が 1.0 年以下とすると、同様に、それぞれ対象人口が 3.2 万人以上と 1.2 万人以上となる。2010～2020 年の 65 歳平均余命の延伸が約 1.0 年と予測されていることを考慮すると（国立社会保障・人口問題研究所の「日本の将来推計人口（平成 24 年 1 月推計）」を参照）、健康寿命の信頼区間の片側幅はできれば 0.5 年以下が、少なくとも 1.0 年以下が望ましいと考えられる。この目安を想定すると、対象人口が 13 万人未満では 3 年間の死亡数を用いることとなり、また、対象人口が 1.2 万人未満では 3 年間の死亡数を用いても満たさないことになる。

以上、本試算結果に基づいて、人口規模の小さい対象集団に対する健康寿命の算定方法の対応を議論することが重要であろう。

E．結論

「日常生活に制限のない期間の平均」（男の 0 歳）の 95%信頼区間の片側幅は、国民生活基礎調査に準ずる調査の回収数が 10,000 人の場合に総人口が 15 万人で 1.0 年、2.1 万人で 2.0 年となり、調査回収数が 3,000 人と 5,000 人の場合にはかなり広かった。「日常生活動作が自立している期間の平均」（男の 65 歳）の 95%信頼区間の片側幅は、単年の死亡数を利用する場合に総人口が 13 万人で 0.5 年、3.2 万人で 1.0 年となり、3 年間の死亡数を利用する場合にはかなり狭かった。いずれの場合も総人口の減少とともに信頼区間の幅が急速に広くなった。本試算結果に基づいて、人口規模の小さい対象集団に対する健康寿命の算定方法の対応を議論することが重要であろう。

F．研究発表

1．論文発表

なし。

2．学会発表

なし。

G．知的財産権の出願・登録状況（予定を含む）

1．特許取得

なし。

2．実用新案登録

なし。

3．その他

なし。

図 1. 人口規模による「日常生活に制限のない期間の平均」の推定精度

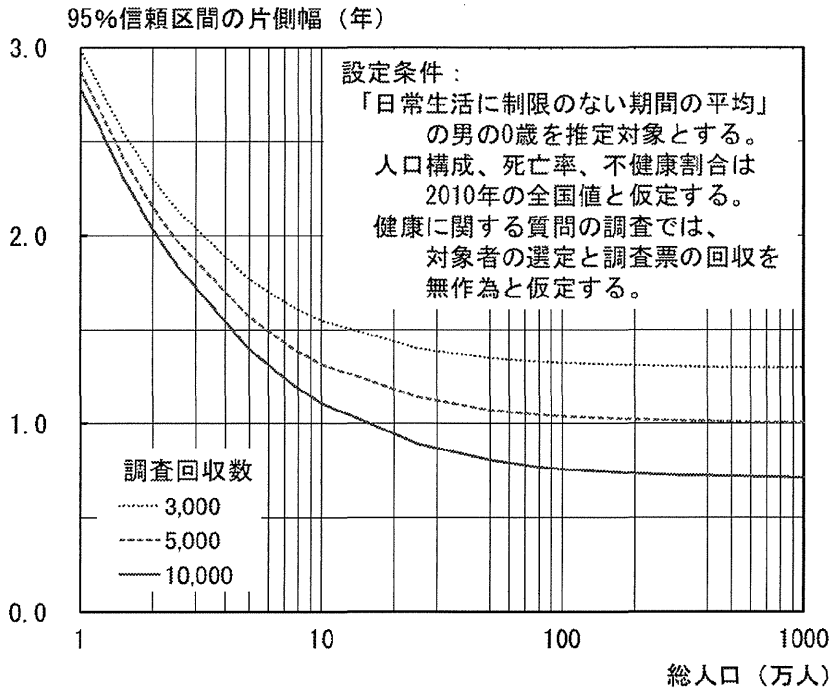
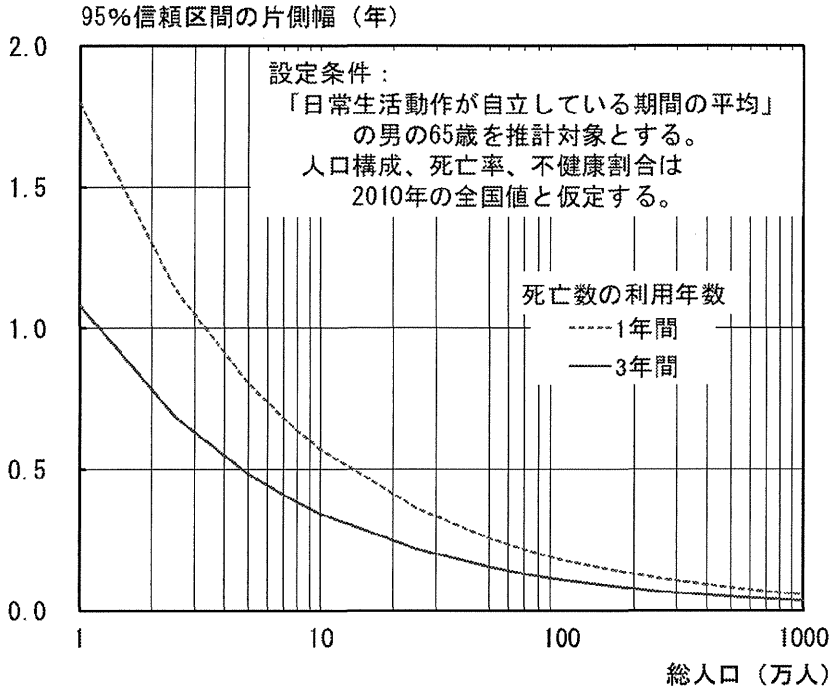


図 2. 人口規模による「日常生活動作が自立している期間の平均」の推定精度



厚生労働科学研究費補助金（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
研究報告書

健康日本21(第2次)における健康寿命の算定
—算定方法の指針と算定プログラム—

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研究要旨　健康日本21(第2次)の健康寿命の算定に関して、「健康寿命の算定方法の指針」を作成するとともに、「健康寿命の算定プログラム」を開発した。同指針は健康寿命の算定方法の説明書・マニュアルであり、A4版37頁で、9つの章から構成される。同プログラムは健康寿命の簡易な算定プログラムであり、EXCEL形式のファイルで、人口、死亡数と不健康割合の分子・分母の人数を入力すると、健康寿命の指標値とその95%信頼区間が出力される。いずれもホームページ「厚生労働科学研究：健康寿命のページ」（http://toukei.umin.jp/kenkoujyumyou/）に公開し、ダウンロード可能とした。今後、その利用によって、自治体などの健康寿命の算定が支援されるとともに、標準的な算定方法の使用と適切な算定結果の解釈に資するものと期待される。

A．研究目的

「二十一世紀における第二次国民健康づくり運動（健康日本21(第2次)）」において、健康寿命の延伸を主要かつ具体的な目標に位置づける上で、多くの研究成果の積み重ねが必要である。とくに、健康寿命の指標とその算定方法を定めるとともに、現状値を算定することが求められる。また、都道府県健康増進計画や市町村健康増進計画の策定を念頭において、自治体などでの健康寿命の算定を支援することが必要となろう。

健康寿命の指標とその算定方法および現状値（都道府県値を含む）については、本研究報告書の「健康寿命の算定方法と年次推移・都道府県分布」にその詳細を示した。

ここでは、健康寿命の算定について、自治体などへの支援を想定して、「健康寿命の算定方法の指針」を作成するとともに、「健康寿命の算定プログラム」を開発した。「健康寿命の算定方法の指針」は健康寿命の標準的な算定方法の説明書・マニュアルであり、「健康寿命の算定プログラム」はその算定方法の簡易なプログラムである。

B．研究方法

「健康寿命の算定方法の指針」の作成と「健康寿命の算定プログラム」の開発においては、3つの検討課題の「健康寿命の算定方法と年次推移・都道府県分布」、「健康寿命の精度の試算」と「健康寿命における将来予測―不健康割合の3つのシナリオに基づく―」の結果およびこれらに対する本研究班構成員での議論・合意を基礎とした。それぞれの検討結果は、本研究報告書の「健康寿命の算定方法と年次推移・都道府県分布」、「健康寿命の精度の試算」と「健康寿命における将来予測―不健康割合の3つのシナリオに基づく―」を参照されたい。

「健康寿命の算定方法の指針」は自治体などの利用者を想定し、平易な文章、明確な表現、詳しい資料に留意した。「健康寿命の算定プログラム」は利用の容易性を重視し、EXCEL形式のファイルとした。

（倫理面への配慮）

本研究では、連結不可能匿名化された既存の統計資料のみを用いるため、個人情報保護に関係する問題は生じない。

C．研究結果

「健康寿命の算定方法の指針」を作成するとともに、「健康寿命の算定プログラム」を開発した。以下に、その概要を示す。いずれもホームページ「厚生労働科学研究：健康寿命のページ」（http://toukei.umin.jp/kenkoujyumyou/）に公開し、ダウンロード可能とした。

1．「健康寿命の算定方法の指針」

表1に「健康寿命の算定方法の指針」の目次を示した。本指針はA4版で37頁であり、9つの章からなる。

「1．緒言」では、本指針のねらいと主な内容を示した。本指針のねらいとしては、保健医療福祉の取り組みの計画・評価への適用に向けて、健康寿命の標準的な算定方法を提案することであった。その取り組みの計画・評価としては、「二十一世紀における第二次国民健康づくり運動（健康日本21（第2次））」の都道府県健康増進計画と市町村健康増進計画を念頭においた。「2．健康寿命とその指標」では、健康寿命の定義と3指標の説明（概念規定と測定法の詳細）を示した。3指標としては「日常生活に制限のない期間の平均」、「自分が健康であると自覚している期間の平均」と「日常生活動作が自立している期間の平均」であった。

「3．健康寿命の算定目的」では、健康寿命の算定目的の確認の重要性、および、算定目的に関係するいくつかの事項を指摘した。「4．健康寿命の算定方法」では、健康寿命の3指標に共通する算定方法の骨格として、基本事項、基礎資料と算定法の概要を示すとともに、「健康寿命の算定プログラム」の使用方法を説明した。

「5．健康寿命の算定上の留意点」では、健康寿命の算定上の留意点として、国民生活基礎調査のデータ、国民生活基礎調査に準じた調査、介護保険の情報、小規模な対象集団を示した。小規模な対象集団では、検討課題の「健康寿命の精度の試算」の検討結果を基礎とした。「6．健康寿命の解釈上の留意点」では、健康寿命の解釈上の留意点として、全国の不健康割合、全国の指標値、算定方法、95%信頼区間、相対比較、ばらつきと範囲、不健康割合の改善と健康寿命の延伸を示した。不健康割合の改善と健康寿命の延伸では、検討課題の「健康寿命における将来予測―不健康割合の3つのシナリオに基づく―」の検討結果を基礎とした。

「7．おわりに」では健康寿命の現状と今後の期待に言及した。「8．文献」では、健康寿命の全般的な文献と算定方法の文献を挙げた。算定方法の文献としては、基礎資料、チャンの生命表法、サリバン法の関係であった。

「9．付録」では、「日常生活に制限のない期間の平均」の算定結果（2010年、都道府県別）、「自分が健康であると自覚している期間の平均」の算定結果（2010年、都道府県別）、「日常生活動作が自立している期間の平均」の

算定結果（2010年、都道府県別）、健康寿命の精度の試算結果、健康寿命の算定法の詳細、対象集団の生命表を用いた健康寿命の算定法を示した。主として、検討課題の「健康寿命の算定方法と年次推移・都道府県分布」の検討結果を基礎した。

２．「健康寿命の算定プログラム」

表２に「健康寿命の算定プログラム」の構成を示した。本プログラムはExcel形式のファイルであった。健康寿命の簡易な算定プログラムで、ホームページからダウンロードされ、使用されることを想定した。９つのシートで構成された。

「readme」シートでは、本プログラムのシートとその内容の概要を示した。「健康寿命の算定表」シートが算定プログラムであり、これに、基礎資料データを入力すると、健康寿命が計算できる。「算定表の使用上の注意」シートでは、指標による基礎資料の違いなどを示した。

「全国の基礎資料」シートでは、全国の基礎資料（2010年）を示した。「都道府県の人口と死亡数」シートでは、都道府県の人口と死亡数（2010年）を示した。「都道府県の不健康割合（１）」、「都道府県の不健康割合（２）」と「都道府県の不健康割合（３）」では、都道府県の不健康割合の分母と分子（2010年）を示した。不健康割合としては、それぞれのシートが各指標に対応し、日常生活に制限のある者の割合、自分が健康であると自覚していない者の割合と日常生活動作が自立していない者の割合であった。

「対象集団の生命表を用いた健康寿命の算定表」シートでは、対象集団の生命表（市町村別生命表など）とその他の基礎資料を入力すると、健康寿命を出力する算定プログラムを示した。

図１と図２に「健康寿命の算定表」シートの画面を示す。画面の上半分が基礎資料の入力用セルであった。基礎資料としては、対象集団の人口、死亡数、不健康割合の分母と分子、および、全国の人口、死亡数と生命表（生存数と定常人口（累積したもの；生命表では、通常、Tと表記））である。画面の下半分が算定結果の表示用セルであった。画面の上半分における基礎資料の入力用セルのデータを変更すると、ただちに算定結果が表示される。算定結果として、性・年齢階級別の健康な期間の平均、不健康な期間の平均とその95%信頼区間などである。

D．考察

健康寿命とは、一般に、ある健康状態で生活することが期待される平均期間またはその指標の総称を指す。様々な指標が提案されている。健康寿命の算定には様々な目的と状況があり、それによって、使用する指標とその算定方法にはかなりの違いが起こりうる。

「健康寿命の算定方法の指針」と「健康寿命の算定プログラム」は、健康日本21(第２次)での健康寿命の算定を想定したものである。そのため、指標として、健康日本21(第２次)に関係する「日常生活に制限のない期間の平均」、「自分が健康であると自覚している期間の平均」と「日常生活動作が自立している期間の平均」を取り上げている。また、算定方法として、対象年次、対象年齢と対象集団、基礎資料と算定法ともに健康日本21(第２次)への適用を想定している。健康日本21(第２次)とは異なる目的と状況への適用にあたって、本指針とプログラムは大いに参考になると思われるが、その利用には注意を要するであろう。

本指針とプログラムは自治体などでの利用を念頭においている。利用を一層容易とするために、一層改善することが重要と考えられる。そのために、まず、問い合わせへの対応などを通して、記載の不明点の解消や記載の追加などを検討することが基礎となろう。

いま、健康寿命について様々な面から研究が進みつつあるが、残された課題も少なくない。新しい指標の開発とともに、既存の指標の算定方法にも検討の余地がある。また、算定方法によって、その算定結果の解釈には違いが起こりうる。本指針とプログラムは、標準的な算定方

法の使用と適切な算定結果の解釈をねらいとしたが、現状までの研究成果に基づいている。今後の研究の進展に応じて、見直しを行うことが大切であろう。

E．結論

健康日本21（第2次）の健康寿命の算定に関して、「健康寿命の算定方法の指針」を作成するとともに、「健康寿命の算定プログラム」を開発した。同指針は健康寿命の算定方法の説明書・マニュアルであり、A4版37頁で、9つの章から構成される。同プログラムは健康寿命の簡易な算定プログラムであり、EXCEL形式のファイルで、人口、死亡数と不健康割合の分子・分母の人数を入力すると、健康寿命の指標値とその95%信頼区間が出力される。いずれもホームページ「厚生労働科学研究：健康寿命のページ」（http://toukei.umin.jp/kenkoujyumyou/）に公開し、ダウンロード可能とした。今後、その利用によって、自治体などの健康寿命の算定が支援されるとともに、標準的な算定方法の使用と適切な算定結果の解釈に資するものと期待される。

F．研究発表

1．論文発表

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G．知的財産権の出願・登録状況（予定を含む）

1．特許取得

なし。

2．実用新案登録

なし。

3．その他

なし。

表 1. 「健康寿命の算定方法の指針」の目次

表 2. 「健康寿命の算定プログラム」の構成

シート	内容
readme	「健康寿命の算定プログラム」のシートとその内容の概要
健康寿命の算定表	対象集団と全国の基礎資料を入力すると、 対象集団の健康寿命を出力する算定プログラム。
算定表の使用上の注意	健康寿命の算定表の使用上の注意。 たとえば、指標による基礎資料の違いなど。
全国の基礎資料	全国の基礎資料（2010 年） （いくつかの資料からの引用）
都道府県の人口と死亡数	都道府県の人口と死亡数（2010 年） （全国の基礎資料と同じ資料からの引用）
都道府県の不健康割合（１）	都道府県の「日常生活に制限のある者の割合」の 分母と分子（2010 年） （国民生活基礎調査に基づく推計数）
都道府県の不健康割合（２）	都道府県の「自分が健康であると自覚していない者の 割合」の分母と分子（2010 年） （国民生活基礎調査に基づく推計数）
都道府県の不健康割合（３）	都道府県の「日常生活動作が自立していない者の割合」の 分母と分子（2010 年） （介護保険の要介護認定者数に基づく推計数）
対象集団の生命表を用いた 健康寿命の算定表	対象集団の生命表（市町村別生命表など）と その他の基礎資料を入力すると、 健康寿命を出力する算定プログラム。

図 1. 「健康寿命の算定プログラム」の「健康寿命の算定表」シートの画面

対象集団の基礎資料の入力［白色セル］　　全国の基礎資料の入力［白色セル］

性別	対象集団					全国（対象集団と同一年次）					
	年齢階級	人口	死亡数	不健康割合の分母	不健康割合の分子	年齢階級	人口	死亡数	年齢	生存数	定常人口
	（歳）	（人）	（人）	（人）	（人）	（歳）	（人）	（人）	x	l_x	T_x
男	0～4	53256	29	53256	0	0～4	2689162	1873	0	100000	7963518
	5～9	56543	6	56543	0	5～9	2841813	261	5	99661	7464920
	10～14	59297	6	59297	0	10～14	3013782	350	10	99614	6966743
	15～19	57170	19	57170	0	15～19	3096387	941	15	99557	6468797
	20～24	53284	38	53284	0	20～24	3228469	1962	20	99403	5971330
	25～29	67089	45	67089	0	25～29	3642952	2412	25	99118	5474998
	30～34	77585	60	77585	0	30～34	4180032	3177	30	98795	4980198
	35～39	90947	86	90947	0	35～39	4926663	4867	35	98421	4487127
	40～44	80663	114	80663	0	40～44	4381848	6629	40	97925	3996178
	45～49	76008	158	76008	102	45～49	4015388	9566	45	97174	3508304
	50～54	76376	284	76376	102	50～54	3807362	14638	50	96004	3025136
	55～59	87172	522	87172	205	55～59	4296539	27134	55	94164	2549369
	60～64	98927	833	98927	617	60～64	4936772	46155	60	91282	2085238
	65～69	78932	1124	78795	1255	65～69	3933785	57468	65	86929	1639074
	70～74	65484	1425	65368	2136	70～74	3235341	73470	70	80842	1218817
	75～79	53661	2072	53275	3346	75～79	2593169	102673	75	72127	835000
	80～84	37102	2590	36836	4172	80～84	1700191	119801	80	58934	505129
	85～	23337	3432	23171	5579	85～	1052072	159813	85	41062	253559
女	0～4	50998	32	50998	0	0～4	2565299	1509	0	100000	8638891
	5～9	53248	2	53248	0	5～9	2708194	219	5	99709	8140093
	10～14	56334	5	56334	0	10～14	2870493	203	10	99671	7641653
	15～19	53954	9	53954	0	15～19	2932213	481	15	99634	7143382
	20～24	51365	11	51365	0	20～24	3076411	791	20	99554	6645388
	25～29	62301	16	62301	0	25～29	3511714	1025	25	99431	6147923
	30～34	72633	31	72633	0	30～34	4033928	1660	30	99286	5651111
	35～39	85951	46	85951	0	35～39	4761382	2688	35	99084	5155164
	40～44	77333	53	77333	0	40～44	4268754	3533	40	98801	4660406
	45～49	74348	91	74348	80	45～49	3950745	4966	45	98385	4167367
	50～54	76109	147	76109	80	50～54	3800955	7376	50	97757	3676902
	55～59	87858	235	87858	160	55～59	4359516	12192	55	96820	3190334
	60～64	101741	403	101741	481	60～64	5117803	19941	60	95500	2709350
	65～69	85861	516	85709	1066	65～69	4296437	25619	65	93592	2236330
	70～74	75759	726	75622	2037	70～74	3752050	36778	70	90872	1774737
	75～79	69931	1200	69432	4219	75～79	3379056	60415	75	86507	1330308
	80～84	56957	1963	56552	7570	80～84	2663083	91456	80	78971	914910
	85～	59664	6364	59241	21500	85～	2761968	292332	85	66190	549344

図 2. 「健康寿命の算定プログラム」の「健康寿命の算定表」シートの画面（続き）

対象集団の算定結果［水色セル］　　#：平均余命に対する割合

性別	年齢	平均余命			健康な期間の平均				不健康な期間の平均			
	(歳)	(年)	95%信頼区間		(年)	95%信頼区間		(%) #	(年)	95%信頼区間		(%) #
男	0	80.08	79.86	80.30	78.68	78.48	78.89	98.3	1.40	1.37	1.42	1.7
	5	75.29	75.08	75.50	73.89	73.70	74.09	98.1	1.40	1.37	1.43	1.9
	10	70.33	70.12	70.54	68.93	68.74	69.12	98.0	1.40	1.37	1.43	2.0
	15	65.36	65.16	65.57	63.96	63.77	64.15	97.9	1.40	1.37	1.43	2.1
	20	60.47	60.27	60.67	59.07	58.88	59.25	97.7	1.40	1.38	1.43	2.3
	25	55.66	55.48	55.85	54.26	54.08	54.43	97.5	1.41	1.38	1.43	2.5
	30	50.84	50.66	51.02	49.43	49.26	49.60	97.2	1.41	1.39	1.44	2.8
	35	46.03	45.85	46.21	44.61	44.45	44.77	96.9	1.42	1.39	1.44	3.1
	40	41.24	41.06	41.41	39.81	39.65	39.97	96.5	1.42	1.40	1.45	3.5
	45	36.52	36.35	36.68	35.08	34.93	35.23	96.1	1.43	1.41	1.46	3.9
	50	31.88	31.72	32.03	30.43	30.29	30.58	95.5	1.44	1.42	1.47	4.5
	55	27.43	27.28	27.57	25.96	25.83	26.10	94.7	1.46	1.44	1.49	5.3
	60	23.17	23.03	23.31	21.67	21.55	21.79	93.5	1.50	1.47	1.52	6.5
	65	19.09	18.96	19.22	17.56	17.45	17.67	92.0	1.53	1.50	1.56	8.0
	70	15.30	15.18	15.41	13.74	13.63	13.84	89.8	1.56	1.53	1.59	10.2
	75	11.76	11.65	11.86	10.19	10.10	10.28	86.7	1.57	1.54	1.60	13.3
	80	8.73	8.65	8.82	7.18	7.10	7.25	82.2	1.56	1.52	1.59	17.8
	85	6.38	6.18	6.57	4.84	4.69	5.00	75.9	1.54	1.48	1.59	24.1
女	0	86.46	86.26	86.66	83.51	83.33	83.69	96.6	2.95	2.92	2.99	3.4
	5	81.73	81.55	81.91	78.77	78.61	78.93	96.4	2.96	2.93	3.00	3.6
	10	76.74	76.56	76.92	73.78	73.62	73.94	96.1	2.96	2.93	3.00	3.9
	15	71.78	71.60	71.95	68.81	68.66	68.97	95.9	2.96	2.93	3.00	4.1
	20	66.83	66.66	67.01	63.87	63.71	64.02	95.6	2.97	2.93	3.00	4.4
	25	61.90	61.73	62.07	58.93	58.78	59.08	95.2	2.97	2.93	3.01	4.8
	30	56.98	56.81	57.14	54.00	53.86	54.15	94.8	2.97	2.94	3.01	5.2
	35	52.09	51.93	52.25	49.11	48.97	49.25	94.3	2.98	2.94	3.02	5.7
	40	47.23	47.07	47.38	44.24	44.10	44.37	93.7	2.99	2.95	3.03	6.3
	45	42.38	42.23	42.53	39.38	39.25	39.51	92.9	3.00	2.96	3.04	7.1
	50	37.63	37.49	37.77	34.62	34.50	34.74	92.0	3.01	2.97	3.05	8.0
	55	32.97	32.83	33.10	29.93	29.82	30.04	90.8	3.04	3.00	3.07	9.2
	60	28.37	28.24	28.49	25.30	25.20	25.40	89.2	3.07	3.03	3.10	10.8
	65	23.90	23.79	24.01	20.79	20.70	20.89	87.0	3.11	3.07	3.14	13.0
	70	19.54	19.44	19.64	16.40	16.32	16.49	83.9	3.14	3.10	3.18	16.1
	75	15.37	15.28	15.46	12.22	12.15	12.29	79.5	3.15	3.12	3.19	20.5
	80	11.53	11.46	11.60	8.40	8.35	8.46	72.9	3.12	3.09	3.16	27.1
	85	8.24	8.05	8.43	5.25	5.12	5.37	63.7	2.99	2.91	3.06	36.3

研究成果の刊行に関する一覧表

書籍

著者氏名	論文タイトル名	書籍全体の編集者名	書籍名	出版社名	出版地	出版年	ページ
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Seko R, Hashimoto S, Kawado M, Murakami Y, Hayashi M, Kato M, Noda T, Ojima T, Nagai M, Tsuji I.	Trends in life expectancy with care needs based on long-term care insurance data in Japan.	J Epidemiol	22(3)	238-243	2012

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1) Hashimoto S, Kawado M, Yamada H, Seko R, Murakami Y, Hayashi M, Kato M, Noda T, Ojima T, Nagai M, Tsuji I. Gains in disability-free life expectancy from elimination of diseases and injuries in Japan. J Epidemiol 2012;22:199-204.

2) Seko R, Hashimoto S, Kawado M, Murakami Y, Hayashi M, Kato M, Noda T, Ojima T, Nagai M, Tsuji I. Trends in life expectancy with care needs based on long-term care insurance data in Japan. J Epidemiol 2012;22:238-243.

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Original Article

Gains in Disability-Free Life Expectancy From Elimination of Diseases and Injuries in Japan

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ABSTRACT

Background: Although disability-free life expectancy has been investigated in Japan, gains from elimination of diseases and injuries have not been examined.

Methods: We used data from the 2007 Japanese national health statistics to calculate the number of years with and without activity limitation that could be expected from eliminating 6 selected diseases and injuries.

Results: At birth, the number of expected years of life without and with activity limitation was 70.8 and 8.4, respectively, in males and 74.2 and 11.8 in females. More than 1.0 expected years without activity limitation were gained from eliminating malignant neoplasms and cerebrovascular diseases; smaller gains were observed after eliminating other diseases and injuries. Elimination of cerebrovascular diseases, dementia, and fracture decreased expected years with activities of daily living (ADL) limitation, and elimination of shoulder lesions/low back pain decreased expected years with non-ADL limitation.

Conclusions: Elimination of diseases and injuries increased expected years with and without activity limitation among Japanese, which suggests that improved prevention of those diseases and injuries—including cerebrovascular diseases and dementia—would result in longer disability-free life expectancy and fewer years of severe disability.

Key words: disability-free life expectancy; healthy life expectancy; life expectancy; activities of daily living; health statistics

INTRODUCTION

Improvement of disability-free life expectancy requires evaluation of the impact of diseases and injuries.[1] Disability-free life expectancy gained from elimination of diseases and injuries was proposed as an indicator of disease burden and has been investigated in several countries.[1–6]

In Japan, life expectancy at birth is now the longest in the world, and gains in years of life due to elimination of causes of death are reported annually in official statistics.[7,8] Recently, expected years of life with and without activity limitation have been studied, but gains from elimination of diseases and injuries have not yet been examined.[9]

In the present study, we used 2007 Japanese national health statistics data to calculate gains in years of life, with and without activity limitation, that would be expected if selected diseases and injuries were eliminated.

METHODS

Data

We used data from life tables, the population, and number of deaths in Japan in 2007.[8,10,11] Data on activity status and disease status for persons living at home were obtained from the 2007 Comprehensive Survey of Living Conditions of the People on Health and Welfare, which was a self-administered questionnaire survey distributed to about 760 000 persons in households randomly selected nationwide.[12] Data for patients admitted to hospitals and clinics were from the Patient Surveys of 2005 and 2008, which included information on

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more than 3 000 000 patients who visited hospitals and clinics randomly selected throughout Japan.[13] Data for Japanese who were admitted to healthcare and welfare facilities for elderly requiring long-term care (hereafter, "residents of long-term elder care facilities") were from the 2007 Survey of Institutions and Establishments for Long-term Care.[14] Data from the 3 surveys were used with permission from the Ministry of Internal Affairs and Communications and the Ministry of Health, Labour and Welfare of Japan.

Activity limitation

The activity status of persons living at home was evaluated using responses to the questions: "Is your daily life now affected by health problems?" and "How is it affected?".[12] The second question was for persons replying "Yes" to the first question. The responses to the second question were "activities of daily living (ADL) (rising, dressing/undressing, eating, bathing, etc)," "going out," "work, housework, or schoolwork," "physical exercise (including sports)," and "other." We accordingly classified the responses into 3 levels of activity. A person replying "Yes" to the first question and "ADL" to the second was classified as having an ADL limitation. A person replying "Yes" to the first question but not "ADL" to the second was classified as having a non-ADL limitation. Respondents with other replies were classified as having no activity limitation. Inpatients in hospitals and clinics and residents of long-term elder care facilities were considered to have an ADL limitation.

Disease status

We selected 6 diseases and injuries: malignant neoplasms (International Classification of Diseases, 10th Revision [ICD-10] code: C00–C97), ischemic heart disease (I20–I25), cerebrovascular diseases (I60–I69), dementia (F00–F03; G30), shoulder lesions/low back pain (M54.3–M54.5; M75), and fracture (S02, S12, S22, S32, S42, S52, S62, S72, S82, S92, T02, T08, T10, T12, T14.2).[11,13]

Disease status for persons living at home was evaluated using responses to the questions: "Do you now go to a hospital, clinic, or facility of Japanese traditional massage, acupuncture, moxibustion, or judo-orthopedics for diseases or injuries?" and "What are your diseases or injuries?".[12] The second question was for persons replying "Yes" to the first question. The responses to the second question were 39 diseases and injuries that were encompassed by the abovementioned 6 diseases and injuries, "other disease or injury", and "unknown." A person who indicated in the second question that they had any of the 6 diseases and injuries was classified as an outpatient with that disease or injury. For inpatients in hospitals and clinics and residents of long-term elder care facilities, the primary disease or injury was used to determine the presence or absence of the 6 diseases and injuries.[13,14] Underlying cause of death was used in the analysis.[11]

Calculation of gains in years with and without activity limitation expected from elimination of diseases and injuries

We calculated expected years of life with and without activity limitation that would be gained from eliminating each of the above 6 diseases and injuries in Japan in 2007. Gains were defined as years after elimination minus those years without disease elimination. The method used to calculate years with no disease elimination was equivalent to one used in a previous Japanese report analyzing the period 1995–2004.[9] The previously used method for calculating years from elimination of a specific disease or injury is described below.[2]

A life table that eliminated deaths caused by disease was constructed using data on number of deaths and life tables without disease elimination.[8,11,15] The probability of survival in age group x with the disease eliminated (p_x^e) was expressed using the probability without disease elimination (p_x), the number of deaths (D_x) from all diseases and injuries, and the number of deaths from the disease (D_x^e), as follows:

$$\ln(p_x^e) = (1 - D_x^e/D_x)\ln(p_x)$$

where ln is a natural logarithm function and the age groups are 0 to 4, 5 to 9,..., 80 to 84, and 85 years or older. Using Chiang's life table method,[16] the number of survivors (l_x^e) and the stationary population (L_x^e), the effect of eliminating a disease was calculated from the values of p_x^e.

We calculated 2007 sex- and age-specific prevalences of ADL limitation and non-ADL limitation after disease elimination. The prevalence of ADL limitation after eliminating a disease was based on the population after excluding outpatients with the disease and ADL limitations, inpatients with the disease in hospitals and clinics, and people with the disease who resided in long-term elder care facilities. The prevalence of non-ADL limitation after eliminating a disease was calculated from the population excluding outpatients with the disease and non-ADL limitation. The prevalence of inpatients in 2007 was estimated from those in 2005 and 2008 using linear interpolation, and other 2007 prevalences were derived from the abovementioned data.

Using the Sullivan method,[17] we divided years of life in age group x (e_x^e) expected after eliminating a disease into those with and without activity limitation, as follows:

$$e_x^e = \Sigma\pi_y^e L_y^e/l_x^e + \Sigma(1 - \pi_y^e)L_y^e/l_x^e$$

where Σ represents the sum from age group x to the oldest age group in the age group of y and π_y^e is the age-specific prevalence of activity limitation after eliminating the disease. In addition, we divided the years with activity limitation expected after eliminating a disease into those due to ADL limitation and those due to non-ADL limitation.

RESULTS

Tables 1 and 2 show death rates, prevalences, and proportions

Table 1. Death rate, prevalence, and proportion of selected diseases and injuries by age group in males

	Death rate (per 100 000 population)	Prevalence (per 1000 population)			Proportion of outpatients (%)[c]		
		Residents admitted to facilities[a]	Inpatients[b]	Outpatients[c]	No limitation of activities	Non-ADL limitation	ADL limitation
Age 0–64 years							
All diseases and injuries	251.1	0.1	5.3	227.5	74.1	19.0	6.9
Malignant neoplasms	88.4	0.0	0.5	1.8	55.0	36.1	8.9
Ischemic heart disease	18.0	0.0	0.1	5.8	64.9	26.4	8.7
Cerebrovascular diseases	20.3	0.1	0.4	4.3	50.6	23.2	26.1
Dementia	0.1	0.0	0.0	0.2	32.6	38.6	28.8
Shoulder lesions/low back pain	0.0	0.0	0.0	26.7	69.9	22.8	7.3
Fracture	3.1	0.0	0.2	3.2	41.3	34.5	24.2
Age 65 years or older							
All diseases and injuries	4010.6	12.6	33.0	654.8	67.0	19.1	13.8
Malignant neoplasms	1361.9	0.3	4.9	12.6	45.6	31.2	23.1
Ischemic heart disease	274.8	0.2	0.7	58.7	53.0	29.3	17.7
Cerebrovascular diseases	436.7	5.0	6.1	44.9	41.8	20.9	37.3
Dementia	18.7	2.8	2.0	10.5	18.2	17.4	64.5
Shoulder lesions/low back pain	0.1	0.0	0.0	96.4	52.3	29.5	18.1
Fracture	12.8	0.2	1.1	6.4	23.8	35.2	41.0

ADL, activities of daily living.
[a]Healthcare and welfare facilities for elderly requiring long-term care.
[b]Inpatients in hospitals and clinics.
[c]Outpatients in hospitals, clinics, and facilities of Japanese traditional massage, acupuncture, moxibustion, and judo-orthopedics.

Table 2. Death rate, prevalence, and proportion of selected diseases and injuries by age group in females

	Death rate (per 100 000 population)	Prevalence (per 1000 population)			Proportion of outpatients (%)[c]		
		Residents admitted to facilities[a]	Inpatients[b]	Outpatients[c]	No limitation of activities	Non-ADL limitation	ADL limitation
Age 0–64 years							
All diseases and injuries	120.6	0.1	4.3	266.9	73.4	19.6	6.9
Malignant neoplasms	58.7	0.0	0.4	4.2	61.0	29.6	9.3
Ischemic heart disease	4.4	0.0	0.0	2.7	64.8	24.2	11.0
Cerebrovascular diseases	9.2	0.1	0.2	2.1	47.7	27.1	25.2
Dementia	0.1	0.0	0.0	0.2	36.0	25.2	38.8
Shoulder lesions/low back pain	0.0	0.0	0.0	44.9	72.0	21.0	7.0
Fracture	1.3	0.0	0.1	2.4	37.8	34.3	27.9
Age 65 years or older							
All diseases and injuries	2907.9	33.8	35.3	635.0	63.2	20.1	16.7
Malignant neoplasms	669.0	0.3	2.4	7.7	41.7	34.1	24.2
Ischemic heart disease	203.6	0.6	0.5	35.7	46.8	27.7	25.5
Cerebrovascular diseases	392.1	8.6	7.2	21.7	34.2	22.3	43.5
Dementia	30.7	10.5	3.4	14.7	18.7	17.4	63.9
Shoulder lesions/low back pain	0.0	0.1	0.1	137.9	50.8	28.3	20.9
Fracture	13.4	1.5	3.4	13.0	25.0	24.9	50.0

ADL, activities of daily living.
[a]Healthcare and welfare facilities for elderly requiring long-term care.
[b]Inpatients in hospitals and clinics.
[c]Outpatients in hospitals, clinics, and facilities of Japanese traditional massage, acupuncture, moxibustion, and judo-orthopedics.

of selected diseases and injuries by age group in males and females, respectively. Malignant neoplasms, ischemic heart disease, and cerebrovascular diseases were associated with high death rates, whereas dementia, shoulder lesions/low back pain, and fracture were associated with low death rates. Among those aged 65 years or older, a large proportion of residents of long-term elder care facilities had cerebrovascular diseases and dementia and a large proportion of inpatients had cerebrovascular diseases. Among those aged 0 to 64 years and those aged 65 years or older, large proportions of outpatients had shoulder lesions/low back pain. Among outpatients with either dementia or fracture, the proportion of those with no limitation of activities was low; a high proportion of outpatients with dementia had an ADL limitation.

Table 3 shows baseline years and gains in years, at birth, with and without activity limitation expected after eliminating the selected diseases and injuries. Life expectancy at birth was 79.2 years in males and 86.0 years in females. There were large gains in life expectancy from eliminating malignant neoplasms, ischemic heart disease, and cerebrovascular

Table 3. Baseline and gains in years with and without activity limitation, at birth, expected from elimination of selected diseases and injuries

		Life expectancy at birth	Expected years at birth			
			Without activity limitation	With activity limitation	With non-ADL limitation	With ADL limitation
Males	At baseline	79.19	70.80	8.39	4.60	3.79
	Gains from elimination of					
	malignant neoplasms	4.00	2.78	1.22	0.48	0.75
	ischemic heart disease	0.72	0.70	0.02	−0.11	0.13
	cerebrovascular diseases	1.04	1.13	−0.09	0.10	−0.19
	dementia	0.03	0.17	−0.14	0.02	−0.16
	shoulder lesions/low back pain	0.00	0.59	−0.59	−0.51	−0.07
	fracture	0.10	0.26	−0.16	−0.07	−0.09
Females	At baseline	85.99	74.20	11.79	5.86	5.93
	Gains from elimination of					
	malignant neoplasms	2.98	1.96	1.02	0.28	0.74
	ischemic heart disease	0.56	0.42	0.14	−0.05	0.19
	cerebrovascular diseases	1.13	1.04	0.09	0.15	−0.06
	dementia	0.07	0.37	−0.30	0.06	−0.37
	shoulder lesions/low back pain	0.00	0.82	−0.82	−0.79	−0.04
	fracture	0.07	0.30	−0.23	−0.04	−0.19

ADL, activities of daily living.

diseases (0.6–4.0 years) and very small gains from eliminating the other 3 diseases and injuries (0.0–0.1 years).

The number of expected years without and with activity limitation was 70.8 and 8.4 years in males, respectively, and 74.2 and 11.8 years in females. Elimination of malignant neoplasms greatly increased expected years without and with activity limitation (2.0–2.8 and 1.0–1.2 years, respectively). Elimination of ischemic heart disease increased expected years without activity limitation (0.4–0.7 years), as did elimination of cerebrovascular diseases (1.0–1.1 years); however, there were only very small changes in years with activity limitation after eliminating these diseases (≤0.1 years). Elimination of the other 3 diseases and injuries slightly increased expected years without activity limitation (0.2–0.8 years) and slightly decreased years with activity limitation (0.1–0.8 years).

At birth, the expected years with non-ADL limitation and with ADL limitation were 4.6 and 3.8 years in males, respectively, and 5.9 and 5.9 years in females. Elimination of malignant neoplasms and ischemic heart disease increased expected years with ADL limitation (0.1–0.8 years). In contrast, elimination of cerebrovascular diseases, dementia, and fracture led to modest decreases (0.1–0.4 years). Elimination of shoulder lesions/low back pain very slightly decreased expected years with ADL limitation (0.0–0.1 years) and decreased years with non-ADL limitations (0.5–0.8 years).

DISCUSSION

Elimination of malignant neoplasms, ischemic heart disease, and cerebrovascular diseases greatly increased life expectancy at birth, whereas elimination of dementia, shoulder lesions/low back pain, and fracture resulted in very small gains. These differences correspond to known disparities between fatal and nonfatal diseases and injuries.[1,8,15] Elimination of nonfatal diseases and injuries, as well as elimination of fatal diseases, increased expected years of life without activity limitation. These findings were consistent with those of previous studies in several countries and confirmed that, in Japan, the effects of diseases and injuries on disability-free life expectancy differ considerably from those on total life expectancy.[1–4,18]

The results observed in the present study were due to the prevalence of activity limitation from diseases and injuries as well as death rates.[1,2] As shown in Tables 1 and 2, individuals with cerebrovascular diseases or dementia had a high prevalence of low ADL.[3,4,19] Therefore, elimination of these diseases decreased expected years with ADL limitation and increased years without activity limitation. Thus, improving prevention of these diseases would be likely to increase disability-free life expectancy and decrease expected years with severe disability. Although elimination of these diseases is unrealistic, these findings illustrate the current burden of selected diseases/injuries on disability-free life expectancy in Japan and provide considerable information for health planning against diseases and injuries.[1,4,6,20]

There were some limitations in the present study. We selected the abovementioned 6 diseases and injuries because malignant neoplasms, ischemic heart disease, and cerebrovascular diseases are the leading causes of death in Japan,[11] because dementia, fracture, and cerebrovascular diseases are the primary reasons for residence in long-term elder care facilities,[14] and because shoulder lesions/low back pain are the most frequently encountered medical conditions

among outpatients in hospitals, clinics, and facilities of Japanese traditional massage, acupuncture, moxibustion, and judo-orthopedics.[12] Treatment in acupuncture and moxibustion facilities, as well as in hospitals and clinics, is covered by the Japanese national health insurance system.[21] Studies focusing on gains in disability-free life expectancy from eliminating other diseases and injuries would provide very useful additional information.

Underlying cause of death was used in the present analysis. If deaths indirectly caused by a disease were not considered, the overall effect of the disease on life expectancy would be underestimated.[15,22] Underestimation of some diseases, including hypertension and diabetes mellitus, would be large, while underestimation of malignant neoplasms, ischemic heart disease, and cerebrovascular diseases (which were selected in the present study) would be relatively small.[23] The problem of using underlying cause of death is a common one—even in official statistics—in studies of life expectancy after eliminating causes of deaths.[1,2,4,6,8,15]

In the present study, we analyzed the primary disease or injury of inpatients in hospitals and clinics and residents of long-term elder care facilities. This, too, might result in an underestimation of the overall effect of diseases and injuries on expected years with and without activity limitation. Inpatient data were obtained from the Patient Survey, and data on residents of long-term elder care facilities were obtained from the Survey of Institutions and Establishments for Long-term Care. These surveys include only the primary disease or injury of the inpatient/resident.[13,14] However, underestimation is unlikely for outpatients because data on the presence or absence of all diseases and injuries were analyzed.[12]

In many persons, activity limitations are associated with 2 or more diseases or injuries. For example, if a patient with cerebrovascular disease sustains a fracture and subsequent ADL limitation, cerebrovascular disease might be selected as the primary reason for the ADL limitation. If such a selection occurred relatively frequently and only data on primary disease or injury were used, the effect of fracture on expected years with ADL limitation would be underestimated. Another possibility is that shoulder lesions/low back pain are more frequent in patients whose activity had been limited by other diseases or injuries. By not excluding the effect of such diseases or injuries, gains in years without activity limitation expected from eliminating shoulder lesions/low back pain would be overestimated.

Data on the disease status of outpatients were obtained from national health statistics, on the basis of responses from patients or their family members, and were not classified by ICD-10 code.[12] The codes used for the response "shoulder lesions/low back pain" were M54.3–M54.5 and M75 in the present study, after referring to the classification of the Patient Survey. The responses to the survey and the codes we used might have been inaccurate. The effect of such errors on our results is unknown. Data for inpatients in hospitals and clinics and residents in long-term elder care facilities were based on the diagnoses of health care professionals, were classified by ICD-10 code, and are assumed to be highly accurate.[13,14]

The prevalence of activity limitation after eliminating a disease was calculated from the population excluding outpatients with the disease and activity limitation, inpatients with the disease in hospitals and clinics, and residents of long-term elder care facilities who had the disease. Persons with a condition of interest who were not receiving medical care were not considered in our study because most would not have been substantially affected by the condition. By not considering those persons, the effect of medical conditions of interest on expected years with activity limitation in the whole population would be slightly underestimated.

Gains in life expectancy at birth in Japan in 2007 after elimination of some diseases and injuries were reported in national official statistics.[8] Those values, which were estimated using complicated approaches, were very similar to our estimates: 4.04 years for males and 3.01 years for females from elimination of malignant neoplasms, and 1.06 years for males and 1.15 years for females from elimination of cerebrovascular diseases (the values in Table 3 were 4.00, 2.98, 1.04, and 1.13 years, respectively).

The method we used to calculate years of life with and without activity limitation expected from elimination of diseases and injuries was proposed in 1983 and applied in several studies.[1,2,4,6] As mentioned above, in this method, the use of life tables and prevalences of disability after eliminating diseases and injuries requires application of the Sullivan method. Although it is assumed that the age-specific prevalence of disability in a stationary population is equivalent to that observed in the real population, the Sullivan method is a common tool for estimating disability-free life expectancy based on cross-sectional data on disability.[17] It would be helpful to use longitudinal data to estimate years gained from eliminating diseases and injuries.[1,3,5]

In conclusion, we estimated gains in years with and without activity limitation expected from elimination of selected diseases and injuries in Japan. Our results indicate that improving prevention of some of these diseases and injuries, including cerebrovascular diseases and dementia, might increase disability-free life expectancy and decrease expected years with severe disability.

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Original Article

Trends in Life Expectancy With Care Needs Based on Long-term Care Insurance Data in Japan

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ABSTRACT

Background: Using a previously developed method for calculating expected years of life with care needs based on data from the Japanese long-term care insurance system, we examined recent trends in expected years of life with care needs by age group and prefecture.

Methods: Information on care needs was available from the long-term care insurance system of Japan. Expected years of life with care needs by age group and prefecture in 2005–2009 were calculated.

Results: Expected years of life with care needs at age 65 increased from 1.43 years in 2005 to 1.62 years in 2009 for men, and from 2.99 to 3.44 years for women. As a proportion of total life expectancy, these values show an increase from 7.9% to 8.6% in men and from 12.9% to 14.4% in women. Expected years with care needs did not increase in the age groups of 65 to 69 and 70 to 74 years but markedly increased in the age group of 85 years or older. Expected years with care needs increased in every prefecture during the period studied. The difference in 2005 between the 25th and 75th percentiles in prefectural distributions was 0.16 years for men and 0.35 years for women. The difference remained nearly constant between 2005 and 2009.

Conclusions: Expected number of years of life with care needs increased among Japanese from 2005 to 2009, and there was a wide range in distribution among prefectures. Further studies on coverage of care needs under the long-term insurance program are necessary.

Key words: disability-free life expectancy; life expectancy; care needs; health statistics

INTRODUCTION

Life expectancy is a major indicator of population health.[1] Among the aged population, life expectancy with disability or care needs is important,[2,3] as it provides information that is valuable in formulating health policies for elderly adults. Expected years with disability has been evaluated in several countries.[3–8]

A system of long-term care insurance was recently implemented in Japan,[9] and a method for calculating expected years of life with and without care needs was developed based on data from this system.[10,11] Expected years of life without care needs was calculated and prefectural distributions were reported in previous studies.[11,12] However, individuals with care needs were not sufficiently analyzed and recent trends in this population have not been examined.[11] The recent gain in expected years of total life among adults aged 75 years or older in Japan was greater than that among those aged 65 to 74 years.[13] The proportion of elderly persons with care needs increases with age.[14] Thus, it is necessary to analyze recent trends in expected years with care needs by age group.

In the present study, we calculated expected number of years of life with care needs among elderly adults in Japan using a previously developed method based on data from the long-term care insurance system. In addition, we examined trends by age group and prefecture in 2005–2009.

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METHODS

Long-term care insurance in Japan

The Japanese government implemented mandatory social long-term care insurance on 1 April 2000.[9,15] Every adult aged 65 years or older in Japan is eligible. Level of care need is based on the individual's physical and mental status, as evaluated by the insurance system. The level determines the extent of service coverage.

Data

We used Japanese population, mortality, and life table data from 2005–2009.[13,16,17] Excepting life tables, data were available from all 47 prefectures. Data on care needs were obtained from the *Report on Long-Term Care Insurance Services* and the *Survey of Long-Term Care Benefit Expenditures* at the end of each September from 2005 to 2009.[14,17,18] The former report is based on administrative records of the long-term care insurance system and includes the actual number of persons for each care need level, as certified by the insurance system, in the age groups of 65 to 74 and 75 years or older in all prefectures. However, it does not include separate values for men and women. The latter survey is based on long-term care benefit statements and includes the approximate number of persons for care need level in 5-year age bands among men and women of all prefectures. Values were estimated using the totals of the actual numbers multiplied by the proportions of the approximate numbers.

Calculation of expected years with care needs

We calculated expected number of years with care needs by using the previously developed method, based on the abovementioned data, as follows.[3,11] Care needs for persons aged 65 or older were evaluated using the care need levels certified by the long-term care insurance system of Japan.[15] A level 2 or greater care need was classified in the present study as "having care needs"; all other care-need levels were classified as "no care needs" in our analysis. Sex- and age-specific prevalences of persons with care needs were then calculated for each prefecture in 2005–2009. The age groups were 65 to 69, 70 to 74, 75 to 79, 80 to 84, and 85 years or older.

Using the Sullivan method,[19] we calculated expected number of years with care needs at age x years during the interval between age y and age z as follows:

$$\Sigma \pi_i L_i / l_x$$

where Σ represents the sum between y and z years in age group i, π_i is the age-specific prevalence of care needs, L_i is the stationary population, and l_x is the number of survivors in the life table. The underlying assumption in this calculation is that age-specific prevalence of care needs in the stationary population is equivalent to that observed in the real population.[3] Data from Japanese nationwide life tables were available. Life tables for prefectures were constructed using Chiang's method, based on prefectural death rates.[20]

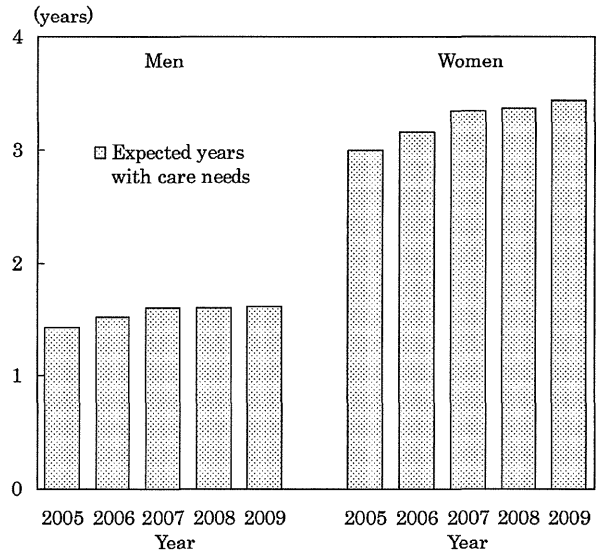

Figure 1. Expected number of years with care needs at age 65 among Japanese men and women in 2005–2009

RESULTS

Figure 1 shows expected years of life with care needs at age 65 years for men and women in 2005–2009. Expected years of life with care needs at age 65 for men was 1.43 in 2005, and monotonically increased to 1.63 in 2009. The values for women monotonically increased from 2.99 to 3.44 during the same period.

Table 1 shows total life expectancy and expected years of life with care needs at age 65 in men and women in 2005 and 2009, by age group. The proportion of expected years with care needs to total life expectancy at age 65 for men was 7.9% in 2005 and 8.6% in 2009. The corresponding proportions for women were 12.9% and 14.4%.

Among men, expected number of years with care needs in 2005 increased from 0.09 years for the age group of 65 to 69 years to 0.64 years for the age group of 85 years or older. The numbers for women in 2005 and for men and women in 2009 also increased with advancing age. The difference between 2005 and 2009 was less than 0.01 years for the age groups of 65 to 69 and 70 to 74 years, less than 0.05 years for the age groups of 75 to 79 and 80 to 84 years, and 0.13 years for men and 0.38 years for women for the age group of 85 years or older.

Expected years with care needs at age 65 years in 2005 and 2009, by prefecture, are shown in Figures 2 and 3 for men and women, respectively. The expected years with care needs for