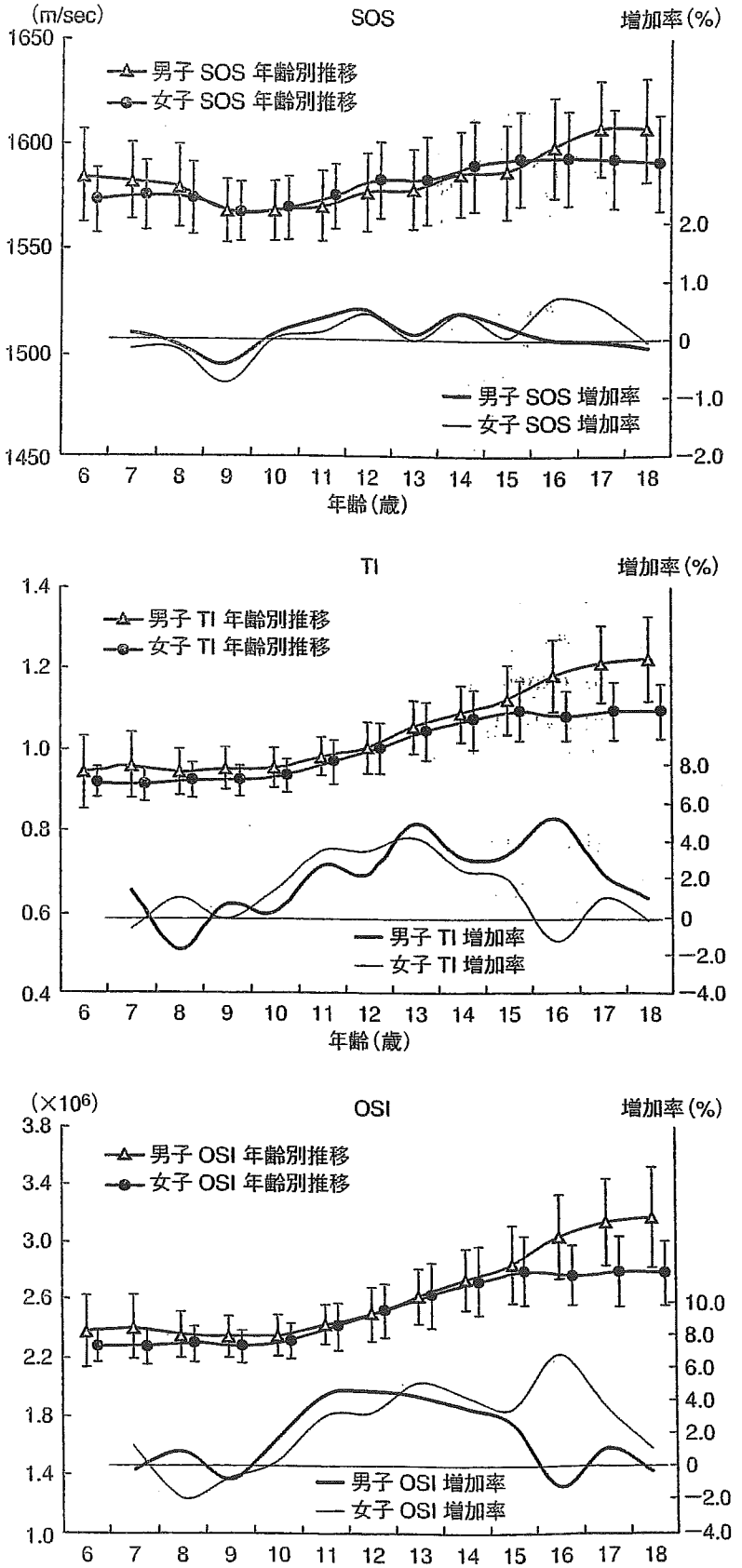

図1　骨評価値の年齢別推移と増加率

表2　PHVに達している群と達していない群の骨評価値

	PHVに達していない群	PHVに達している群
15歳 男子		
身長	159.58 ± 5.79	167.66 ± 5.96 ***
SOS	1579.13 ± 19.78	1589.21 ± 22.82 **
TI	1.0706 ± 0.0700	1.1349 ± 0.0852 ***
OSI	2.6722 ± 0.2143	2.8703 ± 0.2687 ***
16歳 男子		
身長	164.50 ± 6.15	169.51 ± 5.02 **
SOS	1585.38 ± 17.37	1600.24 ± 23.97 *
TI	1.1051 ± 0.0652	1.1903 ± 0.0892 **
OSI	2.7796 ± 0.2005	3.0528 ± 0.2906 **
12歳 女子		
身長	145.50 ± 6.07	149.58 ± 6.18 ***
SOS	1577.93 ± 16.70	1587.99 ± 18.58 **
TI	0.9872 ± 0.0619	1.0207 ± 0.0563 **
OSI	2.4598 ± 0.1865	2.5759 ± 0.1791 **
13歳 女子		
身長	150.63 ± 5.64	152.99 ± 4.97 **
SOS	1578.72 ± 23.63	1584.09 ± 20.04 *
TI	1.0173 ± 0.0757	1.0538 ± 0.0691 **
OSI	2.5399 ± 0.2471	2.6474 ± 0.2202 **

Mean ± SD, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

減少を認め，その後年齢とともに上昇し，12歳で最も増加を認めた（図1）。

各骨評価値とも，男子は18歳まで増加を認めたが，女子は16歳以降，骨評価値の増加は認められなかった。

2) PHVと骨評価値の検討

身長の年齢別推移は，男女とも年齢とともに増加を認め，PHVは男子では（7.59 ± 2.17cm/年：14歳），女子では（6.86 ± 1.72cm/年：11歳）であった。男子15歳と16歳でPHVに達している群と達していない群の各骨評価値を検討した結果，PHVに達している群は達していない群に比べてSOS・TI・OSIは有意に高値を示した。女子12歳と13歳でPHVに達している群と達していない群の各骨評価値を検討した結果，PHVに達している群は達していない群に比べてSOS・TI・OSIは有意に高値を示した（表2）。またPHV経過年数で検討した結果，男子はPHVの2年後に骨評価値は最も増加を示した。女子はPHVの1年後に骨評価値は最も増加を示した（図2）。

3) 初経発来と骨評価値の検討

女子の初経発来は平均12.1 ± 1.17歳であった。12歳と13歳で，初経発来のある群とない群の骨評価値を検討した結果，同じ年齢同士では，初経発来のある群は初経発来のない群に比べて，SOS・TI・OSIは有意に高値を示した（表3）。

4) PHVと初経発来の骨評価値の検討

女子12歳と13歳においてPHVと初経発来について検討した結果，同じ年齢同士では，初経未発来群において，PHVに達している群は達していない群に比べてSOS・TI・OSIは高値を示した。また初経発来群においては，PHVに達している群は達していない群に比べてSOS・TI・OSIは高値を示した。初経未発来群でPHVに達していない群が各骨評価値とも最も低値を示し，初経発来群でPHVに達している群が各骨評価値とも最も高値を示した（図3）。

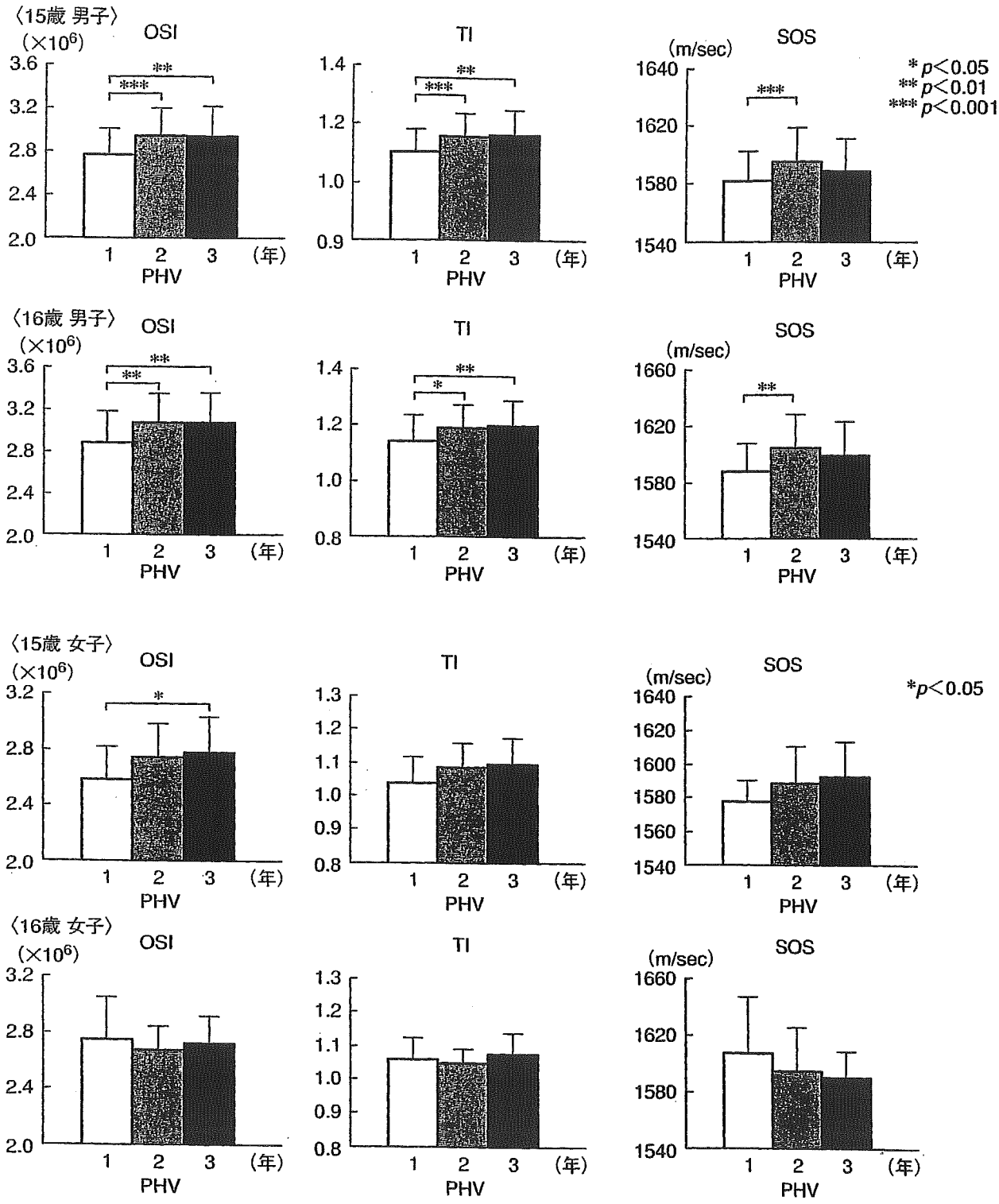

図2　PHV経過年数の骨評価値

表3　初経発来のある群とない群の骨評価値

	初経未発来群	初経発来群
12歳 女子		
SOS	1570.67 ± 16.09	1582.57 ± 17.79 *
TI	0.9852 ± 0.0703	1.0236 ± 0.0511 *
OSI	2.4327 ± 0.2043	2.5656 ± 0.1671 **
13歳 女子		
SOS	1570.43 ± 20.05	1582.26 ± 19.84 *
TI	1.0127 ± 0.0755	1.0546 ± 0.0664 **
OSI	2.5008 ± 0.2328	2.6430 ± 0.2125 **

Mean ± SD, $^{*}p < 0.05$, $^{**}p < 0.01$

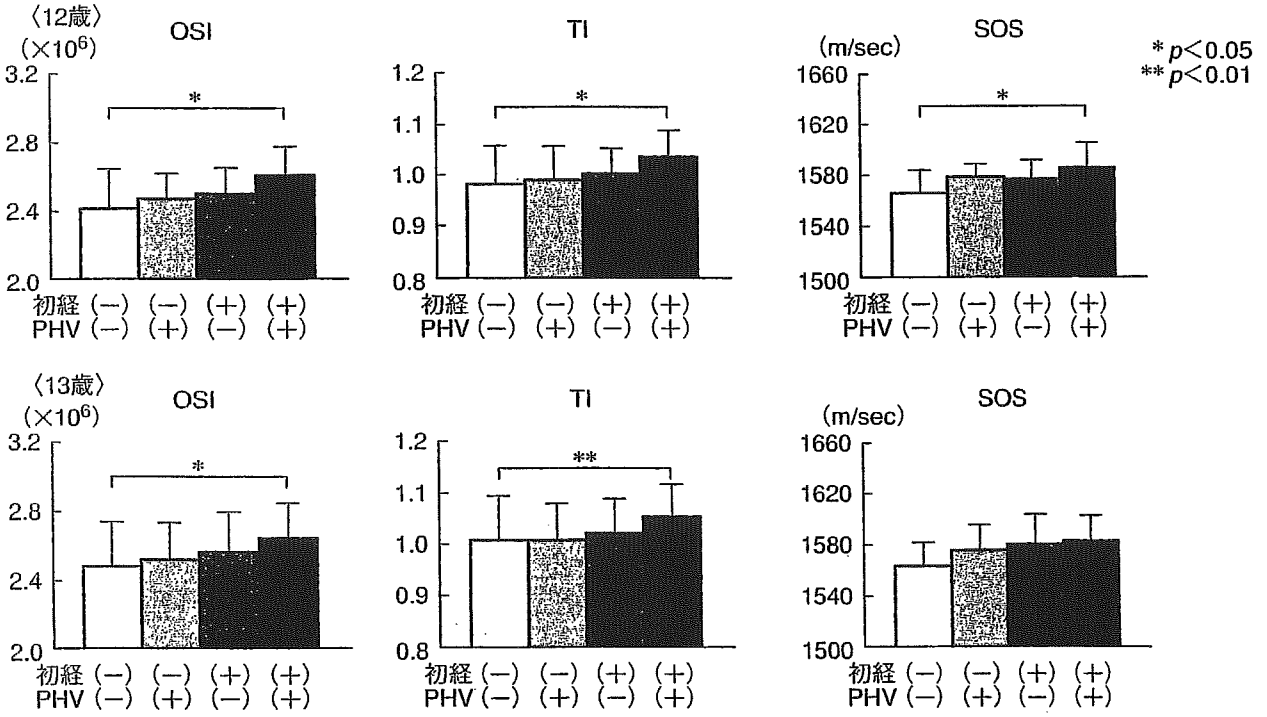

図3　PHVと初経発来の骨評価値

5) 運動習慣についての検討

小・中・高校生に分類し，1日の運動習慣について検討した結果，小学生においては，男女ともに運動習慣のある群がない群に比べてSOS・TI・OSIは有意に高値を示した。また，その運動時間は，運動しない群と比較して，男女ともより長い時間運動する群でSOS・TI・OSIが有意に高値を示した。

中学生においては，男女ともに運動習慣のある群とない群とにおいて，SOS・TI・OSIには差は認められなかった。また，その運動時間においても，男女ともにSOS・TI・OSIに差は認められなかった。

高校生においては，男女ともに運動習慣のある群がない群に比べてSOS・TI・OSIは有意に高値を示した。また，その運動時間は男女ともより長い時間運動する群でSOS・TI・OSIが有意に高値を示した（表4）。

表4　運動習慣のない群とある群の骨評価値

	運動していない群	運動している群	1日の運動時間		
			1時間	2時間	3時間
小学生 男子					
SOS	1572.45 ± 18.61	1576.12 ± 17.76 **	1573.87 ± 17.78	1579.09 ± 16.44 ***	1581.63 ± 18.03 ***
TI	0.9516 ± 0.0625	0.9729 ± 0.0581 ***	0.9683 ± 0.0584 ***	0.9864 ± 0.0555 ***	0.9724 ± 0.0584 ***
OSI	2.3540 ± 0.1764	2.4180 ± 0.1695 ***	2.3998 ± 0.1704 ***	2.4608 ± 0.1662 ***	2.4329 ± 0.1586 ***
小学生 女子					
SOS	1572.16 ± 16.36	1575.66 ± 16.75 *	1574.06 ± 16.50	1581.86 ± 15.09 *	1580.52 ± 19.44 **
TI	0.9375 ± 0.0521	0.9439 ± 0.0556	0.9375 ± 0.0537	0.9646 ± 0.0581 *	0.9715 ± 0.0543 *
OSI	2.3186 ± 0.1561	2.3449 ± 0.1668 **	2.3240 ± 0.1577	2.4155 ± 0.1753 *	2.4295 ± 0.1872 ***
中学生 男子					
SOS	1584.27 ± 22.81	1583.33 ± 19.60	1581.65 ± 18.82	1582.87 ± 20.01	1585.52 ± 19.54
TI	1.1032 ± 0.0836	1.0736 ± 0.0728	1.0789 ± 0.0800	1.0709 ± 0.0686	1.0738 ± 0.0735
OSI	2.7726 ± 0.2630	2.6939 ± 0.2201	2.7012 ± 0.2359	2.6853 ± 0.2094	2.7020 ± 0.2248
中学生 女子					
SOS	1587.39 ± 22.91	1589.72 ± 20.54	1589.33 ± 19.00	1588.02 ± 20.67	1594.65 ± 21.81
TI	1.0720 ± 0.0785	1.0651 ± 0.0715	1.0630 ± 0.0739	1.0643 ± 0.0720	1.0700 ± 0.0679
OSI	2.7057 ± 0.2576	2.6951 ± 0.2304	2.6882 ± 0.2323	2.6874 ± 0.2317	2.7242 ± 0.2264
高校生 男子					
SOS	1596.02 ± 21.59	1606.85 ± 22.89 *	1605.40 ± 27.89	1606.80 ± 25.73 **	1607.24 ± 18.68 *
TI	1.1842 ± 0.0737	1.2070 ± 0.0892	1.2206 ± 0.0886	1.1918 ± 0.0861	1.2184 ± 0.0915 ***
OSI	3.0198 ± 0.2434	3.1205 ± 0.2888 **	3.1492 ± 0.2836	3.0822 ± 0.2936	3.1507 ± 0.2854 ***
高校生 女子					
SOS	1587.40 ± 24.93	1599.95 ± 21.42 ***	1593.30 ± 14.84	1601.80 ± 22.44 ***	1598.50 ± 21.33 **
TI	1.0751 ± 0.0726	1.1087 ± 0.0615 *	1.0823 ± 0.0483	1.1139 ± 0.0660 ***	1.1078 ± 0.0548 **
OSI	2.7135 ± 0.2487	2.8407 ± 0.2043 ***	2.7478 ± 0.1334	2.8608 ± 0.2179 ***	2.8332 ± 0.1914 **

Mean ± SD, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$
有意差検定は運動していない群と比較検討

3　考　　察

成長期の6～18歳の男女4231名について，踵骨超音波法による骨評価値の検討を行った。DXA法 (dual energy X-ray absorptiometetry) による小児の腰椎BMD (bone mineral density) の年齢別推移を検討した徳丸は，腰椎骨密度とSOS・TI・OSIは同様のカーブを描きながら増加すると報告しており[2]，われわれの行った各骨評価値も同様のカーブを描きながら増加を認め，男子は16歳，女子は12～13歳で最も増加を認めた。また各骨評価値は男子では18歳まで増加を認めたが，女子では16歳以降増加は認められなかった。清野らは，腰椎BMDは男子において13～15歳で，女子において12～14歳で急激な増加を認め，女子では15～16歳で若年成人値に達するとしている[3]。また，西山らは腰椎BMDの増加は男子では18歳，女子では16歳でその増加はプラトー化すると報告しており[4]，骨量は成長期において増加・蓄積され最大骨量に達するものであると考えられる。

骨量の増加との要因について検討を行ったところ，各骨評価値は男女ともPHVに達している群は達していない群に比べて有意に高値を認めた。また，男子はPHVの2年後に，女子はPHVの1年後に各骨評価値は最も増加を認め，身長の増加が先行したあとに骨量が増加することが示された。

女子において，骨量と初経発来との関連について検討を行ったところ，初経発来のある群は初経発来のない群に比べて，各骨評価値は有意

に高値を認めた。石川らは，初経年齢は10～13歳で12歳と13歳の腰椎BMDにおいても初経発来例が高値を認めると報告しており[5]，女子において初経発来が骨量増加に影響を与える重要な要因であると考えられる。

さらに女子においてPHVと初経発来の両者あわせた検討を行ったところ，初経発来(－)PHV(－)群，初経発来(－)PHV(＋)群，初経発来(＋)PHV(－)群，初経発来(＋)PHV(＋)群の順で，各骨評価値とも高値を認める結果であった。思春期の女子においては，初経とPHVの両方が相乗的に影響し，骨量増加に大きく関与していると考えられた。高橋は女子では初経後1年から3年が最も骨強度を獲得する時期であると報告している[6]。今回われわれの行った検討においても，女子は初経発来後に最も骨評価値が増加する結果であり，女子においては二次性徴が骨量獲得に強く影響していると考えられた。

次に，骨量の増加の要因として運動習慣と骨評価値について検討を行った。小学生・高校生においては，男女ともに運動習慣のある群がない群に比べて各骨評価値は有意に高値を認めた。井本[7]，三村[8]らも成長期の運動習慣は骨量を増加させると報告しており，発育期の運動習慣は骨量増加に影響を与える重要な因子である。しかし，本検討では，中学生においては男女ともに運動習慣のある群とない群とにおいて，各骨評価値に差は認められず，またその運動時間においても男女ともに差は認められなかった。杉森は，中学生時期(12～13歳)で学童骨折頻度がピークになることを報告しており，この時期に骨の脆弱性が強くなる可能性を指摘している[9]。中学生時期は身体発育が最も盛んな時期であり，特に骨格発育に追いつくために身長は最も上昇し，運動習慣などの要因よりも身体発育の要素が大きいために差が認められない可能性が考えられる。しかしその一方で，腰山らは中学生時期の運動歴は高校生になってから顕在化し，骨評価値は高値を認め，中学生時期の運動習慣が骨量増加に大きく関わっていると報告しており[10]，中学生時期の運動習慣がその後の骨発育に与える影響については今後詳細な検討が必要である。

成長期の骨量増加ならびに蓄積は，PHVなどの身体発育指標との時期に乖離があることが示唆された。骨発育の検討をさらに進めて知見を蓄積し，骨量の増加・蓄積のメカニズムを解明することが重要である。成長期の骨量増加はpeak bone massに関与するとされ，一生涯の骨量を左右する重要な時期である。成長期の骨量増加は，ひいては将来の骨粗鬆症の予防につながると考えられるため，骨発育に関する健康教育の必要性が求められる。

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Original Article

Analysis of factors that influence body mass index from ages 3 to 6 years: A study based on the Toyama cohort study

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Abstract

Background: The aim of the present study was to elucidate both environmental and behavioral factors that influence body mass index (BMI, kg/m^2) among Japanese children from ages 3–6.

Methods: In 1992 (at age 3) and 1995 (at age 6), 8170 6-year-old children (4176 boys and 3994 girls) were surveyed using a questionnaire on both body build (height and weight) and lifestyle. The correlation between BMI for 3-year-olds and for 6-year-olds were analyzed. From the temporal changes of body build between age 3 and 6 years, we categorized children into four groups: group 1, normal at both age 3 years and 6 years (normal/normal); group 2, overweight at age 3 years and normal at age 6 years (overweight/normal); group 3, normal at age 3 years and overweight at age 6 years (normal/overweight); and group 4, overweight at both age 3 years and 6 years (overweight/overweight). The authors compared the four groups with each other according to sex, concerning frequencies of children who matched the categories of environmental and behavioral factors. Each factor was tested using the χ^2 test. Overweight children were defined as those whose BMI value was age-sex specific in the 90th percentile or more.

Results: A significant correlation was found between body builds for children aged 3 and 6 years in both genders (boys, $r = 0.559$, $P < 0.01$; girls, $r = 0.584$, $P < 0.01$). Significant factors associated with overweight children were diet (eating rice, green tea, eggs, meat, but less breads and juice), rapid eating, short sleep duration, early bedtime, long periods of television viewing, avoidance of physical activity, and frequent bowel movement.

Discussion: Temporal changes in BMI from age 3 years to 6 years are significantly associated with both environmental and behavioral factors at age 6 years. The results of this study may be useful for health promotion programs designed to prevent obesity during the early stages of childhood.

Key words children, cohort study, obesity, Toyama Birth Cohort study.

Obesity in childhood is becoming a major area of public health interest, especially prevention of obesity in Japan.[1,2] Obese children may be at increased risk of becoming obese adults, which is related to many acute and chronic medical conditions in adulthood including hypertension, dyslipidemia, coronary heart disease, diabetes mellitus, gallbladder disease, respiratory disease, some types of cancer, gout, and arthritis.[3–5] Also, because most attempts to achieve weight loss during adulthood are unsuccessful, prevention of obesity in youth continues to be the most practical strategy for controlling obesity in adulthood.[6] Therefore, it is preferable to eliminate factors influencing the development of obesity in childhood in order to establish positive long-term lifestyle modifications in early life.[1,7] So far, few studies have assessed the association between temporal changes of body build and lifestyle factors during childhood, especially early childhood.

In previous studies, we reported the factors contributing to obesity in 3-year-old Japanese children through a case-

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control analysis.[7,8] The results indicated that the following five factors were significantly associated with overweight 3-year-old Japanese children: person other than a mother responsible for nursing the child, eating snacks irregularly, short sleep duration, overweight father and mother. These previous findings suggested that inherited factors as well as acquired factors seemed to be associated with the development of obesity in childhood.

In this study, we aimed to elucidate behavioral and environmental factors influencing temporal changes in BMI from ages 3–6 years using large cohort data from the Toyama study, and to analyze in greater detail factors promoting obesity in childhood.[7] In addition to well-known factors such as dietary habits and physical activity, we collected data that we considered to be potential contributors (time spent watching television, particular psychological characteristics, etc.). Furthermore, because we followed the same subjects as in previous the longitudinal study, the present study might be able to elucidate factors which increase the likelihood of obesity during early childhood. Because the lifestyles of children are well known to differ according to sex, in this study we also attempted to elucidate factors stratified by sex.

Method

Subjects

Subjects were selected from the Toyama Birth Cohort Study which was designed to investigate the lifestyle of children born in the 1 year period between 2 April 1989 and 1 April 1990, in Toyama Prefecture, Japan.[9] The first survey was conducted in 1992; initial subjects consisted of 10 177 children aged 3 years. Of those who received questionnaires, 9674 of the parents (95.1%) responded and anthropometric measurements (height and weight) were undertaken. The follow-up survey was conducted in 1996, when subjects were in the first grade of elementary school (6 years of age).[10–13] The following subjects were excluded from the analysis: those who could not be traced at the follow-up survey stage due to having moved from the area (615 children), and those whose questionnaires and anthropometric measurements data were not obtained properly (889 children). Therefore, 8170 eligible 6-year-old children (4176 boys and 3994 girls) participated in this analysis. Informed consent was obtained from all parents of participants.

Medical examination and questionnaire

The questionnaire was distributed through regional public health centers on the day preceding the health checkup, and anthropometrical measurements were conducted by trained public health nurses, according to the protocol of the Law for the Health of Mothers and Children. Body mass index (BMI, kg/m^2) was used for evaluating the degree of overweight in both 3- and 6-year-old age groups. The height and weight of the children were measured with the help of a stadiometer. All children removed their shoes. Height measurements were taken using a movable horizontal bar that noted to the nearest 0.1 cm. The recording of weight was noted to the nearest 100 g, while wearing only light indoor clothing. The stadiometer was checked for accuracy and the scales were calibrated before the examination. Overweight children were defined as those with a BMI index and age-sex specific in the 90th percentile or more.[14,15] To calculate BMI at birth year, both height and weight at birth year was obtained from the questionnaire, which was transcribed from the subject's Maternal and Child Health Handbook data.

The questionnaire was used to collect information on behavioral and environmental factors of children, which consists of a lifestyle survey of the children and the past history of both parents and grandparents. Quality control was done by a standardized protocol that specified exact techniques for collecting and recording results. The following lifestyle data were obtained: items related to meals (regularity of breakfasts, eating breakfast with mother, eating between meals, dinners, late-night meals, eating out, eating speed), food items (rice, bread, milk, juice, green tea, eggs, meat, vegetables, soup, fruit, snack, soft drinks, confectionery, instant noodles, etc), items related to sleep (time of waking, bedtime, duration of sleep), items related to bowel movement (frequency of stool, regularity of stool time zone), physical activities (physical exercise/playing outdoor), physical club activities, duration of TV viewing, and temperamental disposition (enthusiastic, tantrums, competitive spirit, sociable spirit, voluntary spirit), and were compared between the four groups. The questionnaire had been pretested and checked for the reproducibility of lifestyle variables at an interval of 3 months, and proportion of agreement coefficients ranged from 0.50 to 0.83 and Kappa coefficients ranged from 0.48 to 0.64. The questionnaire was considered to have moderate to high reproducibility.

Study design

Temporary course of the children from birth year to 6 years of age

For 8170 children (4176 boys, 3994 girls), we calculated the mean and standard deviation (SD) of BMI (25th percentile, median, 75th percentile, 90th percentile) by age groups at birth year, age 3 years, and age 6 years. Stratified by sex, we obtained scattered diagrams for BMI at 3 years and at 6 years. Furthermore, we analyzed the correlation between BMI at 3 years and at 6 years, and tested the significance of correlations using Pearson's correlation coefficient statistics.

Behavioral and environmental factors at 6 years associated with temporal change of body build from age 3 years to age 6 years (four group comparisons)

In this study, one major objective was to elucidate the influence of behavioral and environmental factors associated with temporal changes in body build ages from 3 to 6 years. Therefore, we categorized children into four groups derived from the temporal changes of body build for both 3 years and 6 years, as follows: group 1, normal both at 3 years and 6 years (normal/normal); group 2, overweight at 3 years and normal at 6 years (overweight/normal); group 3, normal at 3 years and overweight at 6 years (normal/overweight); group 4, overweight both at 3 years and 6 years (overweight/overweight).

In addition, in order to elucidate factors according to sex, we assessed four groups individually stratified by sex. We compared the four groups with each other by sex concerning frequencies of children who matched categories of environmental and behavioral factors at 6 years. Each four frequencies of factors were tested using the χ^2 test. However, since in the multiple comparisons, attention must be paid to the total number of comparisons, we showed precise *P*-values in Tables and demonstrated the significance level of both 0.05 (*) and 0.01[16] (**) as a guide. For variables where there was a significant difference between the four groups, pairwise comparisons were undertaken, using group I (normal/normal) as comparison, to determinate source of the difference.

Results

Temporary course of the children from birth year up to 6 years

Table 1 shows BMI (25 percentile, median, 75 percentile, 90 percentile) according to age and sex. In both genders, mean BMI values increased from birth year to age 3 years, and persisted to age 6 years. In every age group, mean BMI values of boys were a little higher than that of girls. Figures 1 and 2 show scatter diagrams between BMI at 6 years and BMI at 3 years. (Alpha numeric letters A to Z as individual scatter points, means that 'A' represents one observation and 'B' represents two observations on the same scatter points, etc.) Significant correlation was found between BMI for 3 years and that for 6 years in both genders (boys, $r = 0.559$, $P < 0.001$; girls, $r = 0.584$, $P < 0.001$).

Behavioral and environmental factors at 6 years associated with temporal change in body build from ages 3–6 years (four group comparisons)

Table 2 shows factors at 6 years, which are associated with temporal change in boy's BMI from 3 to 6 years of age.

Table 1 Body mass index (BMI) and frequencies of obese children by age group and sex

Age (years)	Boys ($n = 4176$)					Girls ($n = 3994$)					All ($n = 8170$)				
	mean ± SD	Q1	Q2	Q3	90%	mean ± SD	Q1	Q2	Q3	90%	mean ± SD	Q1	Q2	Q3	90%
0	13.0 ± 1.4	12.2	12.9	13.7	14.5	12.9 ± 1.4	12.1	12.8	13.6	14.4	12.9 ± 1.4	12.2	12.9	13.7	14.4
3	16.0 ± 1.3	15.2	15.9	16.7	17.6	15.8 ± 1.3	15.0	15.8	16.6	17.4	15.9 ± 1.3	15.1	15.8	16.7	17.5
6	15.8 ± 1.9	14.6	15.5	16.5	18.0	15.6 ± 1.8	14.5	15.3	16.5	17.8	15.7 ± 1.9	14.6	15.4	16.5	17.9

Q1, 25 percentile; Q2, median; Q3, 75th percentile; 90%, 90th percentile.

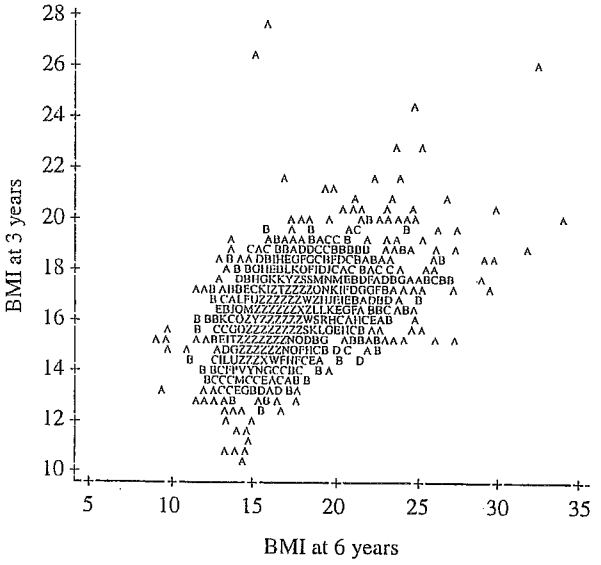

Fig. 1 Scatter diagram of BMI at 3 years and BMI at 6 years in boys. Note: alpha numeric letters A to Z as individual scatter points means that 'A' represents one observation and 'B' represents two observations on the same scatter points, etc. n = 4176; $r = 0.559$.

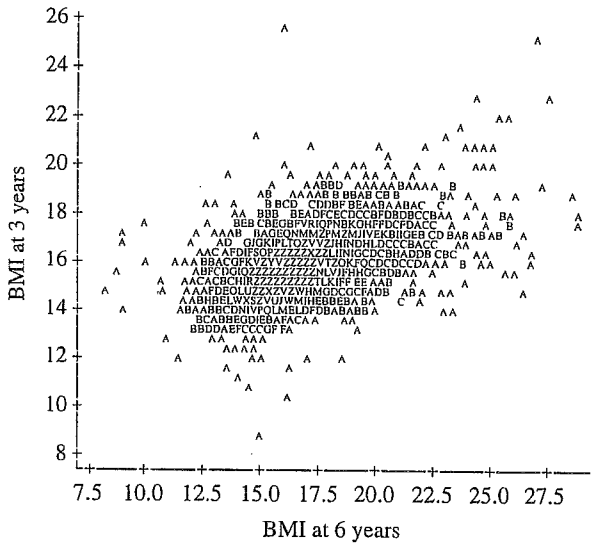

Fig. 2 Scatter diagram of BMI at 3 years and BMI at 6 years in girls. Note: alpha numeric letters A to Z as individual scatter points means that 'A' represents one observation and 'B' represents two observations on the same scatter points, etc.

By comparing frequencies between the four groups, significant factors found in boys were eating between meals, rice, bread, juices, green tea, eggs/meets, eating speed, duration of sleep, physical exercise, playing outside, physical club activity, TV viewing on holiday, and prone to tantrums. Pairwise comparisons of these variables that showed significant positive associations with overweight at age 6 years, were eating between meals (group 3), rice (group 3, 4), breads (groups 3, 4), juices (groups 2, 3), green tea (groups 3, 4), eggs/meats (groups 3, 4), eating speed (groups 2, 3, 4), duration of sleep (groups 2, 3, 4), physical exercise (group 2, 4), playing outside (groups 2, 4), physical club activity (group 3), TV viewing on holiday (group 4), and prone to tantrums (groups 2, 4).

Table 3 shows factors at 6 years, which are associated with temporal change in BMI of girls from 3 to 6 years. By comparing frequencies between the four groups, significant factors found in girls were breakfast, rice, breads, eggs/meets, eating speed, bedtime, regularity of evacuation time, TV viewing on weekdays and holidays, and voluntary. Pairwise comparisons of these variables that showed significant positive associations with overweight at age 6, were breakfast (groups 2, 3), rice (groups 3, 4), breads (groups 3, 4), eggs/meats (group 3), eating speed (groups 2, 3, 4), bedtime (group 3), regularity of evacuation time (group 4), TV viewing on weekdays (group 4) and holidays (group 4), and voluntary spirit (group 2).

Discussion

Education for preventing obesity requires the assessment of risk factors. It is necessary to understand the relationship between obesity in childhood and behavioral and environmental factors influencing obesity.

Although dietary causes of obesity are complex and poorly understood, few attempts have been made to identify eating patterns. In this study, with regard to eating habits, we found that Japanese style food, such as rice and green tea, associated significantly with the overweight groups. Takada *et al.* reported the amount of rice intake was positively associated with the BMI of Japanese children at age 10, and our results were consistent with their report.[17] High rice intake might be an early risk sign for future obesity.[17] However, this might be due in part to other characteristics of the Japanese diet, such as low intake of vegetables, juice, and fruit, which contains a lot of dietary fiber known to associate negatively with obesity.[18] In addition, this might be partly explained by other confounders that would influence a mother's way of nursing or feeding, such as parental socioeconomic status or parental educational background. Further investigations are needed to confirm whether a high intake of rice can be directly associated with obesity or not.

High speed of eating was also significantly associated with overweight groups in both genders. This finding is consistent with previous studies.[19,20] There are several

Table 2 Factors in 6 years associated with the body build of boys from 3 years to 6 years

	Factors in 6 years	Category	Normal/Normal (Group 1)		Obese/Normal (Group 2)		Normal/Obese (Group 3)		Obese/Obese (Group 4)		Among 4 groups χ^2 test
			No.	%	No.	%	No.	%	No.	%	*P*-value
Eating	Breakfast	Eat every day	3210/3485	92.1	237/250	94.8	236/255	92.5	163/174	93.7	0.413
		Eat with his/her mother	2241/3485	64.3	166/249	66.7	163/255	63.9	102/176	58.0	0.300
	Eating between meals	Once a week or more	3213/3463	92.8	231/249	92.8	224/252	**88.9**	155/174	89.1	0.048*
		Snacks	1995/3474	57.4	155/249	62.2	142/245	58.0	111/175	63.4	0.183
	Late-night meal	1–2 times a week or more	389/3486	11.2	23/249	9.2	37/254	14.6	21/176	11.9	0.272
		Soft drink (containing sugar)	54/968	5.6	7/69	10.1	4/66	6.1	1/42	2.4	0.335
		Confectionary	245/674	36.4	20/54	37.0	16/47	34.0	9/25	36.0	0.990
	Food	Rice	2642/3491	75.7	190/250	76.0	222/255	**87.1**	154/176	**87.5**	<0.0001**
		Breads	2166/3492	62.0	153/250	61.2	127/255	**49.8**	78/176	**44.3**	<0.0001**
		Milk	1887/3492	54.0	139/250	55.6	138/255	54.1	94/176	53.4	0.966
		Juices	430/3492	12.3	20/250	**8.0**	14/255	**5.5**	17/176	9.7	0.002**
		Green tea	1041/3429	30.4	66/250	26.4	97/255	**38.0**	73/176	**41.5**	<0.0001**
		Eggs/Meats	2465/3492	70.6	182/250	72.8	203/255	**79.6**	138/176	**78.4**	0.003*
		Vegetables	1030/3492	29.5	80/250	32.0	71/255	27.8	46/176	26.1	0.566
		Soup	328/3492	9.4	18/250	7.2	19/255	7.5	13/176	7.4	0.404
		Fruits	1080/3492	30.9	90/250	36.0	65/255	25.5	53/176	30.1	0.086
	Instant noodles	1–2 times a week or more	625/3265	19.1	38/327	11.6	52/238	21.8	36/162	22.2	0.314
	Eating out	1–2 times a week or more	191/3473	5.5	14/249	5.6	14/252	5.6	12/176	6.8	0.907
	Eating speed	Slightly rapid eating, rapid eating	495/3278	15.1	54/241	**22.4**	97/239	**40.6**	78/165	**47.3**	<0.0001**
Tutoring service		Participate	1115/3294	33.8	88/243	36.2	77/239	32.2	53/166	31.9	0.762
Sleep	Waking time	7 am or earlier	2654/3304	80.3	200/242	82.6	203/239	84.9	140/166	84.3	0.174
	Bedtime	10 pm or later	2971/3304	89.9	217/243	89.3	206/240	85.8	143/166	86.1	0.110
	Duration of sleep	9 h or less	718/3301	21.8	71/243	**29.2**	81/239	**33.9**	61/166	**36.7**	<0.0001**
Bowel movement (stool)	Frequency of evacuation	Once a day or more	2539/3277	77.5	186/243	76.5	194/239	81.2	132/164	80.5	0.445
	Regularity of evacuation time	Almost regular, regular	2124/3280	64.8	164/241	68.0	169/240	70.4	112/165	67.9	0.215
Physical activity	Physical exercise, play outside	Likes very much	1896/3300	57.5	118/243	**48.6**	124/238	52.1	75/166	**45.2**	0.001**
		Plays frequently	1146/2534	45.2	57/180	**31.7**	79/190	41.6	47/137	**34.3**	0.000**
Physical club activity		Participates	887/3278	27.1	56/243	23.0	84/237	**35.4**	44/165	26.7	0.017*
	Frequency of activity	4–5 times a week or more	28/878	3.2	2/54	3.7	3/84	3.6	1/44	2.3	0.977
	Duration of activity	Less than 1 h at a time	191/871	21.9	12/54	22.2	13/82	15.9	14/44	31.8	0.232
TV viewing	Duration of viewing on weekdays	3 h per day or more	1020/3283	31.1	78/241	32.4	79/239	33.1	61/165	37.0	0.404
	Duration of viewing on holidays	4 h per day or more	1075/2938	36.6	82/214	38.3	80/212	37.7	73/151	**48.3**	0.035*
Disposition of children	Enthusiastic	Relatively yes, Yes	2664/3285	81.1	194/242	80.2	192/238	80.7	136/166	81.9	0.972
	Prone to tantrums	Relatively yes, Yes	301/3097	9.7	13/243	**5.3**	19/240	7.9	24/166	**14.5**	0.016*
	Competitive	Relatively yes, Yes	2218/3303	67.2	159/243	65.4	162/240	67.5	108/165	65.5	0.917
	Sociable	Relatively yes, Yes	876/3298	26.6	67/242	27.7	63/237	26.6	38/166	22.9	0.731
	Voluntary	Relatively yes, Yes	1823/3299	55.3	133/242	55.0	143/240	59.6	92/166	55.4	0.631

*$P < 0.05$, **$P < 0.01$. For variables where there was a significant difference between the four groups, pairwise comparisons were undertaken, using Group I (Normal/Normal) as comparison, to determine the source of the difference (these numbers appear in bold).

Table 3 Factors in 6 years associated with the body build of girls from 3 years to 6 years

	Factors in 6 years	Category	Normal/Normal (Group 1)		Obese/Normal (Group 2)		Normal/Obese (Group 3)		Obese/Obese (Group 4)		Among 4 groups χ^2 test *P*-value
			No.	%	No.	%	No.	%	No.	%	
Eating	Breakfast	Eat every day	3050/3299	92.5	221/251	**88.0**	43/246	**17.5**	168/182	92.3	0.012*
		Eat with his/her mother	2088/3306	63.2	156/250	62.4	147/245	60.0	119/182	65.4	0.691
	Eating between meals	Once a week or more	3079/3286	93.7	237/248	95.6	232/247	93.9	166/180	92.2	0.544
		Snacks	1755/3299	53.2	125/251	49.8	147/247	59.5	100/181	55.2	0.150
	Late-night meal	1–2 times a week or more	325/3307	9.8	29/251	11.6	28/247	11.3	28/181	15.5	0.080
		Soft drink (containing sugar)	49/864	5.7	3/67	4.5	7/59	11.9	6/51	11.8	0.083
		Confections	220/638	34.5	20/45	44.4	18/44	40.9	12/36	33.3	0.476
	Food	Rice	2473/3309	74.7	197/251	78.5	203/246	**82.5**	150/181	**82.9**	0.003**
		Breads	2106/3309	63.6	150/251	59.8	140/246	**56.9**	101/181	**55.8**	0.025*
		Milk	1587/3309	48.0	112/251	44.6	127/246	51.6	84/181	46.4	0.455
		Juices	424/3309	12.8	27/251	10.8	23/246	9.3	14/181	7.7	0.077
		Green tea	1065/3309	32.2	76/251	30.3	97/246	39.4	66/181	36.5	0.063
		Eggs/Meats	2322/3309	70.2	179/251	71.3	195/246	**79.3**	135/181	74.6	0.015*
		Vegetables	1015/3309	30.7	90/251	35.9	82/246	33.3	64/181	35.4	0.182
		Soup	288/3309	8.7	20/251	8.0	28/246	11.4	13/181	7.2	0.409
		Fruits	1190/3309	36.0	87/251	34.7	75/246	30.5	52/181	28.7	0.082
	Instant noodles	1–2 times a week or more	488/3078	15.9	34/226	15.0	46/235	19.6	22/175	12.6	0.267
	Eating out	1–2 times a week or more	180/3298	5.5	10/249	4.0	16/247	6.5	14/179	7.8	0.342
	Eating speed	Slightly rapid eating, rapid eating	177/3126	5.7	27/241	**11.2**	53/235	**22.6**	45/168	**26.8**	< 0.0001**
Tutoring service		Participate	1996/3144	63.5	157/239	65.7	139/235	59.1	99/167	59.3	0.320
Sleep	Waking time	7 am or earlier	2587/3151	82.1	199/241	82.6	197/235	83.8	146/169	86.4	0.496
	Bedtime	10 pm or later	2825/3144	89.9	217/239	90.8	193/235	**82.1**	146/169	86.4	0.001**
	Duration of sleep	9 h or less	759/3145	24.1	65/239	27.2	68/235	28.9	52/169	30.8	0.078
Bowel movement (stool)	Frequency of evacuation	Once a day or more	2107/3123	67.5	163/239	68.2	169/232	72.8	123/169	72.8	0.196
	Regularity of evacuation time	Almost regular, regular	1629/3122	52.2	132/239	55.2	134/234	57.3	111/169	**65.7**	0.003**
Physical activity	Physical exercise, play outside	Likes very much	1771/3143	56.3	126/241	52.3	117/233	50.2	86/169	50.9	0.164
		Plays frequently	1020/2347	43.5	60/174	34.5	73/187	39.0	60/137	43.8	0.126
Physical club activity		Participate	624/3123	20.0	50/239	20.9	57/234	24.4	35/166	21.1	0.428
	Frequncies of activity	4–5 times a week or more	9/621	1.4	0/50	0.0	1/56	1.8	1/35	2.9	0.736
	Duration of activity	Less than 1 h a time	150/620	24.2	16/50	32.0	10/57	17.5	8/34	23.5	0.385
TV viewing	Duration of viewing on weekdays	3 h a weekday or more	864/3125	27.6	69/241	28.6	73/234	31.2	68/170	**40.0**	0.005**
	Duration of viewing on holidays	4 h a holyday or more	942/2826	33.3	78/219	35.6	81/211	38.4	72/149	**48.3**	0.001**
Disposition of children	Enthusiastic	Relatively yes, Yes	2401/3127	76.8	186/241	77.2	166/233	71.2	122/168	72.6	0.168
	Prone to tantrums	Relatively yes, Yes	330/3142	10.5	24/241	10.0	35/234	15.0	17/169	10.1	0.190
	Competitive	Relatively yes, Yes	2289/3142	72.9	173/240	72.1	172/235	73.2	121/169	71.6	0.977
	Sociable	Relatively yes, Yes	756/3140	24.1	56/241	23.2	64/235	27.2	37/167	22.2	0.637
	Voluntary	Relatively yes, Yes	1971/3143	62.7	173/241	**71.8**	145/235	61.7	110/169	65.1	0.038*

*$P < 0.05$, **$P < 0.01$. For variables where there was a significant difference between the four groups, pairwise comparisons were undertaken, using Group I (Normal/Normal) as comparison, to determine the source of the difference (these numbers appear in bold).

interpretations for this association. Sakata and Yoshimatsu suggested, from the study of obese rats, that eating rate abnormalities might be the result of a defect in hypothalamic neuronal histamine.[21] Due to a lack of satiety, rapid eating may cause overeating before the stomach senses fullness. A study of a multicomponent and multidisciplinary after-school intervention program indicated the possibility for improving this behavior.[22]

Short sleep duration (≤9 h) reached statistical significance among boys, confirming previous reports.[23] Similar results were previously reported among girls in the Toyama study, which were derived from the same subjects at age 3 years.[7] Because these previous reports demonstrated an association between hyposomnia and obesity by multivariate methods, which took confounders into consideration, these results could minimize the possibility of either a sampling error or an information bias. Serotonin, involved in both bulimic behavior and sleeping disorders, and the reduction of lipolytic activity that is maximal at night, and the reduction of growth hormone secretion, may account for this association.[24] In the boys' analysis, although increase in height from 3 years to 6 years did not reach statistical significance ($P = 0.21$), we found that growth rate of height in short sleepers seemed to be higher (21.4 ± 3.9 cm *vs* 20.8 ± 3.8 cm). However, we need to ascertain whether obesity leads to a shortage of sleep or if short sleepers are at risk of obesity.

Conversely, early bedtime showed significant association with the girls' overweight groups, and this result seems contradictory to results of short sleep duration ostensibly. Further studies, which consider other factors, are needed to validate this discrepancy.

Evacuation frequency seemed to be higher among overweight groups in both genders, which might be caused by higher bowel movement. Alternatively, Pecora *et al.* reported that constipation frequency was significantly higher in obese patients than in normal-weight subjects.[26] Although we need further studies, we should not overlook the association between body build and autonomic imbalance.

Physical inactivity significantly associated with boys' overweight subjects. Physical inactivity is a well-known factor that influences obesity, and in addition, it is expected to provide substantial benefits in reducing future morbidity and mortality from several chronic diseases in adults.[27] Several studies indicated that today's children might be less fit than children several decades ago and they might become more sedentary than earlier.[27] It is necessary to conduct education in early childhood for both high-risk children and their parents, to increase physical activity in daily living. However, among girls, physical inactivity failed to reach statistical significance. There may be gender differences in influencing factors on developing obesity during early childhood, and it might be necessary and practicable to conduct health promotion programs according to sex aimed at preventing obesity.

Concerning boys' psychiatric dispositions, 'prone to tantrums' showed significant association with overweight groups. Although, other personality factors failed to reach significance, they also appeared to be associated with overweight groups. Previous studies have reported association between psychopathology and obesity in adolescence.[28,29] We should not fail to notice this association, and when we conduct education for obesity we should give greater weight to these psychiatric results.

In both genders, duration of TV viewing was significantly higher among overweight groups. Proportions of long TV viewing seemed to increase with BMI values in a dose-dependent manner. These results were consistent with previous reports.[30] Locard *et al.* suggested that TV viewing would reduce energy expenditure in daily life.[23] In addition to this, TV viewing means exposure to advertisements for food products that can be fattening.[31] A national report in Japan suggested that communication between parents and children represented by 'watching TV and having talks' trend upwards as the child grows older.[32] Therefore, it may be important to warn of the risks of long TV viewing, in regards to the development of obesity in early childhood. Before television games were widely preferred among Japanese children, we should also bear in mind this new environmental factor.[7,33]

Eating between meals was associated positively with the overweight group (group 3) among boys. A late, high-calorie dinner was known for its association with obesity. Yet, group 2 showed lower frequency of this item. Group 2 consisted of subjects who were overweight at age 3 years and became normal at age 6 years, and were characterized as 'improving obesity at age 6'. Therefore, this result might be explained by modification of an unhealthy lifestyle (i.e. late-night eating) from ages 3 to 6 years.

There are several limitations in this study. First, we have to consider that we have shown only 'associations' and not 'causality' of changes in children's body build. However, this relatively large cohort population study could be very helpful in teasing out developing child obesity and may help to form intervention strategies. Second, in this study we used anthropometrical measures (height and weight) at birth by the questionnaire. Although they were derived from trustworthy data, namely the Maternal and Child Health Handbook obliged by the Law for the Health of Mothers and Children, we should take into account the reproducibility of anthropometrical data in evaluating the correlations of BMI in different ages. Third, we undertook a large number of statistical analyses and we need to be aware of problems leading from multiple statistical testing. Although we quoted significance level of 0.05, UKPDS group paper used 0.01 and attention must be paid to the interpretation of the results.[16]

In summary, significant factors at age 6 years associated with the overweight body build were: diet items (rice, green tea, eggs, meat, less bread), rapid eating, short sleep duration,

early bedtime, long TV viewing, dislike of physical activity, and frequent bowel movements. Elucidating the factors promoting the reasons for overweight children will be useful in conducting effective health education, aiming both to prevent obesity in childhood and in early life as well as to reduce chronic diseases in adult life.

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高齢者の転倒防止

新野（にいの）　直明（なおあきら）

高齢者の転倒防止の意義

◎高齢者の転倒は、頻度が高く、また、骨折などの重度の外傷を引き起こし、寝たきりの主要原因である。厚生労働省による国民生活基礎調査などの各種調査でも、転倒が寝たきり原因の上位を占める。例えば平成12年国民生活基礎調査では、骨折・転倒は65歳以上の寝たきり原因の11.8％を占めている。

◎転倒問題について検討しその予防を考えることは、単に外傷を予防するだけではなく、ADL（activities of daily living：日常生活動作能力）を保持し、QOL（quality of life：生活の質）の高い健康的な長寿を実現するために意義がある。

転倒した高齢者の割合

◎高齢者では、筋力の低下、平衡能力の低下、外部からの刺激に対する反応の鈍化など、さまざまな心身の機能の低下により転倒が増えるとされている。

◎わが国の地域在宅高齢者では、１年間の転倒者の割合は10～20％前後と考えられる。筆者が主任研究者を務めた厚生労働省長寿科学総合研究「地域の高齢者における転倒・骨折の発生と予防に関する疫学的研究」班では、北海道から沖縄まで複数の地域で転倒調査を実施したが、その結果でも１年間に転倒を経験する高齢者の割合は約13％～21％であった（表１）。

◎日本の高齢者における転倒者割合は、欧米のものよりも低いと言われる[2]。

◎老人ホームなどの施設や病院における転倒した高齢者の割合は、結果にばらつきがあるものの地域の在宅高齢者よりはその数値が高い傾向にある[2]。

表１　５地域の高齢者における１年間の転倒者数と割合

地域	男性（％）	女性（％）	計（％）
北海道	19.2（66/344）	21.7（89/410）	20.6（155/754）
新潟県	8.9（23/257）	15.6（62/398）	13.0（85/655）
静岡県	19.0（33/174）	22.0（62/282）	20.8（95/456）
長崎県	14.5（52/358）	17.0（63/371）	15.8（115/729）
沖縄県	11.1（35/316）	13.4（100/745）	12.7（135/1061）

（新野直明：総括研究報告、平成11年度厚生労働省長寿科学総合研究「地域の高齢者における転倒・骨折の発生と予防に関する疫学的研究」報告書（主任研究者：新野直明）、31-38、1999．より引用）

表2　在宅高齢者の転倒場所について

場所	人数	%
玄関	4	3.6
居間・部屋	5	4.4
廊下	4	3.6
階段	5	4.4
風呂場	4	3.6
その他屋内	8	7.1
屋内　計	30	26.7
庭	17	15.2
平らな道	11	9.8
坂道	4	3.6
田畑	14	12.5
階段	10	8.9
乗り物	6	5.4
その他屋外	20	17.9
屋外　計	82	73.3
総計	112	100.0

（国立長寿医療研究センター疫学研究部の実施する「老化に関する長期縦断疫学研究」の第1回目調査における70～79歳の結果）

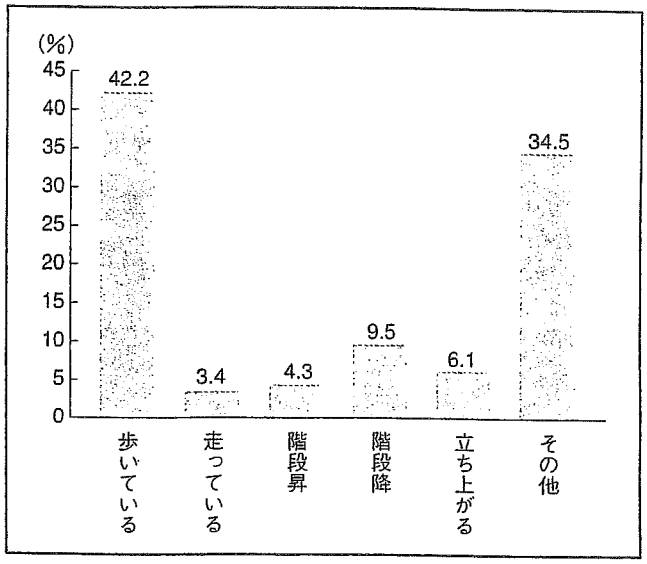

図1　転倒時の動作

（国立長寿医療研究センター疫学研究部の実施する「老化に関する長期縦断疫学研究」の第1回目調査における70～79歳の結果）

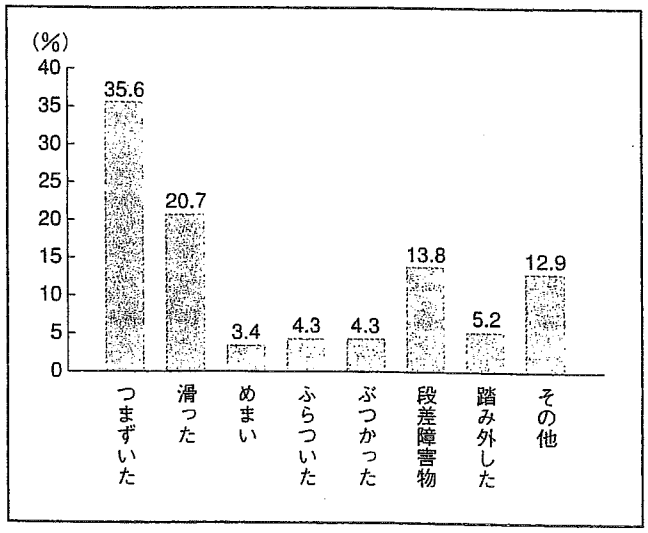

図2　転倒の最大原因

（国立長寿医療研究センター疫学研究部の実施する「老化に関する長期縦断疫学研究」の第1回目調査における70～79歳の結果）

転倒発生時の状況

- 転倒発生の絶対数が多い場所や時刻は、高齢者の利用量、活動量の多い場所、時間帯を反映すると考えられる。具体的には、日中、屋外、歩行中の転倒が多い。
- 国立長寿医療研究センター疫学研究部では、近隣地域の40歳～79歳の人を対象に「老化に関する長期縦断疫学研究」を実施している。その中で過去1年間の転倒状況を調べているが、参考までに70歳以上の人についての結果を見ると、6時～18時の日中に80％の転倒が発生しており、また、全転倒の約70％が屋外で発生していた（表2）。
- 転倒時の動作としては、「歩行中」が圧倒的に多い。階段を降りる場合の転倒も比較的多く報告されている（図1）。
- 転倒原因としては、外因の関与が大きい。前記の縦断研究でも、転倒原因としては「つまずいた」「滑った」「段差があった」などの外因が圧倒的に多い（図2）。
- 骨折の発生は、転倒の10％弱とされる[2]。
- 病院に入院している患者では、転倒発生時間帯としては夜間が多い（夜間に日中より転倒多い、または日中と同程度の頻度）、発生場所としては病室に次いでトイレが多いという傾向があり、在宅高齢者とは異なる傾向が見られる[2]。

表3　転倒の危険要因

1. 年齢
   加齢、高齢
2. 性別
   女性に危険性が高いとするものが多いが、否定的な報告もあり
3. 身体的・精神的疾病
   種々の循環器疾患、神経疾患、感覚器障害、痴呆、うつ、など
4. 薬剤
   睡眠薬、降圧薬、利尿薬、など
5. 特殊な行動
   入浴、排泄、など
6. 環境的要因
   段差、滑る床、不十分な照明、不適切な補助具、など
7. 転倒の既往

表4　転倒予防に役立つ環境整備の一例（在宅の場合を中心に）

A. 照明
   1. 十分な明るさを保つ。特に足元を明るく。
   2. 照明のスイッチをわかりやすいところ、使いやすいところにつける。
   3. 夜間に移動するところ（例：寝室からトイレへの廊下）には、常夜灯をつける。
   4. ちらつきの少ない照明にする。

B. 床
   1. 段差をなくす。
   2. 滑りにくい床にする（材質、ワックスをかけない、水分はすぐふき取るなど）。
   3. 滑りやすい部分には、滑りにくい敷物を敷く。
   4. 敷物が動かないように工夫する（鋲、テープ、など）。
   5. 敷物につまずかないように工夫する（凹凸をなくす、端をテープでとめる、など）。
   6. 床に障害物を置かない（座布団、電気・電話コード、背の低い家具、など）。

C. 家具
   1. 椅子、ベッドなどは移動しやすい高さにする。
   2. 寄り掛かっても倒れないような安定性を考える。
   3. 家具の間隔を十分にとって、移動が妨げられないようにする。

D. 階段
   1. 手すりをつける。
   2. ステップの端を明示する。
   3. ステップの凹凸、傾き、破損などをなくす。

E. その他
   1. 浴室、トイレ、廊下などに手すりをつける。
   2. 電話、電気器具のリモコンなどは使いやすいところに置く。
   3. スリッパなどを室内では利用しない。

（新野直明：“転倒の予防と生活指導”、脳血管障害の長期管理、矢崎義雄、現代医療社、1999、213-220. より引用）

転倒の危険要因

◎高齢者の転倒は、心身機能の変化・低下と周囲の環境が相互に関係しあって発生するものであり、多数の要因が関与すると考えられる。これまでに報告されている高齢者の転倒発生に関連する要因を**表3**にまとめた。

転倒を予防するために

◎転倒の発生を予防するためには、他の疾患、事故と同様にその危険要因を取り除くことが大きな意味を持つ。そのための対応としては、以下のようなことが考えられる。

A. 疾病の予防・治療

◎起立性低血圧などの血圧の変化、関節炎などの筋骨格系疾患、白内障などの感覚器障害は、転倒のリスクを高める。

◎ごく一般的な疾患（胃炎、インフルエンザなど）も、体力の低下などにより転倒を誘発する危険性がある。したがって、健康の維持、各種疾患の予防、あるいは疾病に対する適切な医学的管理、治療が重要である。

B. 適切な薬剤の使用

◎薬剤の中には、転倒との関連が指摘されているものがある。これらの薬剤を適切に使用すること、さらには、薬剤により転倒の危険性が高まることを患者や家族に伝えることも重要である。