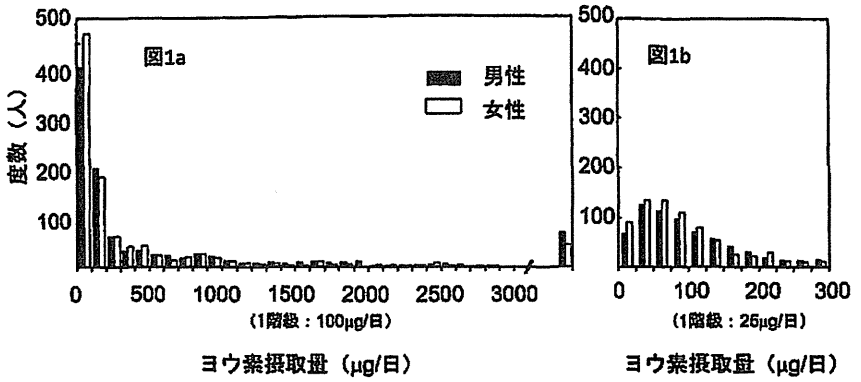


図1　a. ヨウ素摂取量の全体のヒストグラム（μg/日），b. 0-300μg/ 日範囲のヨウ素摂取量のヒストグラム（μg/ 日）

表2　中高年者における性・年代群別ヨウ素摂取量の各パーセンタイル値と食事摂取基準値

	食事摂取基準（2010年版）								パーセンタイル値				
	EAR	RDA	AI	DG	UL	*n*	Mean	SD	5	25	50	75	95
男性（*n*＝1065）													
40-44歳	95	130	—	—	2200	134	582 ± 1715		16	54	108	364	2338
45-49歳	95	130	—	—	2200	95	462 ± 929		21	67	118	388	2470
50-54歳	95	130	—	—	2200	104	659 ± 1464		16	55	117	651	2572
55-59歳	95	130	—	—	2200	147	1017 ± 2279		25	61	150	705	4330
60-64歳	95	130	—	—	2200	139	734 ± 1582		22	69	152	850	3163
65-69歳	95	130	—	—	2200	128	753 ± 1217		23	70	172	1027	3181
70-74歳	95	130	—	—	2200	133	1409 ± 2969		22	78	220	1501	8051
75-79歳	95	130	—	—	2200	113	1134 ± 2440		26	79	250	953	6489
80歳以上	95	130	—	—	2200	72	1301 ± 2348		19	98	271	1075	6666
総数	—	—	—	—	—	1065	890 ± 2012		22	66	151	799	3956
女性（*n*＝1050）													
40-44歳	95	130	—	—	2200	144	441 ± 1081		19	41	79	317	2352
45-49歳	95	130	—	—	2200	103	368 ± 739		19	55	113	306	1617
50-54歳	95	130	—	—	2200	97	546 ± 1333		15	49	97	222	4038
55-59歳	95	130	—	—	2200	137	1018 ± 4016		20	54	112	440	5022
60-64歳	95	130	—	—	2200	138	721 ± 1600		18	61	136	653	3479
65-69歳	95	130	—	—	2200	119	655 ± 1420		23	62	128	566	3671
70-74歳	95	130	—	—	2200	125	786 ± 2302		20	61	138	462	3078
75-79歳	95	130	—	—	2200	109	623 ± 1195		24	68	139	571	2859
80歳以上	95	130	—	—	2200	78	1084 ± 3543		18	75	168	649	3307
総数	—	—	—	—	—	1050	688 ± 2184		19	58	118	480	3167

EAR：推定平均必要量，RDA：推奨量，AI：目安量，DG：目標量，UL：耐容上限量，Mean：1日平均摂取量，SD：標準偏差

2. ヨ ウ 素

ヨウ素摂取量は，幅広く分布していたため，図1aには全体の分布を確認出来るように1階級100 μg/日あたりの度数分布を示し，図1bには最頻値の0-300 μg/日の範囲を1階級25 μg/日で示した。男女ともに50-75 μg/日付近にピークのある非常に右裾に長い尾を引いた分布であることが特徴であった（図1）。3,000 μg/日を超える者は男性で77名（7.2%），女性で56名（5.3%）であった。表2より，食事摂取基準の推奨量と本研究対象者での中央値はほぼ同等であり，女性の45-49歳を除いたすべての群で，95パーセンタイル値が耐容上限値を上回っていた。

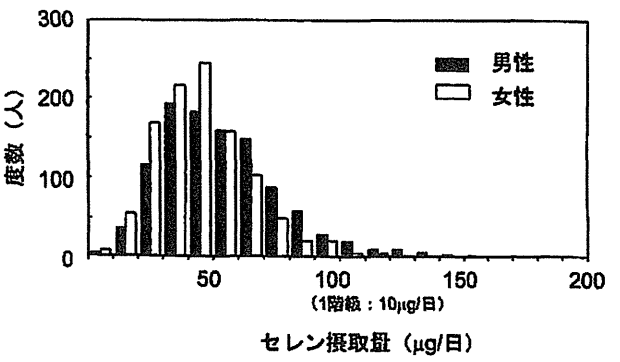


図2　セレン摂取量のヒストグラム（μg/日）

表3 中高年者における性・年代群別セレン摂取量の各パーセンタイル値と食事摂取基準値

	食事摂取基準（2010年版）					パーセンタイル値						
	EAR	RDA	AI	DG	UL	*n*	Mean SD	5	25	50	75	95
男性（*n*＝1065）												
40–44歳	25	30	—	—	300	134	51.4±26.3	20.3	34.5	44.6	64.1	103.0
45–49歳	25	30	—	—	300	95	50.1±24.0	21.5	31.6	45.0	69.9	91.0
50–54歳	25	30	—	—	280	104	55.5±27.5	22.3	39.5	50.0	65.6	100.0
55–59歳	25	30	—	—	280	147	54.1±22.7	23.1	37.4	50.9	68.8	99.0
60–64歳	25	30	—	—	280	139	57.3±23.0	27.0	40.5	56.1	68.0	103.9
65–69歳	25	30	—	—	280	128	58.0±26.8	24.6	35.1	53.7	74.4	104.0
70–74歳	25	30	—	—	260	133	50.6±21.6	19.3	32.0	51.2	65.9	83.9
75–79歳	25	30	—	—	260	113	50.3±20.9	19.2	33.8	47.2	64.1	86.2
80歳以上	25	30	—	—	260	72	54.3±26.9	20.3	33.9	47.1	70.9	111.0
総数	—	—	—	—	—	1065	53.6±24.4	21.7	35.2	50.1	66.9	97.9
女性（*n*＝1050）												
40–44歳	20	25	—	—	230	144	42.1±16.9	16.4	29.0	42.9	52.4	72.2
45–49歳	20	25	—	—	230	103	41.7±16.3	17.5	31.1	42.2	48.5	72.2
50–54歳	20	25	—	—	230	97	47.9±20.9	16.3	34.1	45.0	58.7	89.5
55–59歳	20	25	—	—	230	137	46.4±16.8	24.0	34.8	43.6	54.4	80.4
60–64歳	20	25	—	—	230	138	48.7±19.5	21.0	35.2	45.5	63.6	86.7
65–69歳	20	25	—	—	230	119	45.8±18.2	19.1	31.7	44.8	59.2	73.0
70–74歳	20	25	—	—	210	125	44.7±19.4	19.4	31.6	40.7	56.6	75.8
75–79歳	20	25	—	—	210	109	44.5±19.6	19.2	30.5	42.3	55.8	80.2
80歳以上	20	25	—	—	210	78	39.6±18.7	15.8	25.9	35.9	50.0	74.3
総数	—	—	—	—	—	1050	44.8±18.6	19.2	31.5	42.9	55.1	78.9

EAR：推定平均必要量，RDA：推奨量，AI：目安量，DG：目標量，UL：耐容上限量，Mean：1日平均摂取量，SD：標準偏差

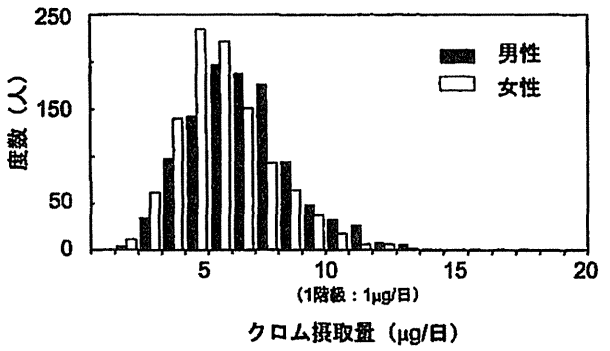


図3 クロム摂取量のヒストグラム（μg/日）

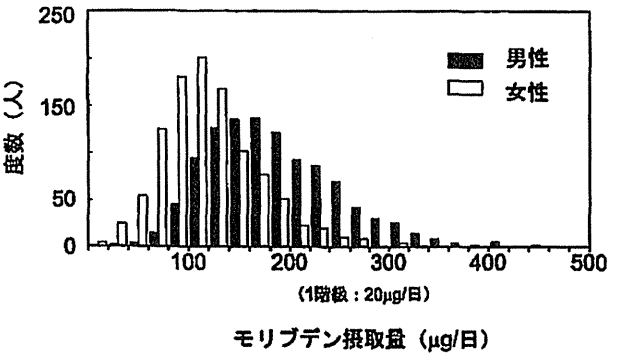


図4 モリブデン摂取量のヒストグラム（μg/日）

3. セ レ ン

セレン摂取量は，男性で30 μg/日付近にピークのある右裾広がりの分布であった。女性は50 μg/日付近にピークのある右裾広がりの分布であった（図2）。食事摂取基準の推奨量に対して中央値では1.5–1.8倍量であり，95パーセンタイル値は耐容上限値の0.3倍であった（表3）。

4. ク ロ ム

クロム摂取量は，男性で6 μg/日付近にピークがあり，女性は5 μg/日付近にピークのある右裾広がりの分布であった（図3）。食事摂取基準の推奨量と比べると中央値で0.15倍量であった。95パーセンタイル値でも推奨量の0.24–0.3倍であった（表4）。

5. モリブデン

モリブデン摂取量は，男性で160–180 μg/日付近にピークがあり，女性は100–120 μg/日付近にピークのある右裾広がりの分布であった（図4）。食事摂取基準の推奨量と比べると5パーセンタイル値で2倍以上摂取されていた。95パーセンタイル値では耐容上限量の約0.5倍であった（表5）。

6. ビ オ チ ン

ビオチン摂取量は，男性で25–30 μg/日付近にピークがあり，女性は20–25 μg/日付近にピークのある右裾広がりの分布であった（図5）。食事摂取基準の目安量と比べると中央値で半量しか摂れておらず，95パーセンタイル値でも男性の60–64歳群を除いたすべての群で目安量を下回った（表6）。

表4　中高年者における性・年代群別クロム摂取量の各パーセンタイル値と食事摂取基準値

	食事摂取基準（2010年版）								パーセンタイル値				
	EAR	RDA	AI	DG	UL	*n*	Mean	SD	5	25	50	75	95
男性（*n*＝1065）													
40–44歳	35	40	—	—	—	134	6.3	2.4	2.6	4.7	5.9	7.7	11.2
45–49歳	35	40	—	—	—	95	6.2	2.4	2.8	4.6	6.0	7.5	10.6
50–54歳	30	40	—	—	—	104	6.7	2.6	3.1	5.0	6.3	8.0	11.6
55–59歳	30	40	—	—	—	147	6.4	2.2	3.3	4.8	6.2	7.6	9.6
60–64歳	30	40	—	—	—	139	6.8	2.5	3.2	5.3	6.3	7.8	11.7
65–69歳	30	40	—	—	—	128	6.8	2.2	3.6	5.2	6.5	8.1	11.1
70–74歳	30	35	—	—	—	133	6.7	2.4	3.1	4.9	6.5	8.1	11.1
75–79歳	30	35	—	—	—	113	6.2	2.1	3.1	4.6	6.0	7.6	9.4
80歳以上	30	35	—	—	—	72	6.6	2.2	3.3	5.2	6.5	7.6	10.2
総数	—	—	—	—	—	1065	6.5	2.4	3.1	4.9	6.3	7.8	10.8
女性（*n*＝1050）													
40–44歳	25	30	—	—	—	144	5.4	2.1	2.5	3.8	5.0	6.6	9.1
45–49歳	25	30	—	—	—	103	5.0	1.6	2.6	3.9	4.7	5.8	8.1
50–54歳	25	30	—	—	—	97	5.8	2.3	3.0	4.2	5.5	6.9	9.9
55–59歳	25	30	—	—	—	137	5.7	2.1	2.8	4.4	5.4	6.6	9.6
60–64歳	25	30	—	—	—	138	5.9	2.0	3.3	4.6	5.6	6.7	9.7
65–69歳	25	30	—	—	—	119	5.7	1.9	2.9	4.6	5.4	6.7	9.7
70–74歳	20	25	—	—	—	125	5.8	2.0	2.9	4.4	5.4	7.3	9.4
75–79歳	20	25	—	—	—	109	5.7	2.1	2.6	4.1	5.4	7.0	9.4
80歳以上	20	25	—	—	—	78	5.8	3.4	2.3	4.3	5.1	6.9	9.7
総数	—	—	—	—	—	1050	5.6	2.2	2.8	4.2	5.3	6.7	9.5

EAR；推定平均必要量，RDA；推奨量，AI；目安量，DG；目標量，UL；耐容上限量，Mean；1日平均摂取量，SD；標準偏差

表5　中高年者における性・年代群別モリブデン摂取量の各パーセンタイル値と食事摂取基準値

	食事摂取基準（2010年版）								パーセンタイル値				
	EAR	RDA	AI	DG	UL	*n*	Mean	SD	5	25	50	75	95
男性（*n*＝1065）													
40–44歳	25	30	—	—	600	134	177.0	69.1	91.8	122.2	173.3	213.1	302.8
45–49歳	25	30	—	—	600	95	185.5	79.4	93.9	129.1	170.8	218.7	312.8
50–54歳	20	25	—	—	600	104	182.2	63.9	81.7	130.9	184.2	229.4	276.0
55–59歳	20	25	—	—	600	147	179.6	62.4	106.2	130.6	171.3	219.2	295.6
60–64歳	20	25	—	—	600	139	191.3	64.0	109.2	144.1	175.8	229.7	312.9
65–69歳	20	25	—	—	600	128	193.3	69.1	95.5	143.9	188.0	237.4	307.6
70–74歳	20	25	—	—	550	133	188.6	65.7	100.2	147.0	173.9	221.3	327.3
75–79歳	20	25	—	—	550	113	181.8	63.0	97.2	137.9	171.6	218.4	277.0
80歳以上	20	25	—	—	550	72	190.5	58.9	109.9	145.3	181.7	232.6	296.3
総数	—	—	—	—	—	1065	185.3	66.3	97.1	137.2	175.8	224.9	305.2
女性（*n*＝1050）													
40–44歳	20	25	—	—	500	144	129.9	47.9	60.6	93.9	124.6	153.6	222.9
45–49歳	20	25	—	—	500	103	119.2	44.1	49.9	90.8	116.0	148.8	194.5
50–54歳	20	25	—	—	500	97	132.8	48.9	60.5	100.5	128.2	156.2	229.9
55–59歳	20	25	—	—	500	137	142.4	47.0	72.6	109.2	139.6	166.7	234.1
60–64歳	20	25	—	—	500	138	141.6	45.2	79.5	110.4	134.6	171.0	222.9
65–69歳	20	25	—	—	500	119	150.8	50.0	84.1	120.7	145.0	171.9	253.4
70–74歳	20	20	—	—	450	125	144.6	49.7	80.0	109.6	132.5	180.8	233.7
75–79歳	20	20	—	—	450	109	146.4	47.5	82.0	115.9	138.9	174.1	228.4
80歳以上	20	20	—	—	450	78	145.7	47.1	79.7	109.1	135.4	174.2	236.5
総数	—	—	—	—	—	1050	139.3	48.2	71.5	106.4	132.4	166.8	229.9

EAR；推定平均必要量，RDA；推奨量，AI；目安量，DG；目標量，UL；耐容上限量，Mean；1日平均摂取量，SD；標準偏差

表6 中高年者における性・年代群別ビオチン摂取量の各パーセンタイル値と食事摂取基準値

	食事摂取基準（2010年版）					パーセンタイル値						
	EAR	RDA	AI	DG	UL	*n*	Mean	SD	5	25	50	75	95
男性（*n*＝1065）													
40–44歳	—	—	50	—	—	134	26.4 ± 11.5		13.9	20.4	24.4	30.5	41.1
45–49歳	—	—	50	—	—	95	27.9 ± 11.0		15.0	20.9	25.9	32.6	50.9
50–54歳	—	—	50	—	—	104	28.2 ± 9.1		16.1	22.2	27.3	32.0	43.3
55–59歳	—	—	50	—	—	147	30.3 ± 13.4		16.0	22.9	28.6	33.8	48.1
60–64歳	—	—	50	—	—	139	33.1 ± 16.2		15.8	24.0	31.0	38.4	54.0
65–69歳	—	—	50	—	—	128	30.9 ± 15.3		16.0	23.6	27.9	34.0	49.9
70–74歳	—	—	50	—	—	133	29.7 ± 10.2		17.2	23.5	28.1	34.2	44.7
75–79歳	—	—	50	—	—	113	28.3 ± 12.4		17.1	21.0	26.0	31.9	40.4
80歳以上	—	—	50	—	—	72	28.6 ± 12.9		16.8	21.6	26.2	32.2	46.1
総数	—	—	—	—	—	1065	29.4 ± 12.9		16.0	22.4	27.3	33.6	46.5
女性（*n*＝1050）													
40–44歳	—	—	50	—	—	144	23.3 ± 12.0		13.1	17.9	21.6	26.0	35.9
45–49歳	—	—	50	—	—	103	22.3 ± 6.5		12.3	17.6	21.8	25.9	36.0
50–54歳	—	—	50	—	—	97	25.2 ± 9.5		11.4	19.4	24.2	29.2	42.2
55–59歳	—	—	50	—	—	137	26.3 ± 9.7		14.2	20.3	24.9	30.3	39.3
60–64歳	—	—	50	—	—	138	27.2 ± 10.0		15.6	21.3	25.2	31.0	43.5
65–69歳	—	—	50	—	—	119	28.1 ± 11.8		16.1	21.2	26.2	31.3	43.2
70–74歳	—	—	50	—	—	125	26.3 ± 11.6		14.4	20.2	23.6	28.3	40.2
75–79歳	—	—	50	—	—	109	24.9 ± 9.0		13.1	19.4	22.9	28.3	42.2
80歳以上	—	—	50	—	—	78	24.5 ± 12.0		13.0	17.9	22.1	26.8	45.0
総数	—	—	—	—	—	1050	25.4 ± 10.5		14.1	20.0	23.8	28.9	40.2

EAR：推定平均必要量，RDA：推奨量，AI：目安量，DG：目標量，UL：耐容上限量，Mean：1日平均摂取量，SD：標準偏差

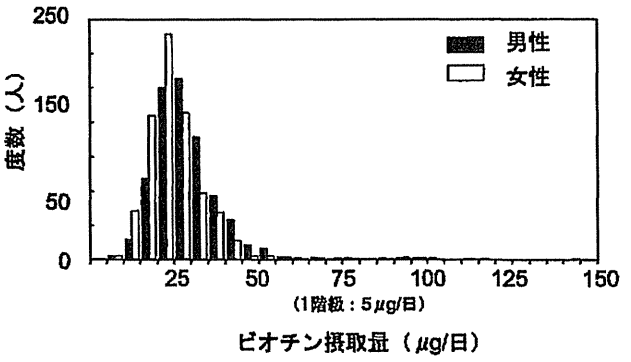


図5 ビオチン摂取量のヒストグラム（μg/日）

考　　察

新しく公表された食品成分表2010のヨウ素，セレン，クロム，モリブデンおよびビオチンの成分値は収載食品数498種（全体の26.5%）と欠損の多いデータベースであり，本調査で出現した全食品コードの中で，これらの成分値が欠損しているものの割合は43%であった。また，我々の食事調査では，「焼きコード」や「ゆでコード」など調理条件コードが存在する場合は，それらを用いてコード化しているため，調理条件コードのデータが欠損しているものの成分値が反映されていない。したがって今回報告したこれらの1日平均摂取量は，真の値を表しているとは言い難い。しかし，わが国の一般地域住民での摂取量を初めて算出した結果であり，その分布形態や性差，年代差を検討することは意義があると考える。

ヨウ素摂取量は，どの年代でも多く摂られており，女性の45–49歳を除いたすべての群で，95パーセンタイル値が耐容上限値を上回っていた。例えば，素干し昆布を10g食べると，ヨウ素摂取量は24mgになる。従来の日本型食生活でわかめや昆布を多く摂る日本人のヨウ素の生体利用や排泄機構が欧米人とは異なることが報告されているが[8]，耐容上限値を超える人の摂取量と健康事象との関わりを明らかにすることが必要である。ヨウ素が特異的に含まれる藻類にデータが収載されているため欠損値の影響は少ないと考えられる。

モリブデン摂取量は，本研究対象者の5パーセンタイル値で，食事摂取基準の推奨量と比べ2倍以上摂取されていた。モリブデンは穀類，豆類に多く含まれており[9]，本研究対象者でも，納豆やご飯など日常的に摂取する食品からの摂取が多く，データ欠損の影響が少ないことが考えられた。また，最頻値に性差が大きく認められたが，男女のモリブデン摂取量の差の1.33倍は，穀類摂取量で調整すると性差は1.07倍と小さくなることより，性差は穀類摂取量の影響が大きいと考えられた。

セレンは，日本では魚介類からの摂取が多く[9]，本研究対象者でも，マグロやカツオ，アジなどからの摂取量が多かった。食事摂取基準の推奨量と比べると中央値で

1.6–1.8倍量多く摂られていた。吉田[9]の報告の食事のセレン含有量である100 μg/日と比べると，やや低い見積もりであった。これは，調理条件コードのデータ欠損の影響が大きいと考えられる。また，モリブデン，セレンともに耐容上限値と比べ95パーセンタイル値は約0.3–0.6倍であり，現状の欠損の多いデータベースではあるが，食事摂取基準の範囲に分布があるモリブデン，セレンは過不足のリスクが低いことが考えられる。

一方，クロム摂取量では95パーセンタイル値でも8.1–11.7 μg/日であり，食事摂取基準の推奨量と比べ，かなり低値であった。クロムは肉類，魚介類，種実類に多いと報告があるが[10]，本研究対象者ではミルクチョコレートや赤ワインからなど嗜好品から摂取されていた。これは，クロムが多く含まれるハムなどの食肉加工品が，今回の成分表では欠損値となっていた影響が大きいと考えられる。

ビオチン摂取量も95パーセンタイル値で35.9–54.0 μg/日であり，男性の45–49歳群，60–64歳群を除いたすべての群で目安量を下回った。ビオチンは卵類，肉類，種実類に多く含まれており[11]，本研究対象者では鶏レバーから摂取されているのが目立った。しかし，今回の成分表では，肉類の一部の品種の「生コード」に分析値が入っているのみであり，調理してから喫食することの多い肉類での欠損の影響が大きいことが考えられた。このことより，クロムおよびビオチンは日常的に摂取する食品や特異的に含まれる食品が欠損値となっているため，ヨウ素，セレン，モリブデンよりも真の摂取量から大きくずれている可能性が推測された。今後の食品成分表の補充整備が望まれる。

今後，摂取量と健康事象などとの関連を調べるには，Sasaki *et al.*[12]によって報告された脂肪酸成分表のようなデータベースの補充整備により調理条件コードの補充を行うことが早急に対応できる方法の一つであると考える。しかし，クロムやビオチンについては，分析対象食品の検討が望まれる。同時に，基準値策定を視野に入れ，日本人を研究対象とした生体利用率などの基礎研究データの報告を待望する。

最後に，これらの微量元素やビタミンでは，マクロの栄養成分と異なり，季節，食品産地や個人内変動が大きく，3日間の食事記録調査では，過不足は言及できない[13]。しかし，日本の中高年者の集団の栄養摂取の現状を示すことによる問題提起の一つになることを期待する。

調査に参加し，ご協力いただいた対象者および調査スタッフ，栄養計算のコード化を請負っていただいた管理栄養士の皆さまに心から感謝いたします。

本研究の一部は長寿医療研究開発費（23-33）「老化及び老年病に関する長期縦断疫学研究」の助成を受けて行ったものです。

文　献

1) 文部科学省科学技術・学術審議会資源調査分科会編（2011）日本食品標準成分表2010．医歯薬出版，東京
2) 文部科学省科学技術・学術審議会資源調査分科会編（2006）五訂増補日本食品標準成分表（第2版）．医歯薬出版，東京
3) 健康・栄養情報研究会（1999）第六次改訂日本人の栄養所要量 食事摂取基準．第一出版，東京
4) 木村修一，小林修平監修（2008）最新栄養学［第9版］．建帛社，東京
5) 厚生労働省「日本人の食事摂取基準」策定検討会（2009）日本人の食事摂取基準［2010年版］．第一出版，東京
6) Shimokata H, Ando F, Niino N（2000）A new comprehensive study on aging—the National Institute for Longevity Sciences, Longitudinal Study of Aging（NILS-LSA）. *J Epidemiol* **10**（suppl. 1）: S1–9.
7) Imai T, Otsuka R, Kato Y, Nakamura M, Ando F, Shimokata H（2009）Advantages of taking photographs with the 3-day dietary record. *J Integr Stud Diet Habits* **20**: 203–10.
8) Zimmermann MB, Hess SY, Molinari L, Benoist B, Delange F, Braverman LE, Fujieda K, Ito Y, Jooste PL, Moosa K, Pearce EN, Pretell EA, Shishiba Y（2004）New reference values for thyroid volume by ultrasound in iodine sufficient schoolchildren: a World Health Organization/Nutrition for Health and Development Iodine Deficiency Study Group Report. *Am J Clin Nutr* **79**: 231–7.
9) 吉田宗弘（1992）日本人のセレン摂取と血中セレン濃度．日本栄養・食糧学会誌 **45**, 485–94.
10) 糸川嘉則編（2003）ミネラルの事典．朝倉書店，東京
11) 渡邊敏明，谷口歩美（2009）日本人における食事からのビオチン摂取量の推定．ビタミン **83**, 461–8.
12) Sasaki S, Kobayashi M, Tsugane S（1999）Development of substituted fatty acid food composition table for the use in nutritional epidemiologic studies for Japanese populations: Its methodological backgrounds and evaluation. *J Epidemiol* **9**: 190–207.
13) Ogawa K, Tsubono Y, Nishino Y, Watanabe Y, Ohkubo T, Watanabe T, Nakatsuka H, Takahashi N, Kawamura M, Tsuji I, Hisamichi S（1999）Inter- and intra-individual variation of food and nutrient consumption in a rural Japanese population. *Eur J Clin Nutr* **53**: 781–5.

J Jpn Soc Nutr Food Sci **64**: 21–28 (2012)

Research Data

Intake of Trace Minerals and Biotin in the Community-dwelling Middle-aged and Elderly

Yuki Kato,*[,1] Rei Otsuka,[1] Tomoko Imai,[1,2] Fujiko Ando,[1,3] and Hiroshi Shimokata[1]

(Received July 19, 2011; Accepted October 24, 2011)

Summary: The Japanese food standard composition table has been revised after an interval of five years, and the last version includes the contents of iodine, selenium, chromium, molybdenum, and biotin. Although these nutrients were already referred to in the sixth revision of the Japanese Dietary Reference Intake for Nutrient Requirements published in 2000, these nutrients had not been included in previous food composition tables, and therefore the average intakes for Japanese have been unclear. In this study, iodine, selenium, chromium, molybdenum, and biotin intakes were calculated based on three-day dietary records (3DR) in a community-dwelling population aged 40–89 years (1,065 men and 1,050 women). The intakes were estimated by sex and five-year age groups. The median daily intakes of iodine, selenium, chromium, molybdenum, and biotin were 151.0 μg, 50.1 μg, 6.3 μg, 175.8 μg, and 27.3 μg in men, and 117.5 μg, 42.9 μg, 5.3 μg, 132.4 μg, and 23.8 μg in women, respectively.

Key words: iodine, selenium, chromium, molybdenum, biotin

* Corresponding author (E-mail: kyuki@ncgg.go.jp)
[1] Department for Development of Preventive Medicine, National Center for Geriatrics and Gerontology, 35 Gengo, Morioka-machi, Obu, Aichi 474–8511, Japan
[2] Faculty of Human Life and Science, Doshisha Women's College of Liberal Arts, Teramachi Nishiiru, Imadegawa-dori, Kamigyo-ku, Kyoto 602–0893, Japan
[3] Faculty of Health and Medical Sciences, Aichi Shukutoku University, 9, Nagakute Katahira, Nagakute-cho, Aichi-gun, Aichi 480–1197, Japan

J Phys Fitness Sports Med, **1(1)**: 1-8 (2012)

JPFSM: ***Regular Article***

Regular exercise history as a predictor of exercise in community-dwelling older Japanese people

Rumi Kozakai[1,2*], Fujiko Ando[2,3], Heung Youl Kim[2,4], Taina Rantanen[1] and Hiroshi Shimokata[2]

[1] *Gerontology Research Center, University of Jyväskylä, P.O. Box 35 (Viveca), Jyväskylä, FIN-40014, Finland*

[2] *Department for Development of Preventive Medicine, National Center for Geriatrics and Gerontology, 35 Gengo, Morioka-cho, Obu, Aichi, 474-8511, Japan*

[3] *Faculty of Health and Medical Sciences, Aichi Shukutoku University, 9, Katahira, Nagakute, Aichi, 480-1197, Japan*

[4] *Department of Sport and Health Science, Tokai Gakuen University, 21-233, Nishinohora, Ukigai-cho, Miyoshi, Aichi, 470-0207, Japan*

Received: November 1, 2011 / Accepted: February 6, 2012

Published by
The Japanese Society of Physical Fitness and Sports Medicine

J Phys Fitness Sports Med, 1(1): 1-8 (2012)

JPFSM: *Regular Article*

Regular exercise history as a predictor of exercise in community-dwelling older Japanese people

Rumi Kozakai[1,2*], Fujiko Ando[2,3], Heung Youl Kim[2,4], Taina Rantanen[1] and Hiroshi Shimokata[2]

[1] *Gerontology Research Center, University of Jyväskylä, P.O. Box 35 (Viveca), Jyväskylä, FIN-40014, Finland*
[2] *Department for Development of Preventive Medicine, National Center for Geriatrics and Gerontology, 35 Gengo, Morioka-cho, Obu, Aichi, 474-8511, Japan*
[3] *Faculty of Health and Medical Sciences, Aichi Shukutoku University, 9, Katahira, Nagakute, Aichi, 480-1197, Japan*
[4] *Department of Sport and Health Science, Tokai Gakuen University, 21-233, Nishinohora, Ukigai-cho, Miyoshi, Aichi, 470-0207, Japan*

Received: November 1, 2011 / Accepted: February 6, 2012

Abstract A physically active lifestyle is important across the entire life span. However, little is known about life-long participation in regular exercise among older people. The purpose of the present study was to describe regular exercise throughout a person's lifetime and evaluate the impact of exercise earlier in life on participation in exercise at age 60 and over. The participants were 984 community-dwelling older people aged 60 to 86 years. Each participant's life was divided into five age categories: 12-19, 20-29, 30-39, 40-59, and 60 years and over. The association between exercise at an earlier age and that at 60 years and over was assessed using logistic regression analysis adjusted for potential confounders. Men had exercised throughout their lives more than women. Among women, participation in exercise during their 20s and 30s showed a sharp decline. The preference for exercise differed according to age and gender. Among men, the most common patterns of exercise throughout life were exercise during all the age categories, and starting exercise at age 60 and over; whereas in women the most common pattern was no exercise at all. The adjusted odds ratio of exercise at 40-59 years for exercise at age 60 and over was 5.85 (95% confidence interval: 3.82-8.96) among men and 6.89 (4.23-11.23) among women. Regular exercise in the younger age categories affected exercise at age 60 and over among men, but not among women. Regular exercise at 40-59 years was a strong predictor of exercise at 60 years and over in both men and women.

Keywords : regular exercise, older people, life course, random sampling data

Introduction

Physical activity is an important health behavior across the course of one's life. The benefits of physical activity in preventing health decline and physical function loss have been demonstrated, especially for frail and aged people[1]. The Ministry of Education, Culture, Sports, Science and Technology in Japan reported that the participation rate of older people in physical activity and fitness has slightly increased in the past decade[2,3]. However, more than 40 % of older people aged 70 years and older did not participate in any exercise during the past year[4]. Insufficient physical activity remains a public health concern among older people in Japan.

Engaging in sports activities in childhood and adolescence is known to predict physical activity in adulthood[5]. A low level of physical activity in early life has been found to predict physical inactivity in adulthood[6]. However, most longitudinal studies have demonstrated that sports activities in early life have an effect on physical activity in young adulthood[5,6]. It remains unclear whether sports activities in early life are associated with physical activity at an older age. Some studies have found that a history of physical activity was associated with current physical activity in older people[7,8]. In an earlier study we found that the experience of exercise in adolescence was associated with a higher level of leisure-time physical activity in middle-aged and elderly Japanese women[9]. However, little basic descriptive data exists on individual variation in participation in exercise throughout the life span and the impacts of early exercise on physical activity in later life among community-dwelling Japanese older people.

The purpose of the present study was to describe regular exercise throughout the life course and evaluate the effect of early exercise on the participation in exercise at the age of 60 years and over.

*Corresponding author. kozakai@ncgg.go.jp

Methods

Study population. The investigation is a part of the 4th survey of the National Institute for Longevity Sciences - Longitudinal Study of Aging (NILS-LSA), which is a follow-up study on the causes of geriatric diseases and health problems in older people. The NILS-LSA was based on data obtained from interviews and laboratory examinations of medical, nutritional, psychological, and physical fitness variables. The details of the study can be found elsewhere[10]. The initial survey of the NILS-LSA involved 2,267 men and women aged 40-79 years, including almost 300 men and 300 women for each decade (40s, 50s, 60s and 70s). The participants were gender- and decade age-stratified random samples of the residents of Obu-shi and Higashiura-cho, Aichi Prefecture, in central Japan. The participants were drawn from resident registrations in cooperation with local governments. All subjects lived or had lived at home in the community. The participants in the present study comprised 523 men and 461 women aged 60-86 years. All the NILS-LSA procedures were already approved by the Ethical Committee of the National Center for Geriatrics and Gerontology, and all of the participants signed a written informed consent.

Measures and Procedures. Regular exercise was assessed using a questionnaire and an interview. The questionnaire was based on a questionnaire developed by the Japanese Lifestyle Monitoring Group[11]. The participants were asked for the type, time, frequency and duration of their regular exercise from the age of 12 years to the present with the question "What physical activities or sports have you participated in during these age categories?" The participants reported the types of physical activities and sports they had engaged in from a list of alternatives. These were coded as 1) light activities such as walking, gymnastic exercise and gardening, 2) moderate activities such as brisk walking, dancing and swimming for pleasure, 3) vigorous activities with increased breathing and sweating such as jogging and playing tennis, 4) exhausting activities such as various competitive sports. Frequency of participation was defined as how often they participated in physical activities or sports per week. The duration of each activity was calculated with 1 year as the basic unit. Physical activities or sports that were engaged in for at least 20 minutes, once a week and over 1 year, excluding physical education at school, were defined as regular exercise. Life span was divided into five age categories: 12-19, 20-29, 30-39, 40-59 and 60 years and over. The age categories of 40 and over included more years with reference to previous studies[7,8], showing physical activity to be stable in middle age[12].

If participants engaged in a number of regular exercises during the same period, the exercise with the longer duration was selected. Interviews were performed by trained staff.

Potential confounders, included age, education, marital status (never married, married, separated, divorced and bereaved), annual income (6,500,000 yen or less vs. more than 6,500,000 yen) and chronic conditions including smoking status (never, former and current), self-rated health (excellent, very good, good, fair and poor) and prevalent diseases (hypertension, ischemic heart disease, diabetes, osteoporosis, arthritis and cancer), were investigated using a questionnaire and interview by a physician. Height and weight were measured using a digital scale. Body mass index was calculated by weight divided by height squared (BMI; kg/m^2). Body fat mass was assessed by dual X-ray absorptiometry (DXA; QDR-4500A, Hologic, USA). Work-related physical activity was estimated using the same questionnaire developed by the Japanese Lifestyle Monitoring Group[11]. Work activities were assigned an intensity coefficient of 1.5, 2.5, 4.5 and 7.5 METs (metabolic equivalents) for sedentary work, work done standing or walking, moderately strenuous work and strenuous work, respectively. The work activity scores were calculated by multiplying the intensity coefficients by the total number of minutes spent on the activity over the last 12 months.

Statistical analysis. The statistical significance of the differences in social and health conditions were analyzed by the Cochran-Mantel-Haenszel test for categorical variables and Student's t-test for continuous variables according to participation in regular exercise at age 60 and over. The participation rate in regular exercise was calculated as the percentage of participants who engaged in exercise in each age category. Gender differences in the participation rate in each age category were analyzed using Pearson's chi-squared test. The relationship between regular exercise in the younger age categories and at age 60 and over was evaluated using multiple logistic regression analysis. Both the unadjusted model and the model adjusted for all potential confounders were analyzed. The analyses were performed for men and women separately, as the gender difference in the participation rate in regular exercise was considerable. Statistical testing was performed using the Statistical Analysis System (SAS), release 9.1.3 (SAS Institute Inc. NC, USA). Probability levels of less than 0.05 were considered to be significant.

Results

Table 1 shows the characteristics of the participants by gender according to participation in regular exercise at age 60 and over. The mean age of the study population was 70.0±6.6 years in men and 69.8±6.7 years in women. Age, weight, BMI, annual income, work-related physical activity, smoking, self-rated health, hypertension and arthritis for men; and height, education, work-related physical activity for women were associated with regular exercise at age 60 and over ($p<0.05$).

The participation rates in regular exercise for age categories 12-19, 20-29, 30-39, 40-59 and 60 years and over

Table 1. Charactaristics of the participants according to regular exercise at age 60 and over for men and women

		Men			Women		
		Regular exercise			Regular exercise		
		Yes	No		Yes	No	
		n=342	n=181	*p*-value	n=263	n=193	*p*-value
Age	years	**70.4 ± 6.3**	**69.2 ± 7.2**	**0.048**	69.7 ± 6.4	70.2 ± 7.0	0.503
Height	cm	163.6 ± 5.7	162.7 ± 5.9	0.108	**150.5 ± 5.6**	**149.1 ± 6.2**	**0.010**
Weight	kg	**62.3 ± 9.0**	**59.2 ± 8.3**	**<0.001**	51.8 ± 7.7	51.7 ± 8.7	0.829
BMI	kg/m^2	**23.3 ± 2.8**	**22.3 ± 2.8**	**<0.001**	22.9 ± 3.0	23.2 ± 3.4	0.246
Body fat	%	22.9 ± 4.4	22.5 ± 4.6	0.395	32.4 ± 5.1	32.6 ± 5.5	0.688
Education	years	11.9 ± 2.9	11.7 ± 3.0	0.513	**11.1 ± 2.3**	**10.6 ± 2.5**	**0.033**
Marital status	%			0.097			0.295
Never		0.0	2.2		3.1	3.7	
Married		94.4	91.2		71.7	64.0	
Separation		0.6	0.6		0.4	0.0	
Divorce		0.6	0.6		1.9	4.2	
Bereavement		4.5	5.5		23.0	28.0	
Annual income	%						
6,500,000 yen and higher		**24.8**	**35.2**	**0.013**	25.8	29.4	0.401
Work-related physical activity	METs*min* 10^{-3}	**130.8 ± 135.9**	**170.7 ± 151.7**	**0.002**	**183.0 ± 85.5**	**206.8 ± 109.0**	**0.010**
Smoking	%			**<0.001**			0.910
Never		**24.8**	**20.3**		93.9	94.2	
Former		**58.1**	**47.3**		2.3	2.6	
Current		**17.1**	**32.4**		3.8	3.1	
Self-rated health	%			**0.001**			0.287
Excellent		**6.5**	**0.6**		3.8	5.2	
Very good		**33.3**	**24.7**		21.7	15.6	
Good		**52.2**	**63.2**		65.0	66.2	
Fair		**7.7**	**9.9**		9.1	12.5	
Poor		**0.3**	**0.6**		0.4	0.5	
Prevalent diseases	%						
Hypertension		**44.5**	**31.3**	**0.003**	40.7	41.2	0.921
Ischemic heart diseases		6.2	9.3	0.188	7.2	6.8	0.852
Diabetes		11.5	11.0	0.860	7.2	5.2	0.385
Osteoporosis		1.2	3.3	0.093	16.4	17.2	0.827
Arthritis		**4.4**	**11.5**	**0.002**	11.8	17.2	0.102
Cancer		6.2	6.6	0.859	5.7	9.4	0.136

Continuous variables are presented as means ± standard deviation (SD), and categorical variables are presented as percentages. The differences between groups were analyzed by Student's t-test for continuous variables and by Cochran-Mantel-Haenszel test for categorical variables. Bold represents significant p-value (<0.05). BMI, Body mass index. METs, Metabolic equivalents

are shown Table 2. The percentage of men who had regular exercise was significantly higher than that of women in all of the age categories ($p<0.05$), except for 40-59 years. Among women, a large drop in the percentage reporting participation in exercise was found during the ages of 20-29 and 30-39 years.

The popular type of exercise reported for the different age categories is presented in Tables 3a and 3b. The most popular activities and sports differed both by gender and by age category. Men frequently reported team sports such as baseball and softball up to 40-59 years of age. In women, volleyball was frequently reported up to 30-39 years of age, while dancing and gymnastics exercise were more likely to be reported among those over 20 years of age. At age 60 and over, walking was the most popular exercise among both men and women.

All the possible patterns of participation in regular exercise from age 12 to the present were examined. Thirty-two

different patterns were identified (Figure 1). In men, the most common patterns were participation in regular exercise during all the age categories (12.6%) and participation in regular exercise at age 60 and over (12.6%). In women, the most common pattern was no regular exercise in any age category (21.1%), followed by participation in regular exercise at age 40 and over (14.3%).

Table 4 shows that participating in regular exercise at age 60 and over is related to participation in regular exercise across one's life span. The participants who had exercised at younger age categories were more likely to participate in exercise at age 60 and over for both men and women.

The odds ratios (OR) and 95% confidence intervals (CI) for those who regularly exercised at age 60 and over are shown in Table 5. Although, among men, the results of the unadjusted model for the age category 12-19 years was of borderline statistical significance (OR1.42, 95% CI 0.99-2.05), the odds ratio for participating in exercise at age 60 and over was higher for men who had regular exercise during each age category. The highest odds ratio was 4.63 (95%CI 3.07-6.98) among men who had regular exercise at 40-59 years. In women, regular exercise in the earlier age categories did not correlate with exercise at age 60 and over. However, the odds ratio for participating in exercise at age 60 and over was about six times higher among those who had regular exercise at 40-59 years (OR 5.85, 95%CI 3.82-8.96). After adjusting for age (continuous variable), BMI (continuous variable), education (continuous variable), annual income (6,500,000 yen or less/ more than 6,500,000 yen), work-related physical activity (1SD), smoking (never/ former/ current), self-rated health (excellent/ very good/ good/ fair/ poor) and chronic diseases (Yes/ No), the associations remained in both men and women. Regular exercise at 40-59 years was strongly associated with exercise at age 60 and over in both men (OR 5.96, 95%CI 3.72-9.57) and women (OR 6.89, 95%CI 4.23-11.23).

Table 2. Participation rate in regular exercise across the life course

age (years)	Men (n=523)		Women (n=461)		*p*-value
	n	%	n	%	
12-19	311	59.5	198	43.0	<0.001
20-29	173	33.1	29	6.3	<0.001
30-39	155	29.8	62	13.5	<0.001
40-59	233	44.6	203	44.0	0.871
60 and over	342	65.4	263	57.1	<0.001

Numbers and percentages are shown for those who participated in regular exercise divided into five age categories. Pearson's chi-squared test. df=1.

Discussion

The present study described regular exercise throughout a person's life and evaluated the impact of early regular exercise on participation in exercise at age 60 and over.

Previous longitudinal studies suggest that physical activity in early life tracks to later life[5,6]. However, most studies have tracked physical activity from childhood and adolescence to young adulthood and the coefficients re-

Table 3a. Popular types of regular exercise across the life course among men (n=523)

age (years)	1st	%	2nd	%	3rd	%
12-19	Baseball	16.6	Track & Field	11.9	Judo	8.4
20-29	Baseball	11.9	Softball	4.6	Table tennis	4.0
30-39	Golf	7.6	Softball	6.5	Baseball	5.9
40-59		Golf / Walking *	16.1		Softball	7.6
60 and over	Walking	34.4	Brisk walking	18.4	Golf	13.2

Percentages are shown for those who participated in the exercise. *, Both golf and walking share in 1st place with the same percentage.

Table 3b. Popular types of regular exercise across the life course among women (n=461)

age (years)	1st	%	2nd	%	3rd	%
12-19	Volleyball	15.8	Softball	7.8	Table tennis	6.1
20-29	Volleyball	1.7	Dancing	1.3	Tennis	0.9
30-39	Volleyball	3.5	Walking	2.8	Tennis, Dancing or Softball	1.5
40-59	Walking	13.9	Gymnastics exercise	8.7	Dancing	8.5
60 and over	Walking	24.7	Gymnastics exercise	15.4	Brisk walking	9.5

Percentages are shown for those who participated in the exercise.

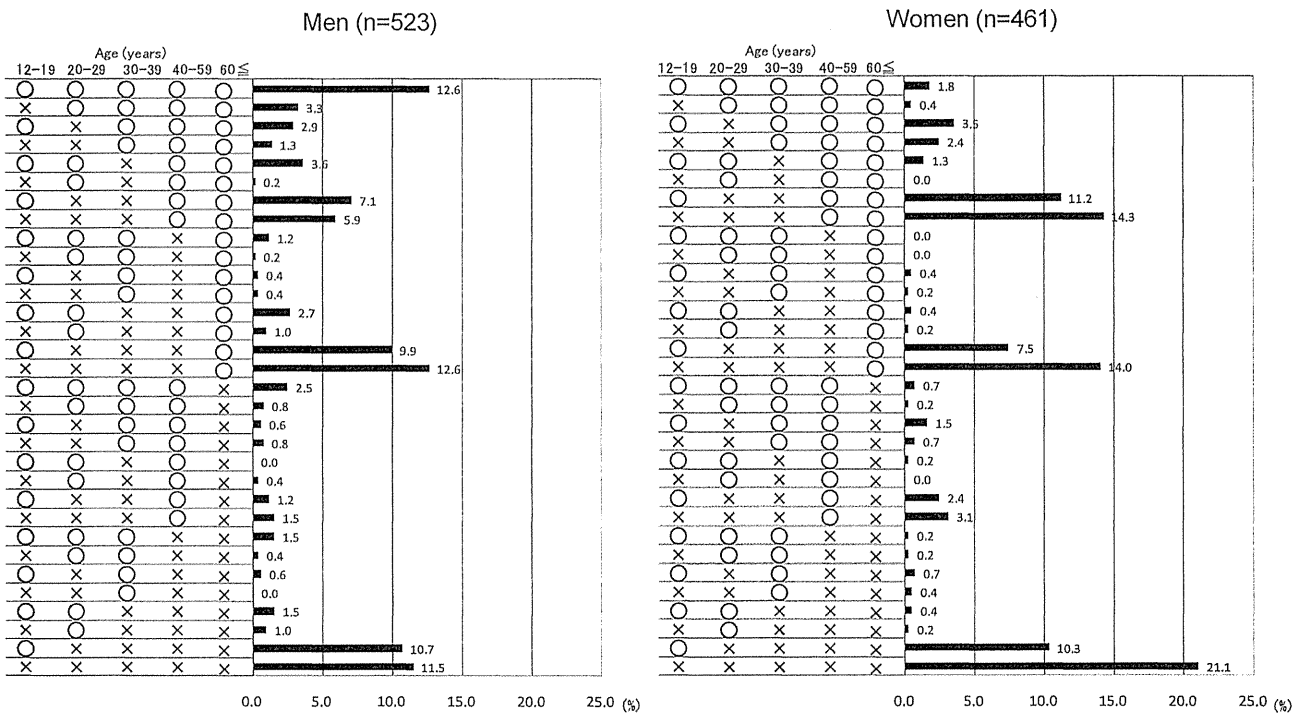


Fig. 1 Participation pattern in regular exercise across the life course for men and women, separately
Regular exercise status: (○) = participants who engaged in regular exercise, (×) = participants who did not engage in regular exercise

Table 4. Distribution of participation in regular exercisre at age 60 and over according to participation in regular exercise across the life course

age (years)	Regular exercise	Men (n=342)		Women (n=263)	
		n	%	n	%
12-19	No	130	61.3	144	54.8
	Yes	212	62.0	119	60.1
20-29	No	213	60.9	244	56.5
	Yes	129	74.6	19	65.5
30-39	No	225	61.4	223	56.0
	Yes	117	75.5	40	64.5
40-59	No	148	51.3	104	40.3
	Yes	194	83.3	159	78.3

Numbers and percentage are shown for those who engaged in regular exercise at age 60 and over.

ported have been only low or moderate[5]. In another study, the correlation between the time points studied was found to weaken over time[13]. Only a few studies have examined whether physical activity in early life tracks to an older age. Retrospective findings that past physical activity predicts physical activity in older people[7,8] can help to explain the positive association between experiences of exercise and physical activity later in life. However, basic descriptive data on individual exercise history throughout life is lacking for the community-dwelling older people in Japan. Assessing life-long regular exercise and the contribution of past exercise experience to engagement in regular exercise later in life are the underlying considerations when promoting an active lifestyle throughout a person's life.

Our finding that men are more physically active than women throughout their lives is partially supported by pre-

Table 5. Odds ratio and 95% confidence interval for those who had regular exercise at age 60 and over

	Model 1				Model 2			
	Men		Women		Men		Women	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Regular exercise								
At 12-19 years of age	1.42	0.99 - 2.05	1.30	0.89 - 1.90	**1.69**	**1.10 - 2.58**	1.06	0.71 - 1.60
At 20-29 years of age	**2.03**	**1.35 - 3.05**	1.43	0.65 - 3.14	**1.87**	**1.21 - 2.90**	1.26	0.55 - 2.87
At 30-39 years of age	**2.02**	**1.32 - 3.09**	1.47	0.84 - 2.58	**2.00**	**1.27 - 3.15**	1.29	0.69 - 2.41
At 40-59 years of age	**4.63**	**3.07 - 6.98**	**5.85**	**3.82 - 8.96**	**5.96**	**3.72 - 9.57**	**6.89**	**4.23 - 11.23**

OR, odds ratio; CI, confidence interval. Model1: unadjusted, Model2: adjusted for age, BMI, education, income, work-related physical activity, smoking, self-rated health, chronic diseases. Bold represents significant p-value (<0.05)

vious studies[14,15]. Women may perceive more traditional, social and environmental barriers than men to engaging in exercise[8,15]. For instance, exercise has been considered "not ladylike"[16]. These aspects may in part be responsible for the lower rate of participation in exercise throughout life among women. Furthermore, a large drop in participation in exercise was observed among women in their 20s and 30s. The transition from adolescence to adulthood is a period of general decline in physical activity[17]. Some life changes, such as getting married and having children, affect physical activity in young adulthood in women more than in men[5]. National data in Japan show that the age of first marriage for men was 26.9 years and for women 24.2 years in 1970[18]. The most common age range for giving birth is 20-39 years[19]. After the fourth decade of life, most people's family and job situations seem to be established and stable. Retirement, in turn, tends to increase physical activity[20]. These life events may be associated with regular exercise. Further research on the relationship between life events and exercise is needed to clarify this issue.

The most popular activities and sports changed between the earlier and later age categories; there was also a gender difference in popular types of activities throughout life. Previous studies have reported a high frequency of ball games among men across ages 14 to 31 years[21]. Dance and gymnastics were more popular with women[15,22]. Our finding supports the previous gender difference in the traditional preferences for specific types of exercise. From the perspective of age, team sport activities were common in adolescence and young adulthood, and individual sports in middle age and older. A possible explanation of the shift is that social situations and lifestyle change according to age, for instance, it is more difficult for a large number of adults to get together, whereas individual sports can be performed in one's own time[21]. Individual sports are sometimes labeled lifetime sports[23] and adult-like activities[17]. Previous studies have reported walking and gardening as the most common activities among older adults[24]. To maintain their exercise levels, people may have to choose specific types of exercise as their lifestyles change with aging[25]. We may consider that older people who engage in regular exercise in our study are those who are able to find suitable activities to match their life changes.

In this study, we tracked regular exercise from adolescence to age 60 and over, and described the individual variation in participation in exercise. A number of participants reported participating in regular exercise at some time in their life, although reports of consistent engagement in regular exercise across several decades were scarce. We have already shown cross-sectionally in Table 2 that the prevalence of regular exercise in the 20s and 30s was low. Figure 1 illustrates the findings as individual transitions of regular exercise throughout life. Although the percentage in each pattern was small, and the patterns of exercise frequency seemed to be similar in both men and women, we found that among men the most frequent pattern was participation in regular exercise at all the life stages; whereas among women the most frequent pattern was no regular exercise at all. Results suggest that encouragement and support for older women should be provided by health professionals as well as the community, since participation in exercise may induce a major behavioral change among older women. There may be a need to tailor health promotion messages and interventions according to gender and personal exercise history.

After fully adjusting for confounding factors such as age, BMI, education, annual income, smoking, work-related physical activity, self-rated health, and chronic diseases, both men and women who had participated in regular exercise during 40-59 years of age had a 5 to 7-fold higher rate of participation in exercise at age 60 and over. This result suggests that participation in exercise during 40-59 years of age predicts exercise at age 60 and over. Our findings are in line with those of some previous studies[7,8]. Frändin et al. , who studied age groups from the age of 10 years, found that physical activity during earlier life was not correlated with physical activity at the age of 76, except for the last age period 66-76 years[7]. Other studies also found the last age group to be better predictors than earlier ones[8,26]. The short interval may be one of the causes for the strong relationship between regular exercise at 40-59 years of age and that at age 60 and over. A number of studies have suggested that childhood is usually considered the best time for socialization into physical activity[8], for encouraging physical activity in adults through the developing of habits[25] and for promoting exercise-related feelings of pleasure and joy[7]. Furthermore, sports activities may have an effect on motor and coordination skills that may be of value later in life[21]. We believe that the positive effects of exercise in early life are associated with physical activity in older life. In fact, regular exercise during all the age categories studied affected exercise at age 60 and over among men. However, demographic, psychological, behavioral, social and environmental factors are associated with adulthood participation in physical activity[27]. These multiple factors may decrease the positive effect of earlier exercise at older ages. Health problems were reported to be the most common barrier to increasing physical activity[28]. We found that the effect of regular exercise at 40-59 years of age on participation in exercise at age 60 and over increased among women who had a history of hypertension in the sub-analyses (data not shown). Chronic health problems may also have influenced the motivation for physical activity as a part of clinical care. Our finding that regular exercise during 40-59 years of age was associated with that at age 60 and over was true for a lot of people who had not engaged in regular exercise earlier in their lives. The motivation to engage in regular exercise in the fourth and fifth decades of life may have important implications for promoting increased physical activity in older age.

This study has several limitations. The first limitation

is that our study was a retrospective study and the regular exercise data were based on self-reports. Possible memory failure and potential recall bias may have influenced the results. In addition, we were not able to take into account the short-term substitution of one exercise for another as regular exercise was defined as an activity lasting one year. Therefore our study may underestimate regular exercise as an indicator of physical activity. Secondly, social and environment factors, which have been indicated as predictors of physical activity, were not widely examined in our study. Environmental factors are among the important factors promoting participation in physical activity[16]. Recent studies suggested that environmental problems, such as poorly lit streets or noisy traffic, are correlated with inactivity[29]. Further studies are needed to confirm the association between regular exercise and a comprehensive range of factors. Finally, the definition of regular exercise in this study was lower than the well-known recommendation of physical activity for adults by the American College of Sports Medicine[30]. However, we previously found that continuation of regular exercise by the same definition as used in this study was associated with higher muscle strength and power in both elderly men and women[31]. A number of older people are physically inactive. "Tojikomori", being housebound, which has been defined in recent studies as going outdoors once or less than once a week, is a serious concern in relation to older people[32]. Pate et al. suggest that an active lifestyle does not require a regimented, vigorous exercise program[33]. To avoid causing undue stress coming from misconceptions, it may be sufficient just emphasizing to older people the importance of being physically active as opposed to having to maintain a disciplined workout schedule.

The strengths of the present study include a large number of randomized community-dwelling people and regular exercise data tracked from age 12 to 60 years and over. These data provide important information for demonstrating the value of life-long physical activity. The participants had a face-to-face interview by trained staff, which increases the reliability of the answers and reduces missing data in the questions. We were able to take into account essential social and health condition data such as education, smoking and disease as confounders. Our study described individual variation in regular exercise throughout the various stages of a person's life and showed the positive impact of experiences of exercise in earlier life on regular exercise in later life; and thus lays a good foundation for persuading the general population of the importance of maintaining physical activity throughout life.

Conclusion

The present study found that men engaged in regular exercise more than women throughout their lifetime. Exercise preferences differed depending on age and gender. Among women, those reporting no regular exercise were the largest group. Among men, regular exercise earlier in life positively affected regular exercise at age 60 years and over. Regular exercise in middle age markedly increased participation in exercise later in life regardless of social and health conditions among both men and women.

Acknowledgments

The authors would like to thank the participants and also colleagues in the NILS-LSA. This study was supported by a Grant-in-Aid for Young Scientists (A) from the Japan Society for the Promotion of Science (#20680034).

References

1) Singh MA. 2002. Exercise comes of age: rationale and recommendations for a geriatric exercise prescription. *The Journals of Gerontology Series A, Biological sciences and medical sciences* 57: M262-282.
2) Ministry of Education, Culture, Sports, Science and Technology in Japan. [Homepage on the internet]. Tokyo: White Paper & Reports. Available from: http://www.mext.go.jp/component/b_menu/other/__icsFiles/afieldfile/2010/10/12/1298223_6.pdf.
3) Ministry of Education, Culture, Sports, Science and Technology in Japan. [Homepage on the internet]. Tokyo: White Paper & Reports. Available from: http://www.mext.go.jp/component/b_menu/other/__icsFiles/afieldfile/2010/10/12/1298223_5.pdf.
4) Chogahara M. 2003. Research on physical activities in middle-aged and older adults: A literature review. *Japan J Phy Educ Hlth Sport Sci* 48: 245-268. (in Japanese)
5) Telama R, Yang X, Viikari J, Valimaki I, Wanne O, and Raitakari O. 2005. Physical activity from childhood to adulthood: a 21-year tracking study. *Am J Prev Med* 28: 267-273.
6) Gordon-Larsen P, Nelson MC, and Popkin BM. 2004. Longitudinal physical activity and sedentary behavior trends: adolescence to adulthood. *Am J Prev Med* 27: 277-283.
7) Frändin K, Mellstrom D, Sundh V, and Grimby G. 1995. A life span perspective on patterns of physical activity and functional performance at the age of 76. *Gerontology* 41: 109-120.
8) Hirvensalo M, Lintunen T, and Rantanen T. 2000. The continuity of physical activity--a retrospective and prospective study among older people. *Scand J Med Sci Sports* 10: 37-41.
9) Kozakai R, Doyo W, Tsuzuku S, Yabe K, Miyamura M, Ikegami Y, Niino N, Ando F, and Shimokata H. 2005. Relationships of muscle strength and power with leisure-time physical activity and adolescent exercise in middle-aged and elderly Japanese women. *Geriatr Gerontol Int* 5: 182-188.
10) Shimokata H, Ando F, and Niino N. 2000. A new comprehensive study on aging--the National Institute for Longevity Sciences, Longitudinal Study of Aging (NILS-LSA). *J Epidemiol* 10: S1-9.
11) Iwai N, Yoshiike N, Saitoh S, Nose T, Kushiro T, and Tanaka H. 2000. Leisure-time physical activity and related lifestyle characteristics among middle-aged Japanese. Japan Lifestyle Monitoring Study Group. *J Epidemiol* 10: 226-233.
12) Lee IM, Paffenbarger RS, Jr., and Hsieh CC. 1992. Time trends in physical activity among college alumni, 1962-1988. *Am J Epidemiol* 135: 915-925.

13) Kirjonen J, Telama R, Luukkonen R, Kaaria S, Kaila-Kangas L, and Leino-Arjas P. 2006. Stability and prediction of physical activity in 5-, 10-, and 28-year follow-up studies among industrial employees. *Scand J Med Sci Sports* 16: 201-208.
14) Dallosso HM, Morgan K, Bassey EJ, Ebrahim SB, Fentem PH, and Arie TH. 1988. Levels of customary physical activity among the old and the very old living at home. *J Epidemiol Community Health* 42: 121-127.
15) Sallis JF, Zakarian JM, Hovell MF, and Hofstetter CR. 1996. Ethnic, socioeconomic, and sex differences in physical activity among adolescents. *J Clin Epidemiol* 49: 125-134.
16) Schutzer KA, and Graves BS. 2004. Barriers and motivations to exercise in older adults. *Prev Med* 39: 1056-1061.
17) Kjonniksen L, Torsheim T, and Wold B. 2008. Tracking of leisure-time physical activity during adolescence and young adulthood: a 10-year longitudinal study. *Int J Behav Nutr Phys Act* 5: 69.
18) Ministry of Health, Labour and Welfare in Japan. [Homepage on the internet]. Tokyo: White Paper & Reports. Available from: http://www.mhlw.go.jp/toukei/saikin/hw/jinkou/suii09/marr4.html.
19) Ministry of Health, Labour and Welfare in Japan. [Homepage on the internet]. Tokyo: White Paper & Reports. Available from: http://www.mhlw.go.jp/toukei/saikin/hw/jinkou/suii09/brth1-1.html.
20) Rhodes RE, Martin AD, Taunton JE, Rhodes EC, Donnelly M, and Elliot J. 1999. Factors associated with exercise adherence among older adults. An individual perspective. *Sports Med* 28: 397-411.
21) Tammelin T, Nayha S, Hills AP, and Jarvelin MR. 2003. Adolescent participation in sports and adult physical activity. *Am J Prev Med* 24: 22-28.
22) Azevedo MR, Araujo CL, Cozzensa da Silva M, and Hallal PC. 2007. Tracking of physical activity from adolescence to adulthood: a population-based study. *Rev Saude Publica* 41: 69-75.
23) Taylor WC, Blair SN, Cummings SS, Wun CC, and Malina RM. 1999. Childhood and adolescent physical activity patterns and adult physical activity. *Med Sci Sports Exerc* 31: 118-123.
24) Swenson CJ, Marshall JA, Mikulich-Gilbertson SK, Baxter J, and Morgenstern N. 2005. Physical activity in older, rural, Hispanic, and non-Hispanic white adults. *Med Sci Sports Exerc* 37: 995-1002.
25) Kuh DJ, and Cooper C. 1992. Physical activity at 36 years: patterns and childhood predictors in a longitudinal study. *J Epidemiol Community Health* 46: 114-119.
26) Evenson KR, Wilcox S, Pettinger M, Brunner R, King AC, and McTiernan A. 2002. Vigorous leisure activity through women's adult life: the Women's Health Initiative Observational Cohort Study. *Am J Epidemiol* 156: 945-953.
27) Trost SG, Owen N, Bauman AE, Sallis JF, and Brown W. 2002. Correlates of adults' participation in physical activity: review and update. *Med Sci Sports Exerc* 34: 1996-2001.
28) Lim K, and Taylor L. 2005. Factors associated with physical activity among older people--a population-based study. *Prev Med* 40: 33-40.
29) Rantakokko M, Iwarsson S, Hirvensalo M, Leinonen R, Heikkinen E, and Rantanen T. 2010. Unmet physical activity need in old age. *J Am Geriatr Soc* 58: 707-712.
30) Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, Macera CA, Heath GW, Thompson PD, and Bauman A. 2007. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc* 39: 1423-1434.
31) Kozakai R, Doyo W, Kim H, Ando F, and Shimokata H. 2010. The association between the continuity of exercise habits through the life and physical fitness in the community-dwelling Japanese elderly. *Tairyoku Kagaku (Jpn J Phys Fitness Sports Med)* 59: 839. (in Japanese)
32) Yasumura S. 2003. Homebound elderly people in Japan-special reference to intervention study including life review method. *Nihon Ronen Igakkai Zasshi* 40: 470-472. (in Japanese)
33) Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C, Buchner D, Ettinger W, Heath GW, King AC, and et al. 1995. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 273: 402-407.

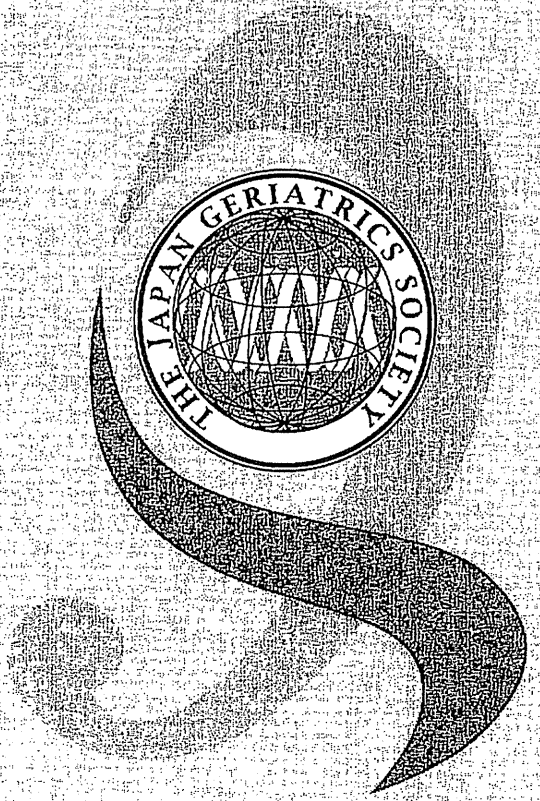
日老医誌　第49巻　第2号　平成24年3月25日発行（奇数月25日発行）平成4年11月20日第3種郵便物認可

ISSN 0300-9173

日本老年医学会雑誌

Japanese Journal of Geriatrics

VOL.49
NO.2
2012
March



社団法人日本老年医学会

日　老　医　誌
Nippon Ronen Igakkai Zasshi

〈原　著〉

全国高齢難聴者数推計と10年後の年齢別難聴発症率
—老化に関する長期縦断疫学研究（NILS-LSA）より

内田　育恵[1)2)]　杉浦　彩子[2)]　中島　務[3)]　安藤富士子[4)5)]　下方　浩史[5)]

要　約　**目的**：我が国における高齢難聴者の現況を推計することを目的として，「国立長寿医療研究センター—老化に関する長期縦断疫学研究（NILS-LSA）」データを検討した．**方法**：NILS-LSA第6次調査（2008～2010年実施）より男性1,118名，女性1,076名の計2,194名を対象として，地域住民の粗率に近似すると考えられる5歳階級別難聴有病率を算出した（算定A）．また，聴力に有害な作用をもたらす耳疾患と騒音職場就労を除外した算出も行った（算定B）．総務省発表人口推計を用いて全国難聴有病者数を推計した．次に第1次調査（1997～2000年実施）時点で，除外項目と難聴定義に該当せず，かつ第6次調査にも参加した男性212名，女性253名の計465名を対象として，10年後の難聴発症率を解析した．**結果**：難聴有病率は65歳以上で急増していた．算定Aでは，男性の65～69歳，70～74歳，75～79歳，80歳以上の年齢群順に43.7%，51.1%，71.4%，84.3%で，女性では27.7%，41.8%，67.3%，73.3%といずれも高い有病率を示した．算定Bでは，同様の年齢群順に男性で37.9%，51.4%，64.3%，86.8%で，女性では26.5%，35.6%，61.4%，72.6%であった．全国の65歳以上の高齢難聴者の数は，算定Aでは1,655万3千人，算定Bでも1,569万9千人に上った．10年後の難聴発症率は，調査開始時年齢60～64歳群では32.5%，70～74歳群では62.5%と，年齢上昇に伴い高くなったが，依然聴力を良好に維持する高齢者が存在した．**結論**：高齢者の難聴有病率は高く，全国難聴有病者数推計から，加齢性難聴が日本の国民的課題であることが再確認された．また年を経ても聴力を良好に維持することが可能であると示唆された．

Key words：加齢性難聴，10年発症率，有病率，人口推計

（日老医誌　2012；49：222-227）

緒　言

加齢性難聴は，高齢者にとって最も一般的な感覚障害であり，加齢とともに有病率が高くなる代表的な老年病の一つと考えられる．聴覚器としての耳に，加齢に伴う組織学的変化が始まり聴力が低下し始めるのは30歳代からと考えられている[1)]．

加齢性難聴は，国家的視野で見た経済試算において，また他の老年病との関わりにおいても重要視されている．65歳以上の難聴者数が2002年時点で約640万人と推計された米国では，直接的な初年度医療費が約82億ドルに上ると試算されている[2)]．またBaltimore Longitudinal Study of Agingからの追跡調査では，聴力障害は他の有力な危険因子から独立した，認知症危険因子である可能性が示唆された[3)]．

しかし他国も経験のない速さで高齢化が進行している我が国において，高齢者の難聴有病率や発症率に関する近年の報告はない．

今回，地域住民対象研究をもとに，以下の項目について明らかにすることを目的として検討したので報告する．

I. 地域住民における5歳階級別難聴有病率をもとにした全国高齢難聴者数推計．

II. 10年後の中高齢者難聴発症率の算出．

方　法

対象は，「国立長寿医療研究センター—老化に関する長期縦断疫学研究（National Institute for Longevity Sciences-Longitudinal Study of Aging）」（以下NILS-LSA

1) Y. Uchida：愛知医科大学耳鼻咽喉科
2) Y. Uchida, S. Sugiura：国立長寿医療研究センター耳鼻咽喉科
3) T. Nakashima：名古屋大学大学院医学研究科頭頸部・感覚器外科学耳鼻咽喉科
4) F. Ando：愛知淑徳大学健康医療科学部スポーツ・健康医科学科
5) F. Ando, H. Shimokata：国立長寿医療研究センター予防開発部
受付日：2011.10.4，採用日：2011.11.14

表1　第6次調査（2008～2010）解析対象の年齢分布

(名)		40～44yr	45～49yr	50～54yr	55～59yr	60～64yr	65～69yr	70～74yr	75～79yr	80yr～	計
男性	算定A	137	108	116	144	138	126	141	119	89	1,118
	算定B	70	56	54	74	73	66	72	70	53	588
女性	算定A	145	110	106	136	142	119	122	110	86	1,076
	算定B	67	49	47	64	83	68	73	70	62	583

算定A　解析に必要な聴力検査結果が揃っている全対象（N＝2,194）
算定B　算定A対象者のうち「耳疾患の既往なし」，かつ「騒音職場の就労歴なし」と答えた者のみを抽出（N＝1,171）

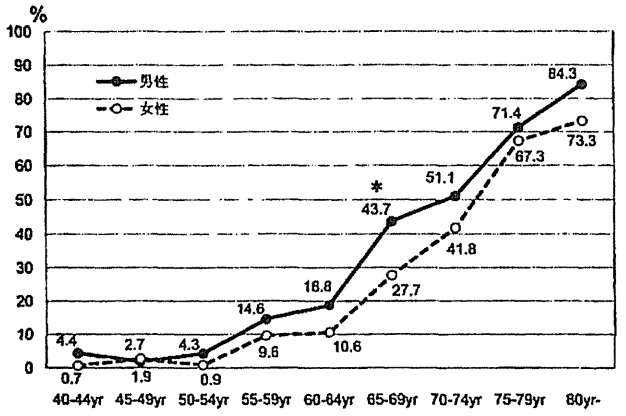


図1　第6次調査（2008～2010）参加者における難聴有病率（算定A）　*P<0.05

と略す）の参加者である．

NILS-LSAは，国立長寿医療研究センターの近隣地域である愛知県大府市と東浦町の住民を対象として，老化過程の経時的な観察を行う疫学研究である．地域住民より抽出された，観察開始時40歳から79歳の基礎集団を，1997年11月から2年ごとの繰り返し調査により縦断的に追跡している．調査におけるすべての検査と結果解析について，施設内倫理委員会の審査を受け承認を得ている．また参加者には充分なインフォームドコンセントを行い，文書による同意を得た者のみに検査を行っている．NILS-LSAについては，本学会誌に詳述した過去の報告を参照されたい[4)5)]．聴力の評価はリオン社製AA-73AおよびAA-78を使用して，標準純音聴力検査を防音室内で行った．全解析を通じて用いた難聴の定義は，World Health Organization（WHO）の聴力障害基準[6)]に従った．すなわち標準純音聴力検査での500，1,000，2,000，4,000 Hzの会話音域4周波数平均気導聴力レベルを基準とした良聴耳聴力レベルが，25 dBを超えた場合を「難聴あり」とした．高齢期の難聴評価には，環境要因による修飾の可能性が少ない良聴耳が先行研究においても用いられており，聴力解析時の取扱いについては，過去の報告を参照願いたい[7)]．

検討Iでは，直近の調査であるNILS-LSA第6次調査（2008～2010年実施）参加者2,302名から，解析に必要な聴力検査結果が揃っている男性1,118名，女性1,076名の計2,194名を対象として，5歳階級別難聴有病率を計算した（算定A）．また，算定A対象者のうち自記式問診票で「耳疾患の既往なし」，かつ「騒音職場の就労歴なし」と答えた者のみを抽出した男性588名，女性583名の計1,171名についても同様に，5歳階級別難聴有病率を算出した（算定B）．統計学的解析には，Statistical Analysis System（SAS）version 9.1.3を用い，難聴有病率の男女間比較を，カイ二乗検定で行った．次に，総務省統計局発表の5歳階級別人口推計（総務省発表2010年8月1日現在）[8)]を用いて全国難聴有病者数を推計した．

検討IIでは，NILS-LSA第1次調査（1997～2000年実施）参加者2,267名より，自記式問診票で「耳疾患の既往なし」，かつ「騒音職場の就労歴なし」と答えた1,202名を抽出し，そのうち第1次調査時に難聴定義に該当せず，かつ第6次調査にも参加した男性212名，女性253名の計465名を対象とした．第1次調査時点での難聴非該当者が，第6次調査時点で難聴に該当したか否かにより，10年後の難聴発症率を解析した．

結　果

検討IにおけるNILS-LSA第6次調査（2008～2010年実施）解析対象者の年齢分布を表1に表した．また算出した，5歳階級別難聴有病率のうち，算定Aの結果を図1に示した．難聴有病率は60～64歳の群までは年齢とともに徐々に増加し，65歳以上で急増していた．男性の65～69歳，70～74歳，75～79歳，80歳以上の年齢群順に43.7%，51.1%，71.4%，84.3%で，女性では27.7%，41.8%，67.3%，73.3%といずれも高い有病率を示した．65～69歳の年齢群においてのみ，男性43.7%，女性27.7%と男女間の有病率に有意な差を認めたが，その他の群で見られた男女差は有意ではなかった．聴力に有害な影響を及ぼすと考えられる耳疾患既往歴と

表2　5歳階級別人口推計（総務省発表2010年8月1日現在）を用いた，全国難聴有病者数推計（単位：千人）

			40～44yr	45～49yr	50～54yr	55～59yr	60～64yr	65～69yr	70～74yr	75～79yr	80yr～
男性	人口		4,375	4,001	3,818	4,311	4,839	3,935	3,237	2,588	2,792
	難聴有病者数	算定A	193	76	164	629	910	1,720	1,654	1,848	2,354
		算定B	125	72	212	408	796	1,491	1,664	1,664	2,423
女性	人口		4,310	3,964	3,835	4,402	5,053	4,313	3,743	3,347	5,410
	難聴有病者数	算定A	30	107	35	423	536	1,195	1,565	2,253	3,966
		算定B	64	0	82	207	365	1,142	1,333	2,056	3,927

表3　第1次調査（1997～2000年）時点での難聴非該当者（耳疾患既往歴および騒音職場就労歴を除外）の10年後の難聴発症率

第1次調査時年齢	40～44yr	45～49yr	50～54yr	55～59yr	60～64yr	65～69yr	70～74yr	75～79yr
対象数（名）	54	98	93	74	77	35	24	10
難聴発症率（%）	5.6	4.1	15.1	27.0	32.5	45.7	62.5	50.0

騒音職場就労歴を除外した算定Bでは，男性の40～44歳から5歳階級別年齢群順に2.9%，1.8%，5.6%，9.5%，16.4%，37.9%，51.4%，64.3%，86.8%で，女性では40～44歳から順に1.5%，0.0%（45～49歳該当者なし），2.1%，4.7%，7.2%，26.5%，35.6%，61.4%，72.6%であった．総務省統計局発表5歳階級別人口推計にあてはめた全国難聴有病者数は，算定Aでは40歳代，50歳代，60歳代，70歳代，80歳代の順に，40万6千人，125万1千人，436万人，731万9千人，631万9千人と推計された．算定Bでは40歳代から順に，26万1千人，90万8千人，379万3千人，671万7千人，635万人と推計された．65歳以上の高齢難聴者の数は，算定Aでは1,655万3千人，算定Bでも1,569万9千人に上った（表2）．

検討IIで解析した10年後の難聴発症率を表3に示した．40～44歳群では10年後に難聴を発症したのは5.6%にとどまったが，60～64歳群では32.5%，70～74歳群では62.5%と，年齢が上がるにつれ急激に高くなったが，依然として聴力を良好に維持する高齢者が存在した．尚75～79歳群は，10年後には85～89歳になり解析可能な対象が10名と少なかった．この群の難聴発症率は50%にとどまった．

考　察

加齢性難聴は，高齢者に生じる難聴のうち年齢以外に特別な原因がなく，一般に両耳対称性の高音漸傾型感音難聴を特徴としている．中等度から高度の加齢性難聴が放置されると，コミュニケーションに深刻な障害をきたし，高齢者の孤立，抑うつ，さらには認知機能低下にも影響を及ぼすとされている[3)9)]．

今回2008～2010年に実施されたNILS-LSA第6次調査における難聴有病率を，地域住民の粗率に近似すると考えられる算定Aと，聴力に対して有害に作用する主要因の，耳疾患既往歴と騒音職場就労歴を除外した算定Bで呈示した．算定Bでは，可能な限り生理的な加齢変化を捉える目的で，問診票上「耳疾患の既往なし」かつ「騒音職場の就労歴なし」と回答した参加者のみに絞った．聴力検査上の良聴耳聴力を判定に用いるWHOの聴力障害基準では，良聴耳が難聴ありの場合は両側性難聴を意味する．すなわち片側難聴者は，今回の解析においては難聴有病率に反映されていない．

本解析で得られた難聴有病率は，両算定のいずれにおいても65歳以上で急峻な増加を示し，算定Aでは70～74歳男性で5割，女性で4割が，75～79歳では約7割の高齢者が難聴に該当していた．算定Bでは，年齢分布全体にわたり，数%少ない傾向があったが，年齢と難聴有病率の推移については著明な差異は認めなかった．

米国の全国調査National Health and Nutrition Examination Survey（NHANES）1999～2004からの報告では，20歳から69歳の成人5,742名のうち，500，1,000，2,000，4,000 Hzの4周波数平均聴力レベルが25 dB以上で定義される難聴者の割合は，両耳難聴の場合，男女併せた40歳代では5.8%，50歳代は15%，60歳代は31%であり[10)]，我々の調査結果と著しい差はなかった．

検討IIで得られた10年後の難聴発症率については，第1次調査時に60歳代であった対象者に注目すると，第1次調査時に難聴の定義に該当しなかった者の3人に

1人が，70歳代となった第6次調査時に難聴を発症していた．しかしすなわち3人に2人は，70歳代になっても難聴を発症していなかったということである．同様に第1次調査時に70歳代であった者の5人に2人は，80歳代になっても難聴を発症していなかった．しかし，本調査には日常生活動作に障害があると参加困難であるというバイアスもあり，検討IIで得られた高齢者の難聴発症率は，実状より軽く算出されている可能性がある．表3に見られる75～79歳群で難聴発症率が70～74歳群より低下したのは，10年後である85～89歳になっても日常生活動作が自立している健康高齢者が対象となった可能性は否めない．

聴覚の老化は，他の身体部位に生じる老化と同様に，遺伝要因と遺伝外要因の多数が複雑に相互関与する多因子性プロセスと考えられており，加齢に伴う聴力変化に個人差が大きいことは古くより知られている[11]．今回高齢の参加者を縦断的に追跡調査することができた結果，良好な聴力の維持が，高齢者においても不可能ではないことが示唆された．

加齢性難聴に寄与する可能性のある遺伝外危険因子としては，騒音曝露，耳毒性薬剤の負荷以外に，医学的健康状態も，循環障害，代謝性変化，酸化ストレス等のメカニズムを介して聴器への有害な作用をもたらす[9][12]～[14]．医学的健康状態の中では，動脈硬化，脳卒中を含む心循環器系疾患，糖尿病，腎疾患などがある．Gopinathらは，Blue Mountains Hearing Studyから，良聴耳の会話音域平均聴力レベルが40 dBを超える中等度以上の難聴がある高齢者では，過去の脳血管障害の既往を持つ率が有意に高かったと報告した[12]．しかし，難聴のない群と比べて，難聴のある高齢者に，その後の5年間に脳血管障害を発症する頻度が高いということはなく，高齢期の難聴がその後の脳血管障害の予測因子になるという結論には至らなかったとしている．我々はNILS-LSAの横断的解析により，糖尿病，虚血性心疾患，腎疾患と，周波数別に検討した聴力障害に関連があることを報告しており[15]，また男性における騒音職場の就労歴と動脈硬化が相乗的に聴力に有害な効果をもたらすことを報告している[16]．糖尿病と聴力の関係に関しても，横断的な解析では，糖尿病群は非糖尿病群に比べて，有意に難聴者比率が高く，糖尿病と加齢の聴力に対する交互効果が有意に認められたことを報告した[17]．この交互効果は高周波数領域聴力に見られ，高齢群より中年群に，より顕著に糖尿病の有害な効果が認められた．糖尿病の聴器障害のメカニズムとしては，蝸牛の糖尿病性微小血管症性変化の他，エネルギー需要が高い聴覚系が酸化ストレスや糖化最終産物（AGE）の標的臓器になりやすく，代謝障害や炎症性サイトカインを介した神経細胞傷害がもたらされるという説もある[18]．

今後は，縦断的な追跡で聴力悪化に寄与する要因や，長期的な聴力保存を実現する難聴予防因子の同定が課題である．

高齢者にとって難聴がどのような影響をもたらすかについては，様々な視点から研究されている．Saitoらは調査開始時に抑うつ症状のない580名の高齢者を対象として，聴覚的なハンディキャップを調べ，3年後にGeriatric Depression Scaleで抑うつ症状を評価した[19]．聴覚的なハンディキャップをもつ群では，もたない群に比べて有意に抑うつ症状を示すリスクが高く，性，年齢，教育レベル，生活環境，喫煙，飲酒，基礎疾患や視力障害合併の有無など，交絡の可能性のある要因を考慮した多変量解析でも有意性は変わらなかったと報告している．難聴対策としての補聴器の有効性に関しては，194名の米国退役軍人無作為化試験より，補聴器装用群でコミュニケーション，認知，社会機能，感情，うつ軽減などの有益な効果が，コントロール群に比べて認められたとの報告がある[20]．補聴器の所有率に関しては，以前にNILS-LSA第3次調査（2002～2004年実施）より補聴器所有に関連する要因について検討した際に，欧米の難聴者補聴器所有率の5割程度にとどまっている可能性を報告した[21]．調査対象の年齢分布や難聴を定義する条件が先行研究ごとに違うため，比較に注意が必要ではあるが，NILS-LSA第5次調査（2006～2008年実施）参加者を集計しても，補聴器所有率は第3次調査に比べて明らかな増加は見られず，また自記式質問票で「所有していても使用していない」と答えた参加者も含まれることを加味すると，依然として我が国における難聴者の補聴器活用は十分でないことが考えられる．

コミュニケーションは双方向性であり，一方に難聴があればコミュニケーション対象者にも影響がある．本研究で高齢難聴人口が1,500～1,600万人と推計されたことにより，有病者を取り巻く家族やケア提供者などコミュニケーション対象者の不利益も含めて勘案すると，加齢性難聴は日本の国民的課題であることが再確認された．

結　語

地域住民対象研究をもとに推計した日本の高齢難聴者は1,500万人超であり，聴力を維持していた60歳代の3人に1人が，70歳代となった10年後に難聴を発症していたことが示された．一方で，年を経ても依然聴力を良好に維持している高齢者の存在も明らかになった．