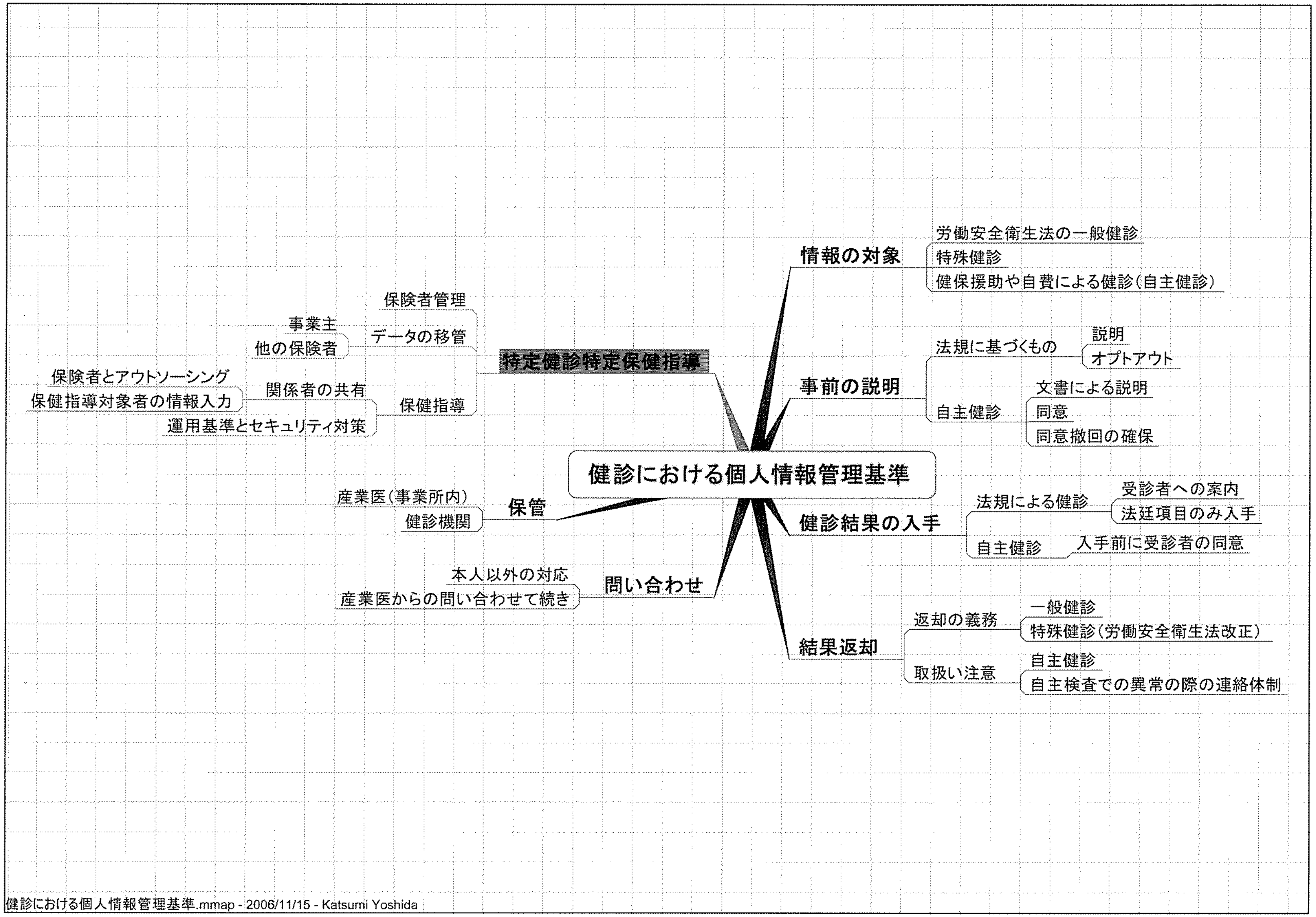
健診における個人情報管理基準
情報の対象
労働安全衛生法の一般健診
特殊健診
健保援助や自費による健診(自主健診)
事前の説明
法規に基づくもの
説明
オプトアウト
自主健診
文書による説明
同意
同意撤回の確保
健診結果の入手
法規による健診
受診者への案内
法廷項目のみ入手
自主健診
入手前に受診者の同意
結果返却
返却の義務
一般健診
特殊健診(労働安全衛生法改正)
取扱い注意
自主健診
自主検査での異常の際の連絡体制
問い合わせ
本人以外の対応
産業医からの問い合わせて続き
保管
産業医(事業所内)
健診機関
特定健診特定保健指導
保険者管理
データの移管
事業主
他の保険者
保健指導
関係者の共有
保険者とアウトソーシング
保健指導対象者の情報入力
運用基準とセキュリティ対策
健診における個人情報管理基準.mmap - 2006/11/15 - Katsumi Yoshida

②特定健診の検査項目と問診項目の項目コード（JLAC10）に関する研究

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研究要旨：　厚生労働省は、特定健診の検査項目と問診項目の項目コードとして、日本臨床検査医学会のJLAC10とそれに準拠したコードを採用する予定である。本稿では、特定健診の検査項目と問診項目の項目コードの妥当性を研究して、予想される問題点と解決策を検討した。

A. 研究目的

メタボリックシンドロームの概念を導入した、生活習慣病予防のための健診・保健指導プログラム（以下、特定健診）が検討されている[1]。特定健診の実施責任は医療保険者にあるが、実際の健診・保健指導の提供は、通常、健康増進機関などにアウトソーシングされる。医療保険者は被保険者とその被扶養者のデータを統括管理しなければならず、また、それらを用いて年度ごとの事業評価をおこなう必要もある。複数のデータソースから収集した大量のデータを継続して蓄積して、しかもデータの互換性を確保するために、データの電子化と標準化（共通フォーマット）が欠かせない。

共通フォーマットの基本になる項目コードは、検査項目に関しては日本臨床検査医学会のJLAC10（ジェイラックテン）[2]を採用することが決定しており、一部未設定の検査項目と問診項目に関してもJLAC10に準拠したコードを新設した。本稿では、特定健診の検査項目と問診項目の項目コードを説明して、予想される問題点と解決策を考察した。

B.研究方法

特定健診の検査項目と問診項目は以下のように設定されている。

【検査項目】

① 基本項目

身長、体重、BMI、腹囲、血圧、中性脂肪、HDL コレステロール、LDL コレステロール、AST (GOT)、ALT (GPT)、γ-GT (γ-GTP)、血清クレアチニン、血糖 (空腹時、随時)、HbA1c、尿酸

② 詳細項目

尿糖、尿蛋白、尿潜血、赤血球数、ヘモグロビン、ヘマトクリット、心電図、眼底

【問診項目】

① 服薬歴

a. 血圧を下げる薬

b. インスリン注射または血糖を下げる薬

c. コレステロールを下げる薬

② 脳卒中（脳出血、脳梗塞等）の既往

③ 心臓病（狭心症、心筋梗塞等）の既往

④ 慢性腎不全（人工透析）の既往

⑤ たばこを習慣的に吸っている

⑥ 体重が 20 歳時から 10kg 以上増加した

⑦ 1 回 30 分以上の軽く汗をかく運動を週 2 日以上 1 年以上おこなっている

⑧ 日常生活において歩行またはそれに相当する身体活動を 1 日 1 時間以上おこ

なっている

⑨ 歩行速度が同性同年代にくらべ速い

⑩ 最近1年間の体重の増減が 3kg 以上ある

⑪ 早食い・ドカ食い・ながら食いが多い

⑫ 夕食を就寝前2時間以内に摂ることが週3日以上ある

⑬ 夜食や間食が多い

⑭ 朝食を抜くことが多い

⑮ ほぼ毎日アルコール飲料を飲む

⑯ 睡眠で休養が得られている

検査項目のうち身長、体重、BMI、腹囲、血圧、血糖（随時）と問診項目は JLAC10 にないため、JLAC10 に準拠したコードを新設した。

C.研究結果

JLAC10 は（1）分析物コード、（2）識別コード、（3）材料コード、（4）測定法コード、（5）結果識別コードから構成され、英数字 17 桁であらわす。

表1は検査項目の項目コードである。新設した身長、体重、BMI、腹囲、血圧は 9 で始まるコードを割り当て、血糖（随時）は識別コード 1299 により血糖（空腹時）から分別した。

表2は問診項目の項目コードである。従来の健診において問診票が統一されておらず、おなじ項目を異なる質問でたずねていることもしばしばである。このようなデータに対応できるように特定健診の問診項目の関連領域を含めている。いずれも 9N で始まるコードを割り当て、おなじ領域の項目は結果識別コードにおいて 01 は定量値、11 は判定（はい、いいえ）、12 はスコア（定量値カテゴリ

ー）のように分別した。

D. 考察

特定健診の検査項目と問診項目についてJLAC10にもとづく項目コードを設定した。特定健診は複数の機関の参加を前提にしており、医療保険者と健康増進機関、医療保険者同士、健康増進機関同士などでデータのやりとりをおこなう必要がある。本コードを活用することで、特定健診の精度や効率が高まると期待される。

特定健診は平成20年度から本格的導入となるが、運用していくなかでおそらく検査項目と問診項目の修正変更もあると予想される。項目コードはこのような状況にフレキシブルに対応できるような構造をもつべきである。しかし、新設した項目コードの大部分は分析物コードのみから構成され、項目間の関連性がわかりにくい。また、拡張性にとぼしいおそれがある。今後、複数の分野の専門家が話し合い、運用上の利便性なども考慮しながら再検討する必要がある。

文献

[1] 厚生労働省「標準的な健診・保健指導の在り方に関する検討会」第2回資料.　http://www.mhlw.go.jp/shingi/2006/06/s0619-5.html

[2] 日本臨床検査医学会「JLAC10」資料. http://www.jscp.org/JLAC10/index.htm

E. 研究発表

1. 論文発表 なし

2. 学会発表 なし

表１ 検査項目の項目コード

項目	単位	分析物名	JLACコード				
			分析物	識別	材料	測定法	結果識別
身長	cm	身長[cm]	9M011	0000	000	000	01
	m	身長[m]	9M012	0000	000	000	01
体重	kg	体重[kg]	9M021	0000	000	000	01
	g	体重[g]	9M022	0000	000	000	01
BMI	kg/m^2	BMI	9M031	0000	000	000	01
腹囲	cm	腹囲	9M041	0000	000	000	01
血圧(収縮期) 1回目	mmHg	血圧[収縮期1回目]	9A751	0000	000	000	01
血圧(収縮期) 2回目	mmHg	血圧[収縮期2回目]	9A752	0000	000	000	01
血圧(拡張期) 1回目	mmHg	血圧[拡張期1回目]	9A761	0000	000	000	01
血圧(拡張期) 2回目	mmHg	血圧[拡張期2回目]	9A762	0000	000	000	01
中性脂肪	mg/dl	トリグリセリド(可視吸光光度法)	3F015	0000	23	271	01
	mg/dl	トリグリセリド(UV法)	3F015	0000	23	272	01
HDLコレステロール	mg/dl	HDLコレステロール(可視吸光光度法)	3F070	0000	23	271	01
	mg/dl	HDLコレステロール(UV法)	3F070	0000	23	272	01
LDLコレステロール	mg/dl	LDLコレステロール(可視吸光光度法)	3F077	0000	23	271	01
	mg/dl	LDLコレステロール(UV法)	3F077	0000	23	272	01
AST(GOT)	IU/l 37℃	AST[GOT]	3B035	0000	23	272	01
ALT(GPT)	IU/l 37℃	ALT[GPT]	3B045	0000	23	272	01
γ-GT(γ-GTP)	IU/l 37℃	γ-GT[γ-GTP](可視吸光光度法)	3B090	0000	23	271	01
	IU/l 37℃	γ-GT[γ-GTP](UV法)	3B090	0000	23	272	01
血清クレアチニン	mg/dl	クレアチニン(血清)(可視吸光光度法)	3C015	0000	23	271	01
血糖(空腹時)	mg/dl	グルコース(血液)(電位差測定)	3D010	0000	019	261	01
	mg/dl	グルコース(血液)(可視吸光光度法)	3D010	0000	019	271	01
	mg/dl	グルコース(血液)(UV法)	3D010	0000	019	272	01
	mg/dl	グルコース(血漿)(電位差測定)	3D010	0000	022	261	01
	mg/dl	グルコース(血漿)(可視吸光光度法)	3D010	0000	022	271	01
	mg/dl	グルコース(血漿)(UV法)	3D010	0000	022	272	01
血糖(随時) ※	mg/dl	グルコース(血液)(電位差測定)	3D010	1299	019	261	01
	mg/dl	グルコース(血液)(可視吸光光度法)	3D010	1299	019	271	01
	mg/dl	グルコース(血液)(UV法)	3D010	1299	019	272	01
	mg/dl	グルコース(血漿)(電位差測定)	3D010	1299	022	261	01
	mg/dl	グルコース(血漿)(可視吸光光度法)	3D010	1299	022	271	01
	mg/dl	グルコース(血漿)(UV法)	3D010	1299	022	272	01
HbA1c	%	グリコヘモグロビンA1c[HbA1c](IA)	3D045	0000	019	062	02
	%	グリコヘモグロビンA1c[HbA1c](HPIC)	3D045	0000	019	204	02
尿酸	mg/dl	尿酸(血清)	3C020	0000	23	271	01
尿糖		グルコース定性(尿)	1A020	0000	001	901	11
尿蛋白		蛋白定性(尿)	1A010	0000	001	901	11
尿潜血		潜血反応(尿)	1A100	0000	001	901	11
赤血球数	万/mm3	赤血球数	2A020	0000	019	301	01
ヘモグロビン	g/dl	ヘモグロビン	2A030	0000	019	301	01
ヘマトクリット	%	ヘマトクリット	2A040	0000	019	301	02

※ 食後時間:hhmmを別途表記する

表2 問診項目の項目コード

項目	記述	分析物名	JLACコード				
			分析物	識別	材料	測定法	結果識別
服薬歴(血圧)	はい/いいえ	服薬歴[血圧]	9N001	0000	000	000	11
服薬歴(血糖)	はい/いいえ	服薬歴[血糖]	9N002	0000	000	000	11
服薬歴(コレステロール)	はい/いいえ	服薬歴[コレステロール]	9N003	0000	000	000	11
既往歴(脳卒中)	はい/いいえ	既往歴[脳卒中]	9N051	0000	000	000	11
既往歴(心疾患)	はい/いいえ	既往歴[心疾患]	9N052	0000	000	000	11
既往歴(慢性腎不全)	はい/いいえ	既往歴[慢性腎不全]	9N053	0000	000	000	11
20歳からの体重変化	はい/いいえ：10kg以上ならば「はい」	体重変化　有無[20歳以降]	9N101	0000	000	000	11
	変化量(kg)	体重変化　変化量[20歳以降]	9N102	0000	000	000	01
最近1年間の体重変化	はい/いいえ：3kg以上ならば「はい」	体重変化　有無[最近1年間]	9N111	0000	000	000	11
	減った/変わらない/増えた	体重変化　傾向[最近1年間]	9N112	0000	000	000	12
	変化量(kg)	体重変化　変化量[最近1年間]	9N113	0000	000	000	01
	変化量(カテゴリー)	体重変化　変化量カテゴリー[最近1年間]	9N114	0000	000	000	12
喫煙	はい/いいえ：習慣的ならば「はい」	喫煙　喫煙習慣	9N521	0000	000	000	11
	吸っている/やめた/吸わない	喫煙　喫煙歴	9N522	0000	000	000	11
	量(本/日)	喫煙　喫煙量	9N523	0000	000	000	01
	量(カテゴリー)	喫煙　喫煙量カテゴリー	9N524	0000	000	000	12
運動	はい/いいえ：1回30分・週2日・1年以上ならば「はい」	運動　運動習慣	9N201	0000	000	000	11
	頻度(日・回/週)	運動　頻度	9N202	0000	000	000	01
	頻度(カテゴリー)	運動　頻度カテゴリー	9N203	0000	000	000	12
	時間(分/日・回)	運動　時間	9N204	0000	000	000	01
	時間(カテゴリー)	運動　時間カテゴリー	9N205	0000	000	000	12
日常の歩行・身体活動	はい/いいえ：1日1時間以上ならば「はい」	歩行・身体活動　習慣	9N211	0000	000	000	11
	時間(分/日)	歩行・身体活動　時間	9N212	0000	000	000	01
	時間(カテゴリー)	歩行・身体活動　時間カテゴリー	9N213	0000	000	000	12
歩行速度	はい/いいえ：同性同年代よりも速いならば「はい」	歩行速度	9N221	0000	000	000	11
	速い/普通/遅い	歩行速度　傾向	9N222	0000	000	000	12
食べかた	はい/いいえ：早食い・ドカ食い・ながら食いならば「はい」	食べかた　習慣	9N301	0000	000	000	11
(1)早食い	はい/いいえ	早食い　有無	9N311	0000	000	000	11
	食事時間(分)	早食い　時間	9N312	0000	000	000	01
	食事時間(カテゴリー)	早食い　時間カテゴリー	9N313	0000	000	000	12
(2)ドカ食い	はい/いいえ	ドカ食い　有無	9N321	0000	000	000	11
(3)ながら食い	はい/いいえ	ながら食い　有無	9N331	0000	000	000	11
おそい夕食	はい/いいえ：多いならば「はい」	おそい夕食　有無	9N401	0000	000	000	11
	頻度(日/週)	おそい夕食　頻度	9N402	0000	000	000	01
	頻度(カテゴリー)	おそい夕食　頻度カテゴリー	9N403	0000	000	000	12
夜食・間食	はい/いいえ：多いならば「はい」	夜食・間食　有無	9N411	0000	000	000	11
	頻度(日/週)	夜食・間食　頻度	9N412	0000	000	000	01
	頻度(カテゴリー)	夜食・間食　頻度カテゴリー	9N413	0000	000	000	12
朝食ぬき	はい/いいえ：多いならば「はい」	朝食ぬき　有無	9N421	0000	000	000	11
	頻度(日/週)	朝食ぬき　頻度	9N422	0000	000	000	01
	頻度(カテゴリー)	朝食ぬき　頻度カテゴリー	9N423	0000	000	000	12
飲酒	はい/いいえ：ほぼ毎日ならば「はい」	飲酒　飲酒習慣	9N501	0000	000	000	11
	頻度(日/週)	飲酒　飲酒頻度	9N502	0000	000	000	01
	頻度(カテゴリー)	飲酒　飲酒頻度カテゴリー	9N503	0000	000	000	12
	量(合/日)	飲酒　飲酒量	9N504	0000	000	000	01
	量(カテゴリー)	飲酒　飲酒量カテゴリー	9N505	0000	000	000	12
睡眠・休養	はい/いいえ：得られているならば「はい」	睡眠・休養　有無	9N231	0000	000	000	11

③血圧２回測定の取り扱いに関する研究

研究者
吉田勝美

A 研究目的　1. 一般健診における血圧２回測定の頻度

2. ２回の測定の採用方法による高血圧の有病率のちがい
(1) １回目優先
(2) ２回目優先
(3) 収縮期血圧が低いほう優先
(4) 拡張期血圧が低いほう優先
(5) ２回の平均

B 対象・方法　東京都予防医学協会 2004 年度一般健診受診者　147,449 名を対象とし２回血圧を測定した

C 結果　1. 一般健診において血圧２回測定の頻度は 15.4%である（表１）
ただし性や年齢により異なる

2. ２回目を考慮せずに１回目優先にすると、高血圧の有病率が高くなる（表２）

D 結論　一般健診において血圧２回測定がおこなわれている場合、
１回目だけを採用することは高血圧の有病率の過大評価につながる

参考　血圧測定指針より抜粋

1. 日本循環器疾患予防協議会（1979 年指針）
同時に連続して２回以上血圧を測定したときは
測定値のとり方を明記する（何回目の値か、
平均か、高いほうか、低いほうかなど）。

2. 高血圧学会（2004 年指針）
1〜2 分の間隔をおいて複数回血圧を測定して、
安定した値（測定値の差が 5mmHg 未満）を示した
２回の平均値を血圧値とする。

なお、家庭内随時血圧については、１回でも構
わないとしている。

表 1 血圧入力状況

年齢	全体			男性			女性		
	1 回目	2 回目		1 回目	2 回目		1 回目	2 回目	
全体	147449	22669	15.4%	85544	16914	19.8%	61905	5755	9.3%
-29	41307	2473	6.0%	17021	1304	7.7%	24286	1169	4.8%
20-44	55471	6119	11.0%	36457	5046	13.8%	19014	1073	5.6%
45-59	41439	10701	25.8%	26258	8144	31.0%	15181	2557	16.8%
60+	9232	3376	36.6%	5808	2420	41.7%	3424	956	27.9%

表 2 高血圧の有病率

年齢	人数	(1)1 回目優先		(2)2 回目優先		(3)収縮期血圧が低いほう優先		(4)拡張期血圧が低いほう優先		(4)2 回の平均	
全体	147449	22277	15.1%	15686	10.6%	15968	10.8%	11918	8.1%	18685	12.7%
-29	41307	1633	4.0%	805	1.9%	816	2.0%	714	1.7%	1155	2.8%
20-44	55471	6168	11.1%	4189	7.6%	4281	7.7%	3251	5.9%	4994	9.0%
45-59	41439	11122	26.8%	8227	19.9%	8384	20.2%	6292	15.2%	9609	23.2%
60+	9232	3354	36.3%	2465	26.7%	2487	26.9%	1661	18.0%	2927	31.7%

④コレステロール、LDL-コレステロールのメガスタディによる基準値と有所見に関する研究

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研究要旨

BMI とコレステロールはどちらも性・年齢の影響を受けるが、このような相互作用を考慮した BMI とコレステロールの関係は報告されていない。

そこで、2001 年の定期健診のデータ（男性 337690 名、女性 293918 名）を用いて、日本の成人における性・年齢・BMI 別のコレステロールレベルを検討した。

その結果、総コレステロール（TC）と LDL コレステロール（LDL-C）はどちらも、男性では 50 歳、女性では 60 歳まで、年齢に依存して増加した。線形回帰分析において、TC と LDL-C はどちらも、すべての年齢グループで、BMI に依存して増加した。ただし、BMI の回帰係数は 60 歳までは高年齢グループほど小さく、男性では 20•29 歳グループ、女性では 30-39 歳グループで最大であった。ロジスティック回帰分析において、高コレステロール血症（TC：240mg/dl 以上、LDL-C：160mg/dl 以上）の調整オッズ比を計算した結果からも同様の傾向が示された。

以上から、高コレステロール血症を予防する減量指導はとくに若年者において効果的であり、男性では 40 歳未満、女性では 50 歳未満が重要なターゲットになると考えられた。

なお詳細は以下に示す発表文献に記載してある通りである。

研究発表

1 論文発表：Suka M, Yoshida K, Yamauchi K : Impact of body mass index cholesterol levels of Japanese adults.　IJCP 2006; 60: 770-782

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Impact of body mass index on cholesterol levels of Japanese adults

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SUMMARY

There have been few studies that examine the relation between body mass index (BMI) and cholesterol in consideration of potential interactions between age, sex, BMI and cholesterol. We determined age-, sex- and BMI-specific cholesterol levels of Japanese adults using the 2001 health examination data (337,690 men and 293,918 women). Both total cholesterol (T-C) and low-density lipoprotein cholesterol (LDL-C) levels increased with age until 50 years of age in men and until 60 years of age in women. Linear regression analysis showed significant BMI-dependent increases of T-C and LDL-C in all age groups, but the regression coefficients of BMI in relation to T-C and LDL-C became lower in older age groups until 60 years of age, with the highest value at ages 20–29 years in men and at ages 30–39 years in women. This result was consistent with the result of multiple logistic regression analysis regarding the risk of having hypercholesterolaemia. Weight reduction should be more strongly recommended to younger people, especially men aged under 40 years and women aged under 50 years, to prevent developing hypercholesterolaemia.

Keywords: Cholesterol; body mass index; age distribution; sex distribution

INTRODUCTION

Hypercholesterolaemia is a main contributor of atherogenesis. In order to reduce morbidity and mortality from cardiovascular disease, it is important to maintain a desirable cholesterol level (1).

Sex hormones play a role in cholesterol metabolism (2,3), which results in significant differences in cholesterol levels between men and women (4–8). Population-based cross-sectional studies have shown a significant impact of age on cholesterol levels in both sexes, but more markedly in women (4–8).

Overweight and obesity are associated with increased risk of cardiovascular disease (9). It is thought that at least part of the increased risk of cardiovascular disease is explained by the effect of overweight and obesity on cholesterol metabolism (1,9). Many investigators have reported that cholesterol levels increase with body mass index (BMI), which has been used as a measure of overweight and obesity (5,10–14). The distribution of BMI, as well as cholesterol, may depend on age and sex (10,14–16). However, there have been few studies that examine the relation between BMI and cholesterol in consideration of potential interactions between age, sex, BMI and cholesterol. The impact of BMI on cholesterol levels may probably be under- or overestimated, when the effects of age and sex on the relation between BMI and cholesterol are not included in the analysis. Overweight and obesity can be modified through lifestyle therapy (9). A proper understanding of the relation between BMI and cholesterol may contribute to improving hypercholesterolaemia and consequently promote the prevention of cardiovascular disease. In this study, we determined age-, sex- and BMI-specific cholesterol levels of Japanese adults using the 2001 health examination data. The impact of BMI on cholesterol levels was evaluated separately for age and sex groups to examine the effects of age and sex on the relation between BMI and cholesterol.

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METHODS

Multiphasic health examinations are annually performed according to the law in community and worksite in Japan. Electronic data of the health examinations in the year 2001 were accumulated from 24 different prefectural health service facilities affiliated with the Japan Association of Health Service (http://www.yobouigaku-chuo.or.jp). Database included age, sex and the following laboratory data: height, weight, blood pressure, total cholesterol (T-C), high-density lipoprotein cholesterol (HDL-C), triglyceride, blood glucose, uric acid, haemoglobin and liver function tests (17). This study was approved by the ethics committee of St Marianna

University School of Medicine in March 2003 and has been conduced in accordance with the guidelines for epidemiological studies by the Japanese Ministry of Health, Labour and Welfare and the Japanese Ministry of Education, Culture, Sports, Science and Technology.

Eligible 631,608 adults (337,690 men and 293,918 women) aged 20 years or older, whose blood sample had been taken in the fasting state, were included in this study. Height and weight were measured according to a standard protocol with participants standing without shoes and heavy garments. Cholesterol concentrations (T-C and HDL-C) were determined by the enzymatic method on the day of blood collection in each health service facility of the Japan Association of Health Service, but internal and external quality control of laboratory data has regularly been performed in the health service facilities as instructed by the expert committee for data standardisation (17). In the recent quality control survey, the coefficients of variation for T-C and HDL-C are around 1 and 1–3%, respectively (18). Low-density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald formula for samples with triglyceride ≤400 mg/dl (4.52 mmol/l): LDL-C = T-C–HDL-C–triglyceride/5 (19). Hypercholesterolaemia was defined as T-C ≥ 240 mg/dl (6.20 mmol/l) or as LDL-C ≥ 160 mg/dl (4.13 mmol/l) (1). BMI, which was calculated as weight (kg) divided by square of height (m^2), was classified as underweight (−18.5), normal (18.6–24.9), overweight (25.0–29.9) and obesity (30.0+) (9).

The *t*-tests and the analysis of variance (ANOVA) were used to assess statistical differences between the mean values. The χ^2-test was used to assess statistical significance in the prevalence values. The relation between BMI and T-C as well as BMI and LDL-C was evaluated using linear regression models separately for age and sex groups. Moreover, odds ratios for having hypercholesterolaemia were calculated using multiple logistic regression model with age and BMI groups as the independent variables separately for men and women; in the first stage, 28 age and BMI groups were the independent variables with normal weight subjects aged 20–29 years as the reference; in the second stage, the analyses were repeated separately for age groups, and 4 BMI groups were the independent variables with normal weight subjects of the same ages as the reference. Probability values were two-tailed and a value of $p < 0.05$ was considered significant. Confidence intervals were estimated at the 95% level. All statistical analyses were performed using the Statistical Analysis Systems (SAS, version 8.2).

RESULTS

Figure 1 shows the distribution of BMI. The distribution of BMI was significantly associated with age in both men and women, but the age-dependent pattern differed between sexes. In men, the prevalence of overweight plus obesity was over 30% for ages 30–69 years and decreased with age after 70 years of age. The prevalence of underweight was in the 3% level for ages 30–69 years and increased with age after 70 years of age. In women, the prevalence of overweight plus obesity was 7.4% in the group of 20–29 years and increased with age up to 30.6% in the group of 70–79 years. The prevalence of underweight was 25.7% in the group of 20–29 years, decreased with age up to 4.8% in the group of 60–69 years and gradually increased after 70 years of age.

Table 1 presents the means and prevalence of hypercholesterolaemia for T-C. The mean T-C levels significantly varied according to age in both men and women. In men, the mean T-C levels increased with age up to 207 mg/dl (5.35 mmol/l) in the groups of 40–49 and 50–59 years and gradually decreased after 60 years of age. In women, the mean T-C levels increased with age up to 222 mg/dl (5.75 mmol/l) in the groups of 50–59 and 60–69 years and gradually decreased after 70 years of age. The prevalence of hypercholesterolaemia (T-C ≥ 240 mg/dl, 6.20 mmol/l) showed the corresponding age-dependent pattern, reaching the peak at ages 40–49 years in men (16.3%) and at ages 50–59 years in women (29.2%). The age-dependent increase of T-C was more pronounced in women than in men. Consequently, men had significantly higher T-C levels than women for ages 20–49 years but significantly lower T-C levels after 50 years of age. As shown in Figure 2, the distribution of T-C was shifted towards higher values in higher BMI groups in both men and women. The mean T-C levels and the prevalence of hypercholesterolaemia significantly increased with BMI in all age groups, but the BMI-dependent increase of T-C became smaller in older age groups in both men and women.

Table 2 presents the means and prevalence of hypercholesterolaemia for LDL-C. Similar to T-C, LDL-C showed significant relations with age and BMI in both men and women. In men, the mean LDL-C levels increased with age up to 125 mg/dl (3.23 mmol/l) in the group of 50–59 years and gradually decreased after 60 years of age. In women, the mean LDL-C levels increased with age up to 139 mg/dl (3.59 mmol/l) in the group of 60–69 years and gradually decreased after 70 years of age. The prevalence of hypercholesterolaemia (LDL-C ≥ 160 mg/dl, 4.13 mmol/l) reached the peak at ages 50–59 years in men (13.4%) and at ages 60–69 years in women (23.1%). Men had significantly higher LDL-C levels than women for ages 20–49 years but significantly lower LDL-C levels after 50 years of age. As shown in Figure 3, the distributison of LDL-C was shifted towards higher values in higher BMI groups. The mean LDL-C levels and the prevalence of hypercholesterolaemia significantly increased with BMI in all age groups, but the BMI-dependent increase of LDL-C became smaller in older age groups in both men and women.

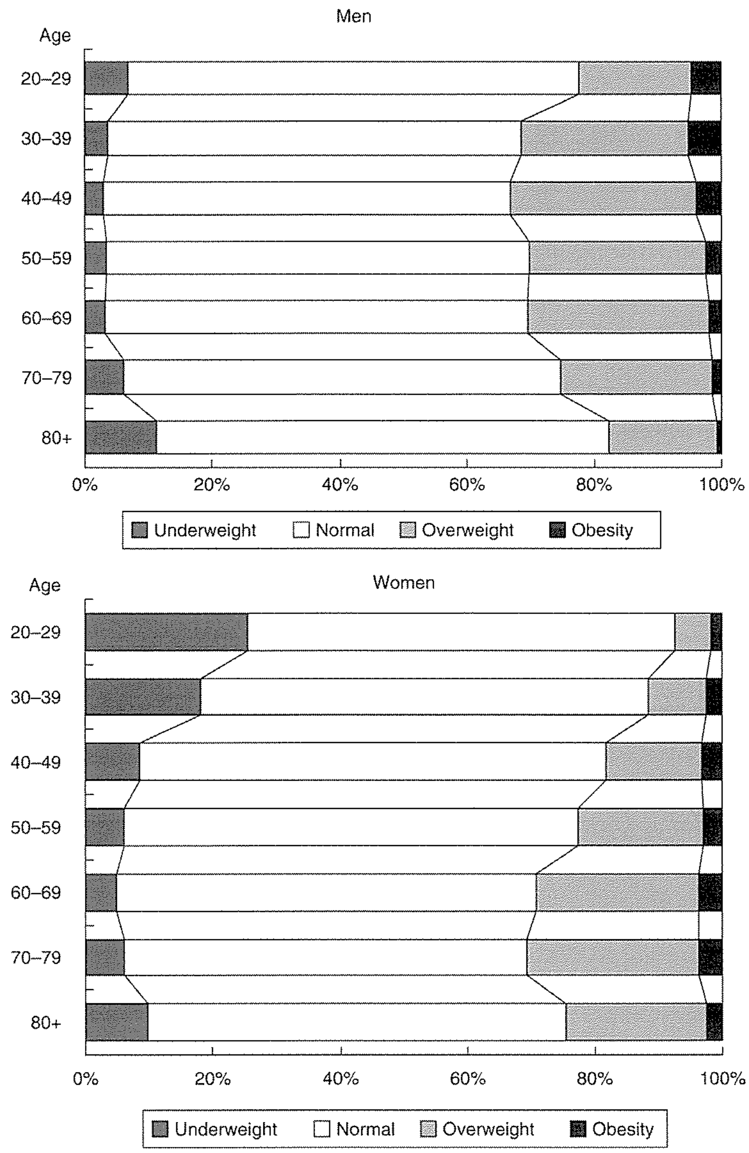

Figure 1 Distribution of BMI. BMI: underweight −18.5; normal 18.6–24.9; overweight 25.0–29.9; obesity 30.0+

Table 3 presents the regression coefficients of BMI in relation to T-C and LDL-C, which indicate a predicted increase of T-C (mg/dl) or LDL-C (mg/dl) for each unit increase of BMI. The regression coefficients were estimated at significantly positive values, which indicate the BMI-dependent increases of T-C and LDL-C, in both men and women, but the regression coefficients for men were higher than those for women in all age groups. With the highest values at ages 20–29 years in men and at ages 30–39 years in women, the regression coefficients became lower in older age groups until 60 years of age in both men and women.

Table 4 presents the odds ratios for having hypercholesterolaemia according to the T-C value (≥240 mg/dl, 6.20 mmol/l). The estimated odds ratios from the model with normal weight subjects aged 20–29 years as the reference (upper side) confirmed the age- and BMI-dependent increase of the prevalence of hypercholesterolaemia, what was elicited from the descriptive analysis (Table 1). Women had higher odds ratios than men at the same age and BMI groups, because the prevalence of hypercholesterolaemia of the reference was considerably low (2.8%). In order to elucidate the interacting effects of age and BMI on the prevalence of hypercholesterolaemia, the analyses were repeated separately for age groups. The estimated odds ratios (lower side) showed the BMI-dependent increase of the prevalence of hypercholesterolaemia with a tendency to decrease with age until 70 years of age in both men and women.

Table 1 Means and prevalence of hypercholesterolaemia (≥240 mg/dl, 6.20 mmol/l) for total cholesterol

		Men					*Women*				
			Mean ± SD		*Hypercholesterolaemia*			*Mean ± SD*		*Hypercholesterolaemia*	
Age	*BMI*	*n*	*(mg/dl)*	*(mmol/l)*	*n*	*%*	*n*	*(mg/dl)*	*(mmol/l)*	*n*	*%*
All		337690	202.1 ± 35.1	5.22 ± 0.91*,†	46967	13.9¶,**	293918	209.0 ± 36.4	5.40 ± 0.94*,†	56865	19.3¶,**
20–29		26623	181.7 ± 32.1	4.70 ± 0.83†	1273	4.8**	21628	177.6 ± 29.3	4.59 ± 0.76†	644	3.0**
30–39		61332	199.4 ± 35.3	5.15 ± 0.91†	7744	12.6**	36391	186.5 ± 30.9	4.82 ± 0.80†	1925	5.3**
40–49		84272	207.0 ± 35.2	5.35 ± 0.91†	14358	17.0**	64742	201.1 ± 32.8	5.20 ± 0.85†	7680	11.9**
50–59		87597	207.0 ± 34.4	5.35 ± 0.89†	14393	16.4**	80619	222.3 ± 34.7	5.74 ± 0.90†	23541	29.2**
60–69		49105	203.0 ± 33.4	5.25 ± 0.86†	6511	13.3**	54291	222.4 ± 33.4	5.75 ± 0.86†	15491	28.5**
70–79		24083	196.7 ± 33.1	5.08 ± 0.86†	2375	9.9**	30130	215.5 ± 32.4	5.57 ± 0.84†	6540	21.7**
80+		4678	191.0 ± 33.1	4.94 ± 0.86†	313	6.7**	6117	209.5 ± 33.0	5.41 ± 0.85†	1044	17.1**
All	Underweight	13182	184.4 ± 32.9	4.76 ± 0.85†,‡	689	5.2††	27891	194.1 ± 34.6	5.02 ± 0.89†,‡	2853	10.2††
	Normal	222868	199.5 ± 34.3	5.16 ± 0.89†	27115	12.2	203522	208.2 ± 36.1	5.38 ± 0.93†	38042	18.7
	Overweight	90570	209.5 ± 35.1	5.41 ± 0.91§	16790	18.5	53673	218.2 ± 35.4	5.64 ± 0.91§	13837	25.8
	Obesity	11070	213.3 ± 36.5	5.51 ± 0.94§	2373	21.4	8832	217.3 ± 35.7	5.61 ± 0.92§	2133	24.2
20–29	Underweight	1846	166.3 ± 26.3	4.30 ± 0.68‡	14	0.8††	5553	174.3 ± 27.5	4.50 ± 0.71‡	114	2.1††
	Normal	18798	178.3 ± 30.0	4.61 ± 0.78	586	3.1	14465	177.5 ± 28.9	4.59 ± 0.75	401	2.8
	Overweight	4743	194.7 ± 33.9	5.03 ± 0.88	469	9.9	1212	187.0 ± 32.5	4.83 ± 0.84	80	6.6
	Obesity	1236	206.1 ± 37.2	5.33 ± 0.96	204	16.5	398	198.0 ± 38.5	5.12 ± 0.99	49	12.3
30–39	Underweight	2269	179.7 ± 30.2	4.64 ± 0.78‡	73	3.2††	6630	182.1 ± 29.7	4.71 ± 0.77‡	259	3.9††
	Normal	39715	195.0 ± 33.4	5.04 ± 0.86	3803	9.6	25561	185.4 ± 29.9	4.79 ± 0.77	1157	4.5
	Overweight	16164	209.8 ± 36.2	5.42 ± 0.94	3111	19.2	3297	198.1 ± 34.0	5.12 ± 0.88	366	11.1
	Obesity	3184	215.3 ± 37.4	5.56 ± 0.97	757	23.8	903	207.2 ± 37.1	5.35 ± 0.96	143	15.8
40–49	Underweight	2518	188.2 ± 31.7	4.86 ± 0.82‡	129	5.1††	5645	194.9 ± 31.4	5.04 ± 0.81‡	456	8.1††
	Normal	53825	203.9 ± 34.3	5.27 ± 0.89	7898	14.7	47317	199.7 ± 32.1	5.16 ± 0.83	5086	10.7
	Overweight	24687	214.2 ± 35.7	5.53 ± 0.92	5513	22.3	9778	209.0 ± 34.3	5.40 ± 0.89	1726	17.7
	Obesity	3242	217.7 ± 37.1	5.63 ± 0.96	818	25.2	2002	212.9 ± 35.1	5.50 ± 0.91	412	20.6

Table 1 Continued

		Men					Women				
			Mean ± SD		Hypercholesterolaemia			Mean ± SD		Hypercholesterolaemia	
Age	BMI	n	(mg/dl)	(mmol/l)	n	%	n	(mg/dl)	(mmol/l)	n	%
50–59	Underweight	2921	191.6 ± 33.7	4.95 ± 0.87‡	238	8.1††	5010	214.6 ± 33.4	5.55 ± 0.86‡	1109	22.1††
	Normal	58243	205.4 ± 33.9	5.31 ± 0.88	8850	15.2	57315	221.9 ± 34.4	5.73 ± 0.89	16432	28.7
	Overweight	24388	212.2 ± 34.6	5.48 ± 0.89	4912	20.1	15951	225.9 ± 35.5	5.84 ± 0.92	5245	32.9
	Obesity	2045	212.7 ± 34.4	5.50 ± 0.89	393	19.2	2343	225.6 ± 36.3	5.83 ± 0.94	755	32.2
60–69	Underweight	1625	190.3 ± 34.3	4.92 ± 0.89‡	123	7.6††	2611	214.3 ± 33.0	5.54 ± 0.85‡	539	20.6††
	Normal	32459	202.2 ± 33.4	5.22 ± 0.86	4188	12.9	35791	222.3 ± 33.3	5.74 ± 0.86	10176	28.4
	Overweight	14043	206.0 ± 32.9	5.32 ± 0.85	2053	14.6	13933	224.3 ± 33.8	5.80 ± 0.87	4258	30.6
	Obesity	978	206.2 ± 33.6	5.33 ± 0.87	147	15.0	1956	221.4 ± 33.1	5.72 ± 0.86	518	26.5
70–79	Underweight	1476	188.0 ± 33.9	4.86 ± 0.88‡	95	6.4††	1847	207.5 ± 33.1	5.36 ± 0.86‡	306	16.6††
	Normal	16501	196.1 ± 33.1	5.07 ± 0.86	1577	9.6	19049	215.3 ± 32.5	5.56 ± 0.84	4123	21.6
	Overweight	5758	200.2 ± 32.4	5.17 ± 0.84	655	11.4	8153	217.6 ± 32.0	5.62 ± 0.83	1890	23.2
	Obesity	348	203.6 ± 32.6	5.26 ± 0.84	48	13.8	1081	215.5 ± 32.1	5.57 ± 0.83	221	20.4
80+	Underweight	527	180.9 ± 31.8	4.67 ± 0.82‡	17	3.2††	595	201.5 ± 32.0	5.21 ± 0.83‡	70	11.8††
	Normal	3327	191.0 ± 32.9	4.94 ± 0.85	213	6.4	4024	209.3 ± 32.7	5.41 ± 0.84	667	16.6
	Overweight	787	197.1 ± 33.1	5.09 ± 0.86	77	9.8	1349	212.8 ± 33.5	5.50 ± 0.87	272	20.2
	Obesity	37	203.8 ± 37.6	5.27 ± 0.97	6	16.2	149	216.8 ± 33.9	5.60 ± 0.88	35	23.5

BMI: underweight –18.5; normal 18.6–24.9; overweight 25.0–29.9; obesity 30.0+. To convert cholesterol to mmol/l, divide values by 38.7 (240 mg/dl = 6.20 mmol/l).*p < 0.001 for age groups by ANOVA. †p < 0.001 men vs. women by *t*-test. §p < 0.05 men vs. women by *t*-test. ‡p < 0.001 for BMI groups by ANOVA. ¶p < 0.001 for age groups by χ^2-test. **p < 0.001 men vs. women by χ^2-test. ††p < 0.001 for BMI groups by χ^2-test.

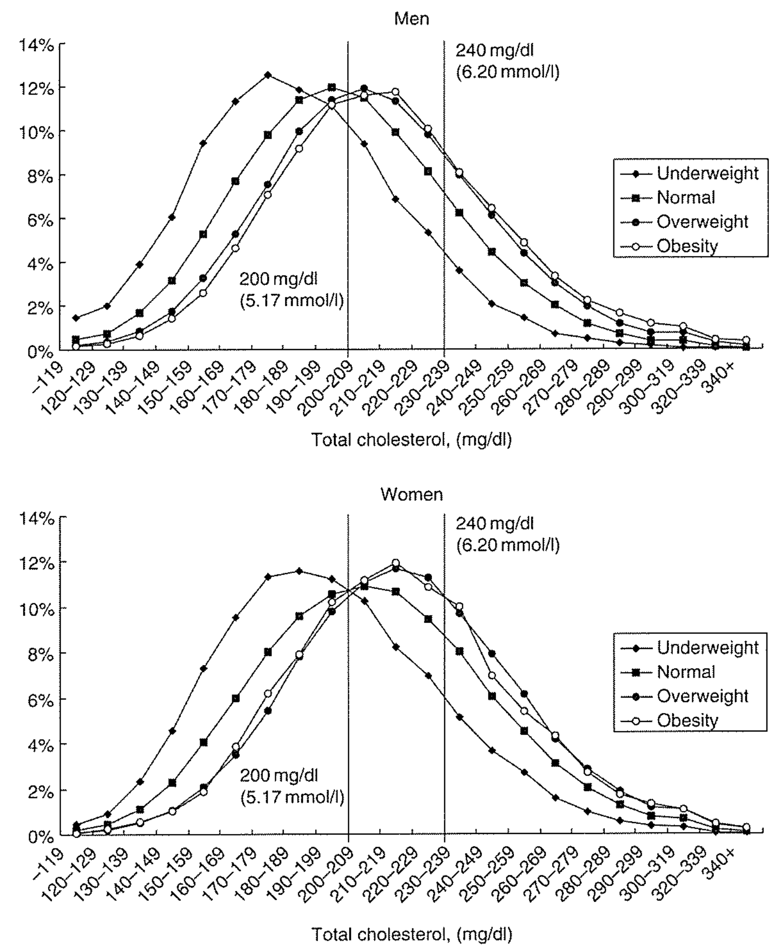

Figure 2 Distribution of total cholesterol by BMI. BMI: underweight −18.5; normal 18.6–24.9; overweight 25.0–29.9; obesity 30.0+. To convert cholesterol to mmol/l, divide values by 38.7

Table 5 presents the odds ratios for having hypercholesterolaemia according to the LDL-C value (≥160 mg/dl, 4.13 mmol/l). The estimated odds ratios were slightly higher than those shown in Table 4, but the two odds ratios indicated similar interacting effects of age and BMI on the prevalence of hypercholesterolaemia.

The prevalence of hypercholesterolaemia according to the T-C value (i.e. percentages of T-C ≥ 240 mg/dl, 6.20 mmol/l) was higher than that according to the LDL-C value (i.e. percentages of LDL-C ≥ 160 mg/dl, 4.13 mmol/l). The differences between the two percentages were more pronounced in underweight subjects, who had higher HDL-C levels than normal, overweight and obesity subjects; the mean (±SD) HDL-C levels in the underweight, normal, overweight and obesity subjects were 65.3 (±16.0), 57.5 (±14.4), 50.8 (±11.9) and 47.4 (±10.4), respectively, in men ($p < 0.001$ with ANOVA) and 71.8 (±15.0), 65.8 (±14.7), 58.8 (±13.1) and 56.1 (±12.0), respectively, in women ($p < 0.001$ with ANOVA).

DISCUSSION

We determined age-, sex- and BMI-specific cholesterol levels of Japanese adults using the 2001 health examination data. The distributions of T-C and LDL-C as well as BMI depended on age and sex. Increased T-C and LDL-C were significantly associated with increased BMI in both men and women. When the impact of BMI on cholesterol levels was evaluated separately for age and sex groups, it was estimated greater in men than in women in all age groups, and greater in younger age groups in both men and women. These results indicate significant effects of age and sex on the relation between BMI and cholesterol. For an accurate estimate of the impact of BMI on cholesterol levels, it is necessary that the effects of age and sex on the relation between BMI and cholesterol should be included in the analysis.

The WHO MONICA Project examined the relationship between age, sex, BMI and hypercholesterolaemia using pooled data from 27 populations aged 25–64 years in 15 countries (14). Multiple logistic regression analysis showed a

Table 2 Means and prevalence of hypercholesterolaemia (≥160 mg/dl, 4.13 mmol/l) for LDL cholesterol

		Men					*Women*				
			Mean ± SD		*Hypercholesterolaemia*			*Mean ± SD*		*Hypercholesterolaemia*	
Age	*BMI*	*n*	*(mg/dl)*	*(mmol/l)*	*n*	*%*	*n*	*(mg/dl)*	*(mmol/l)*	*n*	*%*
All		329724	121.2 ± 31.8	3.13 ± 0.82*,†	36699	11.1§,¶	292999	126.1 ± 32.9	3.26 ± 0.85*,†	43988	15.0§,¶
20–29		26356	105.4 ± 28.7	2.72 ± 0.74†	1078	4.1¶	21612	98.3 ± 25.0	2.54 ± 0.65†	425	2.0¶
30–39		59742	118.9 ± 31.6	3.07 ± 0.82†	5975	10.0¶	36325	105.8 ± 27.0	2.73 ± 0.70†	1314	3.6¶
40–49		81406	124.0 ± 32.3	3.20 ± 0.83†	10603	13.0¶	64574	118.4 ± 29.7	3.06 ± 0.77†	5592	8.7¶
50–59		85259	125.0 ± 32.0	3.23 ± 0.83	11390	13.4¶	80289	137.3 ± 32.1	3.55 ± 0.83	18113	22.6¶
60–69		48377	122.8 ± 30.7	3.17 ± 0.79	5332	11.0¶	54062	138.8 ± 30.6	3.59 ± 0.79	12514	23.1¶
70–79		23917	118.9 ± 29.7	3.07 ± 0.77	2026	8.5¶	30033	133.3 ± 29.4	3.44 ± 0.76	5221	17.4¶
80+		4667	115.7 ± 29.1	2.99 ± 0.75	295	6.3¶	6104	128.7 ± 28.9	3.33 ± 0.75	809	13.3¶
All	Underweight	13080	102.4 ± 29.7	2.65 ± 0.77†,‡	457	3.5¶,**	27872	109.2 ± 29.4	2.82 ± 0.76†,‡	1585	5.7¶,**
	Normal	219122	119.1 ± 31.3	3.08 ± 0.81†	21578	9.8¶	203082	125.2 ± 32.5	3.24 ± 0.84†	28918	14.2¶
	Overweight	87076	128.1 ± 31.4	3.31 ± 0.81†	12891	14.8¶	53309	136.5 ± 32.0	3.53 ± 0.83†	11660	21.9¶
	Obesity	10446	130.8 ± 32.5	3.38 ± 0.84†	1773	17.0¶	8736	136.1 ± 31.8	3.52 ± 0.82†	1825	20.9¶
20–29	Underweight	1844	90.9 ± 22.8	2.35 ± 0.59‡	13	0.7**	5552	93.7 ± 22.7	2.42 ± 0.59‡	61	1.1**
	Normal	18695	102.7 ± 26.9	2.65 ± 0.70	510	2.7	14463	98.2 ± 24.4	2.54 ± 0.63	240	1.7
	Overweight	4632	116.9 ± 30.3	3.02 ± 0.78	382	8.2	1207	111.8 ± 29.0	2.89 ± 0.75	75	6.2
	Obesity	1185	126.7 ± 33.6	3.27 ± 0.87	173	14.6	390	121.6 ± 33.6	3.14 ± 0.87	49	12.6
30–39	Underweight	2257	99.4 ± 27.6	2.57 ± 0.71‡	52	2.3**	6627	99.3 ± 24.7	2.57 ± 0.64‡	121	1.8**
	Normal	39106	115.5 ± 30.3	2.98 ± 0.78	3071	7.9	25538	104.9 ± 25.9	2.71 ± 0.67	764	3.0
	Overweight	15422	127.9 ± 31.8	3.30 ± 0.82	2304	14.9	3268	119.9 ± 29.8	3.10 ± 0.77	311	9.5
	Obesity	2957	132.2 ± 33.1	3.42 ± 0.86	548	18.5	892	128.2 ± 32.2	3.31 ± 0.83	118	13.2
40–49	Underweight	2485	103.5 ± 30.7	2.67 ± 0.79‡	95	3.8**	5642	108.4 ± 27.0	2.80 ± 0.70‡	230	4.1**
	Normal	52524	121.5 ± 31.7	3.14 ± 0.82	5974	11.4	47241	116.8 ± 28.9	3.02 ± 0.75	3562	7.5
	Overweight	23377	130.5 ± 32.2	3.37 ± 0.83	3981	17.0	9708	128.8 ± 30.9	3.33 ± 0.80	1439	14.8
	Obesity	3020	133.2 ± 32.6	3.44 ± 0.84	553	18.3	1983	133.2 ± 30.9	3.44 ± 0.80	361	18.2

50–59	Underweight	2878	106.0 ± 32.2	2.74 ± 0.83‡	152	5.3**	5003	125.0 ± 29.8	3.23 ± 0.77‡	624	12.5**
	Normal	56969	123.6 ± 31.7	3.19 ± 0.82	7078	12.4	57141	136.6 ± 31.8	3.53 ± 0.82	12419	21.7
	Overweight	23459	130.2 ± 31.4	3.36 ± 0.81	3826	16.3	15835	142.9 ± 32.5	3.69 ± 0.84	4431	28.0
	Obesity	1953	130.8 ± 31.8	3.38 ± 0.82	334	17.1	2310	142.9 ± 32.9	3.69 ± 0.85	639	27.7
60–69	Underweight	1618	107.3 ± 30.6	2.77 ± 0.79‡	71	4.4**	2608	126.7 ± 29.5	3.27 ± 0.76‡	324	12.4**
	Normal	32098	121.9 ± 30.7	3.15 ± 0.79	3420	10.7	35686	138.6 ± 30.4	3.58 ± 0.79	8142	22.8
	Overweight	13711	126.6 ± 29.9	3.27 ± 0.77	1722	12.6	13827	141.7 ± 30.9	3.66 ± 0.80	3614	26.1
	Obesity	950	125.4 ± 30.4	3.24 ± 0.79	119	12.5	1941	138.5 ± 30.3	3.58 ± 0.78	434	22.4
70–79	Underweight	1471	106.7 ± 29.5	2.76 ± 0.76‡	64	4.4**	1845	123.1 ± 28.6	3.18 ± 0.74‡	187	10.1**
	Normal	16408	118.3 ± 29.5	3.06 ± 0.76	1313	8.0	18995	133.2 ± 29.3	3.44 ± 0.76	3265	17.2
	Overweight	5694	123.3 ± 29.3	3.19 ± 0.76	610	10.7	8119	135.8 ± 29.2	3.51 ± 0.75	1570	19.3
	Obesity	344	126.6 ± 28.2	3.27 ± 0.73	39	11.3	1074	134.1 ± 29.3	3.47 ± 0.76	199	18.5
80+	Underweight	527	104.0 ± 26.8	2.69 ± 0.69‡	10	1.9**	595	119.2 ± 26.8	3.08 ± 0.69‡	38	6.4**
	Normal	3322	115.7 ± 28.8	2.99 ± 0.74	212	6.4	4018	128.7 ± 28.6	3.33 ± 0.74	526	13.1
	Overweight	781	123.1 ± 29.2	3.18 ± 0.75	66	8.5	1345	132.3 ± 29.6	3.42 ± 0.76	220	16.4
	Obesity	37	127.2 ± 33.3	3.29 ± 0.86	7	18.9	146	133.9 ± 28.9	3.46 ± 0.75	25	17.1

BMI: underweight –18.5; normal 18.6–24.9; overweight 25.0–29.9; obesity 30.0+. To convert cholesterol to mmol/l, divide values by 38.7 (160 mg/dl = 4.13 mmol/l). *p < 0.001 for age groups by ANOVA. †p < 0.001 men vs. women by *t*-test. ‡p < 0.001 for BMI groups by ANOVA. §p < 0.001 for age groups by χ^2-test. ¶p < 0.001 men vs. women by χ^2-test. **p < 0.001 for BMI groups by χ^2-test.

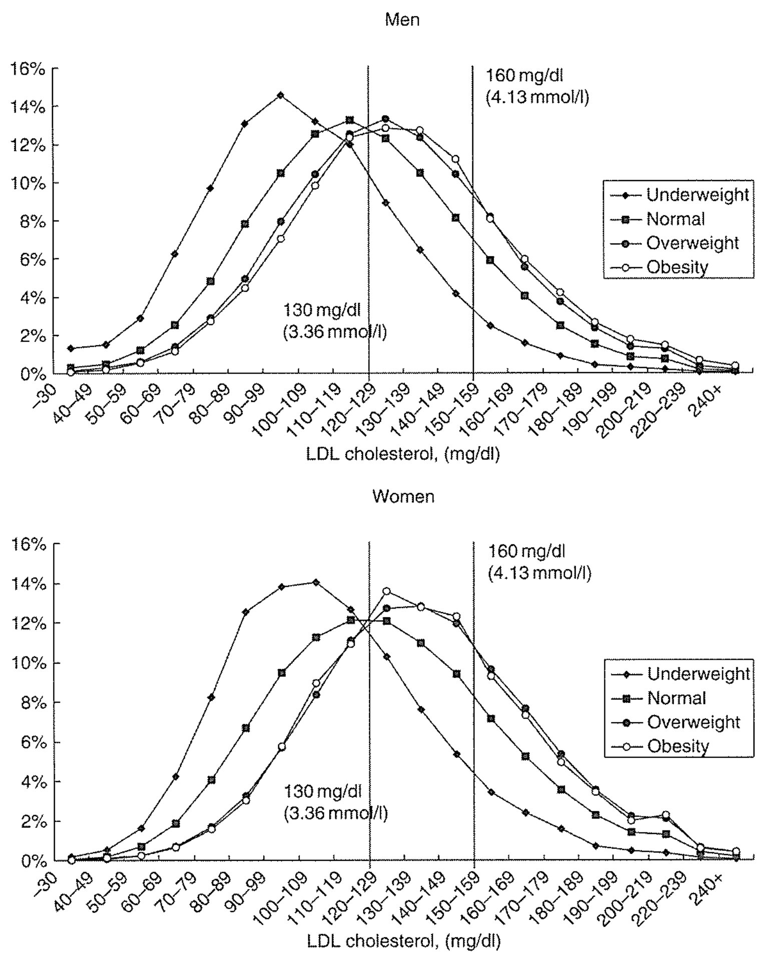

Figure 3 Distribution of LDL cholesterol by BMI. BMI: underweight –18.5; normal 18.6–24.9; overweight 25.0–29.9; obesity 30.0+. To convert cholesterol to mmol/l, divide values by 38.7

Table 3 Regression coefficients (β) with 95% confidence intervals (CIs) of BMI in relation to total cholesterol and LDL cholesterol

	Age	*Men* *β (95% CI)*	*Women* *β (95% CI)*
Total cholesterol	20–29	2.80 (2.70–2.90)	1.30 (1.18–1.42)
	30–39	2.70 (2.60–2.75)	1.70 (1.62–1.80)
	40–49	2.19 (2.12–2.27)	1.48 (1.40–1.55)
	50–59	1.72 (1.64–1.80)	0.89 (0.82–0.96)
	60–69	1.21 (1.11–1.32)	0.47 (0.38–0.55)
	70–79	1.23 (1.09–1.37)	0.61 (0.50–0.72)
	80+	1.69 (1.37–2.00)	1.01 (0.77–1.26)
LDL cholesterol	20–29	2.52 (2.43–2.61)	1.74 (1.64–1.84)
	30–39	2.37 (2.30–2.44)	2.10 (2.02–2.19)
	40–49	2.09 (2.02–2.16)	2.02 (1.95–2.08)
	50–59	1.86 (1.79–1.94)	1.43 (1.36–1.49)
	60–69	1.48 (1.38–1.57)	0.79 (0.71–0.87)
	70–79	1.58 (1.46–1.71)	0.79 (0.69–0.89)
	80+	1.98 (1.70–2.25)	1.08 (0.87–1.29)

Regression coefficients indicate a predicted increase of total cholesterol (mg/dl) or LDL cholesterol (mg/dl) for each unit increase of BMI.

Table 4 Odds ratios (ORs) with 95% confidence intervals (CIs) for having hypercholesterolaemia (TC $\geq$ 240 mg/dl, 6.20 mmol/l)

	Men				*Women*			
	Underweight	*Normal*	*Overweight*	*Obesity*	*Underweight*	*Normal*	*Overweight*	*Obesity*
Age	*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*
20–29	0.24 (0.14–0.41)	1.00 (reference)	3.41 (3.01–3.87)	6.14 (5.18–7.29)	0.74 (0.60–0.91)	1.00 (reference)	2.48 (1.94–3.18)	4.92 (3.59–6.75)
30–39	1.03 (0.81–1.32)	3.29 (3.01–3.60)	7.41 (6.76–8.11)	9.69 (8.63–10.88)	1.43 (1.22–1.67)	1.66 (1.48–1.87)	4.38 (3.78–5.07)	6.60 (5.38–8.10)
40–49	1.68 (1.38–2.04)	5.35 (4.91–5.82)	8.94 (8.19–9.75)	10.49 (9.36–11.76)	3.08 (2.69–3.54)	4.22 (3.81–4.68)	7.52 (6.72–8.41)	9.09 (7.85–10.53)
50–59	2.76 (2.36–3.22)	5.57 (5.11–6.06)	7.84 (7.18–8.56)	7.39 (6.45–8.48)	9.97 (8.85–11.24)	14.10 (12.74–15.59)	17.18 (15.48–19.08)	16.68 (14.62–19.02)
60–69	2.55 (2.08–3.11)	4.60 (4.21–5.03)	5.32 (4.84–5.85)	5.50 (4.53–6.67)	9.12 (7.95–10.47)	13.93 (12.58–15.43)	15.44 (13.89–17.16)	12.63 (10.97–14.55)
70–79	2.14 (1.71–2.67)	3.28 (2.98–3.62)	3.99 (3.55–4.48)	4.97 (3.63–6.82)	6.96 (5.95–8.16)	9.69 (8.72–10.76)	10.58 (9.46–11.84)	9.01 (7.54–10.77)
80+	1.00 (0.64–1.69)	2.13 (1.81–2.50)	3.37 (2.63–4.32)	6.02 (2.50–14.47)	4.68 (3.58–6.12)	6.97 (6.12–7.93)	8.86 (7.50–10.46)	10.77 (7.28–15.93)
20–29	0.24 (0.14–0.41)	1.00 (reference)	3.41 (3.01–3.87)	6.14 (5.18–7.29)	0.74 (0.60–0.91)	1.00 (reference)	2.48 (1.94–3.18)	4.93 (3.60–6.75)
30–39	0.31 (0.25–0.40)	1.00 (reference)	2.25 (2.14–2.37)	2.95 (2.70–3.22)	0.86 (0.75–0.98)	1.00 (reference)	2.63 (2.33–2.98)	3.97 (3.29–4.79)
40–49	0.31 (0.26–0.38)	1.00 (reference)	1.67 (1.61–1.74)	1.96 (1.81–2.13)	0.73 (0.66–0.81)	1.00 (reference)	1.78 (1.68–1.89)	2.15 (1.92–2.41)
50–59	0.50 (0.43–0.57)	1.00 (reference)	1.41 (1.35–1.46)	1.33 (1.19–1.49)	0.71 (0.66–0.76)	1.00 (reference)	1.22 (1.17–1.27)	1.18 (1.08–1.29)
60–69	0.55 (0.46–0.67)	1.00 (reference)	1.16 (1.09–1.22)	1.19 (0.99–1.43)	0.66 (0.59–0.72)	1.00 (reference)	1.11 (1.06–1.16)	0.91 (0.82–1.01)
70–79	0.65 (0.53–0.81)	1.00 (reference)	1.22 (1.10–1.34)	1.51 (1.11–2.06)	0.72 (0.63–0.82)	1.00 (reference)	1.09 (1.03–1.16)	0.93 (0.80–1.08)
80+	0.49 (0.30–0.81)	1.00 (reference)	1.59 (1.21–2.08)	2.83 (1.17–6.86)	0.67 (0.52–0.87)	1.00 (reference)	1.27 (1.09–1.49)	1.55 (1.05–2.28)

ORs with 95% CIs in the upper side were calculated using the model with normal weight subjects aged 20–29 years as the reference. The analyses were repeated separately for age groups, and ORs with 95% CIs in the lower side were calculated using the model with normal weight subjects of the same ages as the reference.

significant negative interaction between age and BMI on the risk of having hypercholesterolaemia (T-C $\geq$ 6.5 mmol/l) in both men and women. Adjusted odds ratios for having hypercholesterolaemia significantly increased with BMI in men aged 25–44 years and in women aged 25–49 years, but the BMI-dependent increase was smaller (or not significantly observed) in older age groups. The study subjects of the WHO MONICA Project consisted of western populations except for the population of Beijing in China. The prevalence of hypercholesterolaemia as well as overweight and obesity was remarkably higher than that shown in our study. Despite these differences in population, the findings of our study were consistent with the findings of the WHO MONICA Project. The effects of age and sex on the relation between BMI and cholesterol may be of universal application independently of population.

Linear regression analysis showed significant BMI-dependent increases of T-C and LDL-C in both men and women, but the regression coefficients for men were higher than those for women in all age groups. The impact of BMI on T-C and LDL-C levels may be greater in men than in women. Menopausal status is an important determinant of cholesterol level of women (20,21). Although information on menopausal status was not included in the analysis, the result that women had significantly higher T-C and LDL-C levels than men after 50 years of age may be explained by the effect of menopause on cholesterol metabolism rather than the relation between BMI and cholesterol. Compared with western countries, hormone replacement therapy is not so commonly used in Japan (22). Thus, the findings of this study are unlikely to be affected by the use of hormone replacement therapy.