表1　前向き研究による喫煙のASO発症に対するリスク

著者名	実施した国(地域)	サンプルサイズ	追跡期間	喫煙のカテゴリー	症候性ASOの発症リスク
Hooiら	オランダ	2,327人	7.2年	非喫煙者 過去喫煙者 現在喫煙者	1.0(基準) オッズ比　1.4 (95%信頼区間：0.5～3.7) オッズ比　4.3 (95%信頼区間：1.9～10.1)
Ingolfssonら	アイスランド	8,045人	記載なし (数年の間隔の連続した調査の間)	非喫煙者 紙巻きタバコ 1～14本/日 15～24本/日 25本/日以上 パイプと葉巻 過去喫煙者	1.0(基準) オッズ比　2.6(有意差なし) オッズ比　7.7(P＜0.001) オッズ比　10.2(P＜0.001) オッズ比　3.6(P＜0.01) オッズ比　2.3(有意差なし)
Murabitoら	アメリカ (フラミンガム)	5,209人	4年	10本/日の増加ごと	オッズ比　1.4 (95%信頼区間：1.3～1.5)
Priceら	イギリス (エジンバラ)	1,592人	5年	0 Pack-years 1＜ Pack-years≦25 25 Pack-years＜	1.0(基準) 相対危険度　1.87 (95%信頼区間：0.9～3.9) 相対危険度　3.94 (95% 信頼区間：2.0～7.6)

(文献2)より．ただし個々の研究結果はそれぞれ元の論文から引用追記)

表2　ASOの治療法として下肢の症状改善に有効と考えられるもの(外科的，観血的治療法は除く)

禁煙：医師のアドバイス，ニコチン代替療法，ニコチン拮抗薬(bupropion)*
運動：体系的な運動プログラムを考慮すること
スタチンの使用：コレステロール低下作用よりもプレイオトロピック(多面的な)作用の効果の可能性
降圧剤の使用：アンギオテンシン転換酵素阻害薬
Cilostazol：心不全患者には禁忌

*：日本では未承認．このレビューの執筆時にはバレニクリン($\alpha_4\beta_2$ニコチン受容体拮抗薬)は未発売．　(文献4)より)

(former smoker)の非喫煙者に対するASOのオッズ比は，同じ集団内でみると現在喫煙者よりは低いものの，そのリスクは現在喫煙者に近く，喫煙のリスクは禁煙後も長く残ることが示唆されます．したがって，一刻も早く禁煙することが予防の第一歩となるのです．

II 治療としての禁煙

すでに発症したASOの患者に対して，禁煙がどのような効果をもたらすかということについての知見は乏しいのが現状です．一つの理由として，ASOを発症すると禁煙を指示されるのが当然であるため，無作為化割りつけのデザインで禁煙を勧めない対照群を置くことができないことがあります．ASOによる間欠性跛行の非薬物療法についてのメタアナリシスをみても[3]，引用されているすべての研究が観察研究や非ランダム割りつけによるものです．Hankeyらは，ASOに対する治療についての文献をレビューし[4]，禁煙は間欠性跛行患者の歩行能力を改善するとまではいえないが，跛行の重症度を改善したり，安静時疼痛発症のリスクを減らしたりする可能性があることを示しました(表2)．

Hennrikusらは，ASOの患者集団を対象とした6ヵ月間の禁煙プログラムを開発し，通常指導群に比し約3倍(21.3% vs. 6.8%)禁煙を達成できたという無作為化比較対照試験の結果を報告しています[5]．このプログラムの禁煙指導の密度は半年間で約8.5回(中央値)の指導，1回の時間は約20分，1人当たりの半年間の指導時間の中央値は3.2時間です．また，カウンセリングの26%は面談だが，残りは電話で行われています．さらに介入群には薬物療法の利用も勧められ，禁煙治療薬の利用率は介入群のほうが高いです．このプログラムと同程度の密度の禁煙支援をわが国でやる場合，ASOの外来担当医と禁煙外来担当者との連携が不可欠になります．ASOの外来で上記のよ

表3　喫煙経験のある糖尿病患者男性における喫煙者と禁煙者との心理社会的要因の比較

	喫煙継続者 (n=192)	禁煙者 (n=279)	P-value
「道徳的・批判的」高得点	94 (50.5)	114 (44.7)	0.226
「保護的・養育的」高得点	62 (33.3)	105 (41.2)	0.094
「客観的・論理的」高得点	54 (29.0)	109 (42.7)	0.003
「衝動的・自己中心的」高得点	106 (57.0)	75 (29.4)	＜0.001
「従順・内向的」高得点	78 (41.9)	92 (36.1)	0.212
同居者あり	173 (91.1)	263 (94.6)	0.135
喫煙する同居者あり	73 (42.2)	33 (12.5)	＜0.001
職業あり	98 (51.6)	107 (38.6)	0.009
教育歴(～中学)	56 (29.5)	38 (13.6)	＜0.001

エゴグラム：回答に欠損のなかった喫煙者186人，禁煙者255人の結果を示した．
喫煙する同居者の有無：同居者のいた437人の結果を示した．
教育歴(～中学)：高等小学校・国民学校・中学校卒業．　(文献6)より)

うなカウンセリングを行うことは時間的に不可能であるため，ASOの治療の一環として禁煙外来の受診も組み込むべきでしょう．ただし，禁煙外来に丸投げするのではなく，ASOの担当医からも禁煙が必須であることを常に言い続ける必要があります．

禁煙指導の中身については，禁煙外来として保険診療を行う際のマニュアルが整備されており，関連学会(日本循環器学会など)のホームページから「禁煙治療のための標準手順書」をダウンロードできるので，それに従えば大きな問題はありません．一般の禁煙外来の受診者であろうともASOの患者であろうとも，とくに違いがあるわけではありません．ただし，以下の2点は注意が必要です．通常の禁煙外来の際はまず喫煙の有害性を説くことが多いのですが，ASOの患者はすでに喫煙の有害性は十分認識していることが多く，単に喫煙のリスクを説くのは意味がありません．むしろ症状の軽減や再発予防，合併症(心筋梗塞など)の阻止などに焦点を絞って説明すべきです．次に禁煙補助剤ですが，現在，日本で主に行われているのはニコチン補充療法(ニコチンパッチ，ニコチンガムなど)とバレニクリン($\alpha_4\beta_2$ニコチン受容体拮抗薬)です．作用機序からいって両者の併用はできないため，どちらか一つを選択する必要がありますが，ニコチン補充療法の禁忌として，発症後3ヵ月以内の不安定狭心症や急性心筋梗塞，重篤な不整脈，経皮的冠動脈形成術直後や冠動脈バイパス術直後，脳血管障害回復初期などがあり，これらが合併する危険性が高いASOの患者には使いにくいのです．したがって，ASO喫煙者に対する第一選択はバレニクリンが望ましいです．ただし，腎機能については極端に悪くないかどうか事前チェックが必要です．

残された課題

現在の禁煙指導は基本的に禁煙したい人のための手法であり，本人に全くその気がない場合は対象としていません．先ほどのHennrikusらのASO患者を対象としたプログラムも，介入研究への参加要件を30日以内に禁煙したいASO患者としています[5]．要するに，現状ではやめたくない患者をやめさせるプログラムは存在していません．さらに，指導手法も「将来の発症リスク」や「禁煙した場合の節約効果」など比較的論理的な内容で構成されているため，感情の赴くままに行動しているような人への効果は薄いのです．表3は，ASOでの検討ではありませんが，2型糖尿病と診断された後，喫煙を継続している者と禁煙した者の性格特性をエゴグラムという手法で比較した結果です[6]．詳細はもとの論文をみていただきたいのですが，禁煙者では「客観的・論理的(エゴグラムのA，adultの特性)」が高得点の人の割合が多く，逆に喫煙継続者では「衝動的・自己中心的(FC，free

childの特性）」が高得点の割合が多いのが明らかにみてとれます．今後，性格別の禁煙指導手法などを検討する必要があると考えられます．とりあえずは原点に戻って，今まで培ってきた医師・患者の信頼関係を生かしながら患者の意識を変えていくしかないでしょう．

喫煙はASOの最も重要な危険因子であり，またASO患者には禁煙が必須です．日常診療の場で喫煙を継続しているASO患者に対して，根気強く禁煙を働きかけることが必要です．

まとめ

喫煙はASOの最大の危険因子である．喫煙でASOの発症リスクは約2倍となり，ヘビースモーカーだと4倍に達する．ASO患者を禁煙させることで間欠性跛行の重症度を改善し，安静時疼痛発症のリスクを減少させることができる．禁煙治療を効果的に行うためには，担当医からの働きかけと禁煙外来との連携が必要である．喫煙しているASO患者に対しては単に喫煙の害を説くのではなく，症状の軽減や再発予防，合併症（心筋梗塞など）の阻止などに焦点を絞るべきである．また，禁煙補助剤についてバレニクリンが第一選択となる．ただし，腎機能については事前にチェックが必要である．今後，禁煙する気がない個人への対応や，性格特性別の禁煙指導法の開発が必要とされている．

参考文献

1) Ueshima H, Choudhury SR, Okayama A, et al：Cigarette smoking as a risk factor for stroke death in Japan：NIPPON DATA80. Stroke, 35：1836-1841, 2004.

2) Willigendael EM, Teijink JA, Bartelink ML, et al：Influence of smoking on incidence and prevalence of peripheral arterial disease. J Vasc Surg, 40：1158-1165, 2004.

3) Girolami B, Bernardi E, Prins MH, et al：Treatment of intermittent claudication with physical training, smoking cessation, pentoxifylline, or nafronyl：a meta-analysis. Arch Intern Med, 159：337-345, 1999.

4) Hankey GJ, Norman PE, Eikelboom JW：Medical treatment of peripheral arterial disease. JAMA, 295：547-553, 2006.

5) Hennrikus D, Joseph AM, Lando HA, et al：Effectiveness of a smoking cessation program for peripheral artery disease patients：a randomized controlled trial. J Am Coll Cardiol, 56：2105-2112, 2010.

6) Morimoto A, Miyamatsu N, Okamura T, et al：What psychosocial characteristics are associated with smoking cessation behavior and readiness to quit smoking among Japanese male ever-smokers with type 2 diabetes mellitus? J Atheroscler Thromb, 17：361-368, 2010.

危険因子の最新知見

心血管病の危険因子としての喫煙

Smoking is an important risk factor for cardiovascular disease in Japan

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Key words：喫煙，コレステロール，交互作用，メタボリックシンドローム，人口寄与危険割合

はじめに

欧米諸国に比べてアジア諸国における喫煙率はいまだ高く，世界の喫煙者のうち約2/3がアジア環太平洋地域の国民であると報告されている．同時にこの地域では近年の急速な経済発展に伴い血清総コレステロール値や肥満度の上昇も報告されており，高コレステロール血症やメタボリックシンドローム(MetS)の増加も懸念されている．これらはすべて冠動脈性心疾患の危険因子であるため，喫煙単独のリスクだけでなく，これら代謝性因子との合併リスクや個々の危険因子の頻度などを踏まえて予防対策を考えていく必要がある．我が国もその例外ではなく，日本国民を対象とした疫学研究で喫煙や喫煙と他の危険因子が合併した場合のリスクを検証しておく必要がある．

本稿では，最近の国内のコホート研究の知見を中心に述べてみる．

1．喫煙と循環器疾患の関連

表1に1990年以降の我が国の喫煙と冠動脈性心疾患，心血管病の発症および死亡に関する前向きコホート研究をまとめた．我が国の疫学研究では1990年代に久山町研究で男女ともに喫煙は冠動脈性心疾患発症の危険因子であることが示された[1]．そして2000年以降，大規模な前向きコホート研究であるNIPPON DATA80やJACC study，JPHC studyにより，1日の喫煙本数が多い者では冠動脈性心疾患の死亡リスクはより上昇すること[2,3]，喫煙者は非喫煙者に比べて多変量調整しても冠動脈性心疾患の発症リスクが約3倍上昇すること[4]，冠動脈性心疾患死亡の相対リスクは男性より女性で高いこと[3]などが示された．

また近年，吹田研究やNIPPON DATA90で，喫煙とMetSの合併リスクについて検討が行われている．吹田研究の男性の心血管病(心筋梗塞と脳卒中)発症の相対危険度は，非喫煙かつMetSなしを1とすると，喫煙のみで2.1倍，MetSのみでも2.1倍，両方を有すると3.6倍であった．これは女性では2.7倍，2.3倍，4.8倍であった(年齢，飲酒，腎機能，non-HDLコレステロールを調整．MetSはmodified NCEP-ATP IIIの基準で定義)[5]．一方，NIPPON DATA90では同じMetSの基準を用いて心血管病死亡をエンドポイントとした相対危険度を算出し，男性では喫煙のみで3.5倍，喫煙＋MetSで3.2倍，女性では喫煙のみで3.6倍，喫煙＋MetSで4.9倍であった[5]．

これらのコホート研究は実施された場所も時代も異なり，またエンドポイントも異なってい

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表1 喫煙と冠動脈性心疾患，心血管病の発症および

	著者	雑誌名(年；巻)	対象者数	追跡年数
久山町研究[1]	藤島ら	Clin Exp Hypertens A(1992; 14)	1,603(第一集団) 2,048(第二集団)	26(第一集団) 13(第二集団)
NIPPON DATA80[2]	上島ら	Stroke(2004; 35)	9,638	14
JACC study[3]	磯ら	Am J Epidemiol(2005; 161)	94,683	10
JPHC study[4]	馬場ら	Eur J Cardiovasc Prev Rehabil (2006; 13)	41,282	11
吹田研究[5]	東山ら	Circ J(2009; 73)	3,911	11.9
NIPPON DATA90[6]	高嶋ら	BMC Public Health(2010; 10)	6,650	15

NIPPON DATA: National Integrated Project for Prospective Observation of Non-communicable Disease
JACC study: Japan Collaborative Cohort study, JPHC study : Japan Public Health Center-based prospec-

るが全体の傾向はほぼ同じである．これらをまとめると，我が国における喫煙による冠動脈性心疾患や心血管病リスクの上昇は2-4倍であり，相対危険度は男性よりもむしろ女性で高いこと，また喫煙とMetSが併存すると単独の場合よりもリスクが増強されるという結果であった．

2. 喫煙，血清総コレステロールと冠動脈性心疾患の関連

前述のように我が国の疫学研究でも喫煙は心血管病の明らかな危険因子であることが示されているが，1990年以前の疫学研究でははっきりした関連を認めていなかった．日本人の移民研究であるNIHON SAN研究では，喫煙の冠動脈性心疾患死亡に対するリスクがハワイ在住日系人では高いにもかかわらず，日本在住日本人では明確ではなかった[7]．そのため喫煙と総コレステロールの冠動脈性心疾患への影響には交互作用があり，喫煙のリスクはコレステロールレベルが高くなるほど増強されるのではないかという仮説が提唱された[2]．NIPPON DATA80の19年追跡では，喫煙による虚血性の心血管病(冠動脈性心疾患＋非出血性脳卒中)のリスクは(非喫煙者を1とする)，血清総コレステロール(TC)低値群(165 mg/dL未満)で男性1.07，女性1.86なのに対し，TC高値群(209 mg/dL以上)では男性2.60，女性4.24であり，この仮説が支持された[8]．

アジア太平洋地域の34のコホート研究を個人データベースで統合して解析を行っているAsia Pacific Cohort Studies Collaboration(APCSC)でもこの仮説の検証が行われている．約250万人・年，冠動脈性心疾患3,298例(1,044例はアジア地域で残りはオーストラリアとニュージーランド)，脳卒中4,318例(同じくアジア地域が2,976例)という巨大なデータセットが用いられた[9]．その結果を**図1**に示す．ここではNIPPON DATAとは逆にTC(とHDLコレステロール，HDLC)の冠動脈性心疾患に対するリスクを喫煙者と非喫煙者で比較している．**図1-a**のTCの結果をみると，TCの上昇に伴う冠動脈性心疾患リスクの上昇が喫煙者の方でより急峻なことがわかる．またHDLCの低値に伴うリスク上昇も喫煙者の方が大きい．TCの一標準偏差(1.06 mmol/L)上昇あたりの冠動脈性心

死亡に関する日本の前向きコホート研究

エンドポイント	主要な結果
冠動脈性心疾患発症	喫煙者は非喫煙者に比べて冠動脈性心疾患の発症率が高かった．男女ともに，喫煙は冠動脈性心疾患発症の危険因子であることが示された．
全心疾患死亡 冠動脈性心疾患死亡	男性では，1日の喫煙本数が21本以上の喫煙者は非喫煙者に比べて冠動脈性心疾患の死亡リスクは約4倍，全心疾患の死亡リスクは約2倍高かった．女性では，有意な関連は認められなかった．
冠動脈性心疾患死亡	喫煙者は非喫煙者に比べて冠動脈性心疾患の死亡リスクが男性で約2.5倍，女性で約3.5倍高かった．1日の喫煙本数が20本以上の喫煙者だと，非喫煙者に比べて同死亡リスクが男性で約3倍，女性で約6倍高かった．
冠動脈性心疾患発症 心筋梗塞発症	男女ともに，喫煙者は非喫煙者に比べて冠動脈性心疾患の発症リスクは約3倍，心筋梗塞の発症リスクは約3-4倍高かった．
循環器疾患発症 心筋梗塞発症	男女ともに，喫煙とメタボリックシンドロームの2つの危険因子をあわせもつと循環器疾患発症のリスクは高くなった(男性3.6倍，女性4.8倍)．男性では，喫煙の循環器疾患発症への人口寄与危険割合はメタボリックシンドローム単独より高い．
循環器疾患死亡	男女ともに，喫煙とメタボリックシンドロームの2つの危険因子をあわせもつと循環器疾患死亡のリスクは高くなった(男性3.2倍，女性4.9倍)．男女とも，喫煙の循環器疾患死亡への人口寄与危険割合はメタボリックシンドローム単独より高い．

And its Trends in the Aged.
tive study.

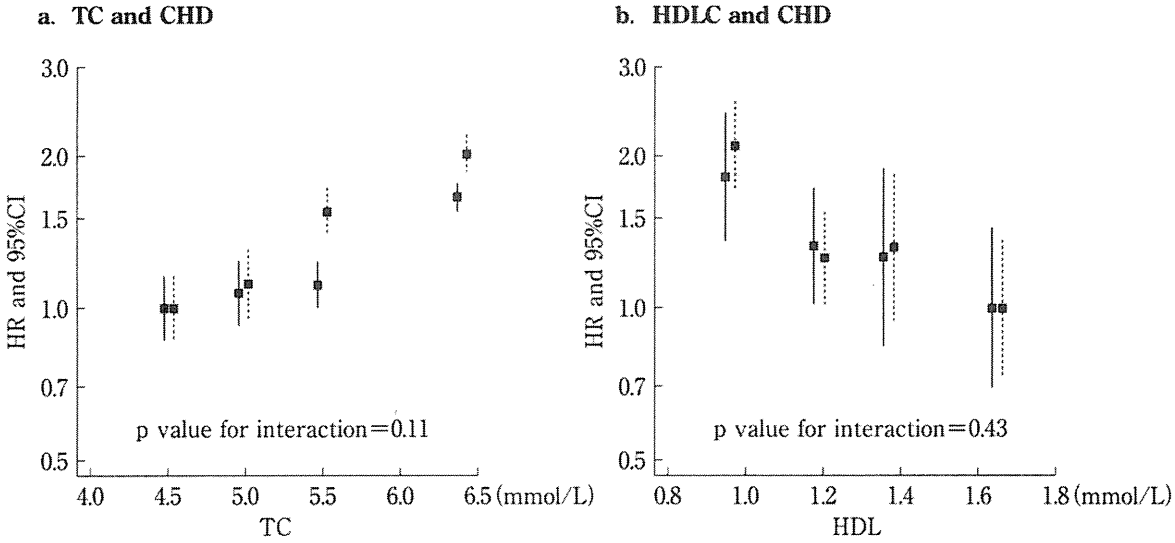

図1 喫煙状況別にみた血清総コレステロールと冠動脈性心疾患の関連(文献[9]より引用)

TC: 血清総コレステロール，CHD: 冠動脈性心疾患，HDLC: HDLコレステロール，HR: ハザード比，interaction: 交互作用．

コレステロール1mmol/Lは38.7mg/dL．信頼区間の線が実線の場合は非喫煙者，点線の場合は喫煙者．

疾患相対リスクの上昇(ハザード比，HR)は，非喫煙者で1.38，喫煙者で1.54であり，連続量の交互作用は有意であった(p=0.02)．同様にHDLCの一標準偏差(0.40mmol/L)減少あたりの冠動脈性心疾患リスクの上昇は，非喫煙者で1.28，喫煙者で1.67であり，こちらも交互作用は有意であった(p=0.04)．

この理由としてTC(LDLコレステロール)は，小児の動脈に既にfatty streakがあるなど比較的若年期から動脈硬化の危険因子として作用し，

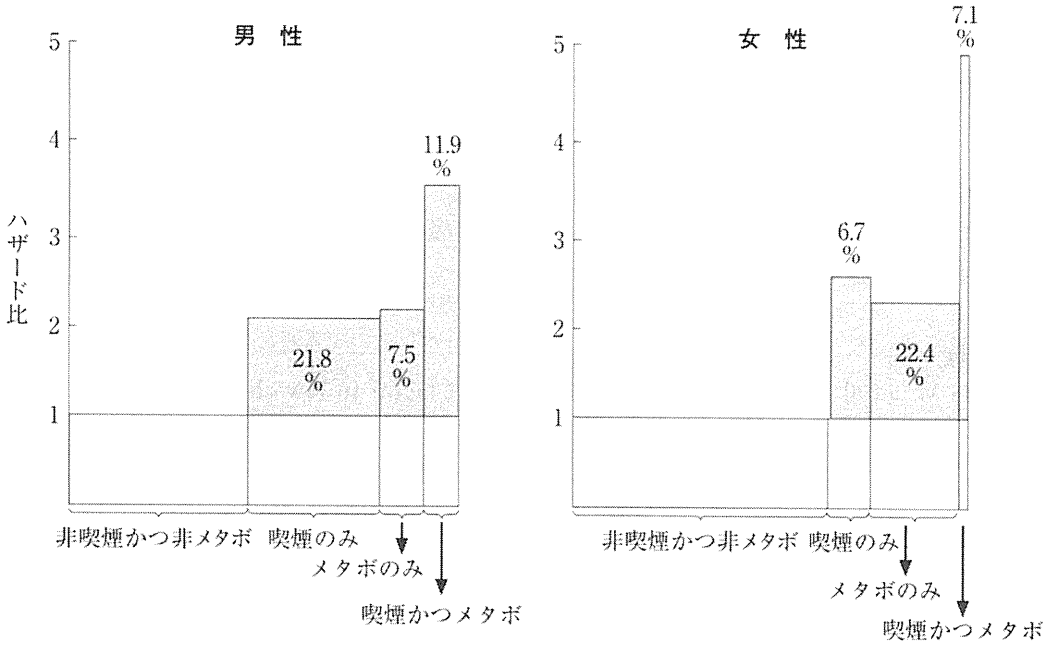

図2　喫煙とメタボリックシンドロームの心血管病に対する人口寄与危険割合：吹田研究
（文献[5]より引用）

喫煙は成人期以降の動脈硬化の危険因子であることが考えられる．両者は異なる機序と時間軸で冠動脈性心疾患のリスクになっており，その結果，相乗的に作用している可能性が考えられた．吹田研究などで示されたMetSや喫煙と心血管病の関連にも同じことがいえるかもしれない[5,6]．このように喫煙と代謝性の危険因子を複合してもっている者に対しては，まず禁煙させることにより大きなリスク減少が期待されるため禁煙指導が非常に重要となる．

3. 喫煙の集団全体の心血管病発症数への影響

ある曝露要因が集団内のある疾患の患者数をどれだけ増やしているかは，人口寄与危険割合（population attributable fraction: PAF）という指標で計算できる．PAFには幾つかの計算手法があるが，基本的には曝露要因の影響の強さ（相対危険度やHRで示される）と曝露要因の集団内での頻度で決定される．日本人男性の喫煙率は欧米諸国より高いため，喫煙の疾病に対するPAFは大きくなりやすい．わかりやすくするためにMetSと喫煙のPAFを比べてみた．

図2は前述した吹田研究におけるMetSと喫煙のPAFであり[5]，棒グラフの高さは相対危険度を，グラフの面積は曝露要因を有する心血管病患者の数を示している．男性のPAFは喫煙のみ群で21.8％，MetSのみ群で7.5％であり，喫煙で発症した心血管病はMetSの約3倍多いことがわかる．一方，女性では喫煙のPAFは小さくMetSのPAFが大きい．これは女性の喫煙率が低いためであるが，この研究のMetSはmodified NCE基準で定義されている．これをもしMetSの日本基準に置き換えると，ウエスト90 cm以上が必須項目になっているため女性のMetSの頻度が激減し，心血管病に対するPAFは喫煙のみ群で8.1％，MetSのみ群で5.2％，両方有する群で1.8％となった（岡村智教ほか．平成22年度厚生労働科学研究‘各種禁煙対策の経済影響に関する研究—医療費分析と費用対効果分析—’分担研究報告より）．NIPPON DATA90の心血管病死亡に対する喫煙のみ群のPAFは，男性で35.6％，女性で7.2％であり，やはり男性で大きな割合を示した．男性の場合，MetS対策も重要であるが，まず喫煙率を下げることが心血管病患者を減らすために有効な手

段と考えられた.

おわりに

従来から心血管病の予防というとMetSや高コレステロール血症などの代謝性の因子や高血圧などに目が向きがちであり，現在もその傾向はあまり変わっていない．また，喫煙対策というとがん予防という意識がいまだ国民感情としても強い．しかし，日本人男性の喫煙率は先進国中で最も高いレベルにあり，すぐ実行可能な心血管病の予防対策として禁煙の推進は非常に重要である．日常診療や健診などの場で喫煙者への啓発が必要である．

文　献

1) Fujishima M, et al: Smoking as cardiovascular risk factor in low cholesterol population: the Hisayama Study. Clin Exp Hypertens A **14**: 99–108, 1992.
2) Ueshima H, et al; NIPPON DATA80 Research Group: Cigarette smoking as a risk factor for stroke death in Japan: NIPPON DATA80. Stroke **35**: 1836–1841, 2004.
3) Iso H, et al; JACC Study Group: Smoking cessation and mortality from cardiovascular disease among Japanese men and women: the JACC Study. Am J Epidemiol **161**: 170–179, 2005.
4) Baba S, et al; JPHC Study Group: Cigarette smoking and risk of coronary heart disease incidence among middle-aged Japanese men and women: the JPHC Study Cohort I. Eur J Cardiovasc Prev Rehabil **13**: 207–213, 2006.
5) Higashiyama A, et al: Risk of smoking and metabolic syndrome for incidence of cardiovascular disease—comparison of relative contribution in urban Japanese population: the Suita study. Circ J **73**: 2258–2263, 2009.
6) Takashima N, et al; NIPPON DATA90 Research Group: Population attributable fraction of smoking and metabolic syndrome on cardiovascular disease mortality in Japan: a 15-year follow up of NIPPON DATA90. BMC Public Health **10**: 306, 2010.
7) Yano K, et al: A comparison of the 12-year mortality and predictive factors of coronary heart disease among Japanese men in Japan and Hawaii. Am J Epidemiol **127**: 476–487, 1988.
8) Hozawa A, et al: Is weak association between cigarette smoking and cardiovascular disease mortality observed in Japan explained by low total cholesterol? NIPPON DATA80. Int J Epidemiol **36**: 1060–1067, 2007.
9) Nakamura K, et al: Does cigarette smoking exacerbate the effect of total cholesterol and high-density lipoprotein cholesterol on the risk of cardiovascular diseases? Heart **95**: 909–916, 2009.

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Nonfilter and filter cigarette consumption and the incidence of lung cancer by histological type in Japan and the United States: analysis of 30-year data from population-based cancer registries

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Shifts in the histologic type of lung cancer accompanying changes in lung cancer incidence have been observed in Japan and the United States. We examined the association between the shift in tobacco design from nonfilter to filter cigarettes with changes in the incidence of adenocarcinoma (AD) and squamous cell carcinoma (SQ) of the lung. We compiled population-based incidence data from the Surveillance, Epidemiology and End Results in the United States (1973–2005) and from selected Japanese cancer registries (1975–2003). Trends in age-standardized rates of lung cancer incidence by histologic type were characterized using joinpoint analyses. A multiple regression framework was used to examine the relationship between tobacco use and incidence by histologic type. We observed that AD has replaced SQ as the most frequent histologic type in males and females in both Japan and the United States. Filter cigarette consumption was positively associated with the incidence of AD, with time lags of 25 and 15 years in Japan and the United States, respectively ($\hat{\beta}_2^{AD}$: 1.946×10^{-3}, $p < 0.001$ and 3.142×10^{-3}, $p < 0.001$). In contrast, nonfilter cigarette consumption was positively associated with the incidence of SQ, with time lags of 30 and 20 years in Japan and the United States, respectively ($\hat{\beta}_2^{SQ}$: 0.464×10^{-3}, $p = 0.006$ and 0.364×10^{-3}, $p = 0.008$). In conclusion, the shift from nonfilter to filter cigarettes appears to have merely altered the most frequent type of lung cancer, from SQ to AD.

Epidemiology

The association between cigarette smoking and lung cancer was firmly established in the 1950s.[1] The rapid increase in incidence rates in the 20th century has led to an epidemic of lung cancer, particularly among men in industrialized countries.[2,3] In the United States, where serious smoking control efforts were instituted almost 50 years ago, the incidence of lung cancer among men peaked in 1982 and began to decline thereafter,[4] but it continues to rise in countries where smoking control efforts have been less aggressive. In Japan, despite a continuous decline in smoking rates over the last 50 years, lung cancer incidence continues to rise.[4,5]

Lung cancer incidence patterns and trends vary by histological type[6] and have been shown to be related to smoking patterns and exposures to other lung risk factors.[3] Shifts in histologic type have been reported to accompany changes in lung cancer incidence. Relative and absolute increases in adenocarcinoma (AD) of the lung were first recognized in the 1970s[7] and continued to be observed in the United States[8,9] and European countries.[10] Although this trend has now peaked in the United States,[11,12] incidence appears to be still increasing in certain areas of Japan.[13–15]

Trends in the incidence of lung cancer by histologic type are of interest in the evaluation of the impact of changes in cigarette manufacture. In particular, although low-tar, low-nicotine, filtered cigarettes appear to have contributed to the overall decline in lung cancer, and most notably in squamous

Key words: population-based cancer registration, lung adenocarcinoma, filter cigarettes
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cell carcinoma (SQ),[16] they may have simultaneously increased the risk of certain peripheral tumors, such as AD,[17–20] and it has been hypothesized that the upward trend in the incidence of AD is mainly due to the dissemination of low-tar filtered cigarettes.[18–20] Smoke from low-yield filter-tipped cigarettes is inhaled more deeply than that from earlier unfiltered cigarettes.[21,22] Inhalation transports tobacco-specific carcinogens more distally toward the bronchioalveolar junction, where ADs often arise. The change in cigarette consumption from nonfiltered to filtered cigarettes also reduces the yield of carcinogenic polycyclic aromatic hydrocarbons, which are inducers of SQs, while simultaneously increasing that of carcinogenic tobacco-specific N-nitrosamines, which are inducers of ADs.[19]

Here, we investigated differences in the effects of nonfilter and filter cigarette consumption on changes in the incidence of SQ and AD in Japan and the United States.

Material and Methods

Lung cancer incidence data in Japan were obtained from nine of the 36 regional registries used to estimate nationwide incidence, namely Yamagata, Niigata, Fukui, Shiga, Osaka, Okayama, Saga, Nagasaki and Hiroshima City, which together account for about 18% of the Japanese population. For the United States, lung cancer incidence data were obtained from the Surveillance and End Results (SEER) program of the US National Cancer Institute, which makes aggregate data available to the public. The data cover about 10% of the US population in nine geographical regions, namely the states of Connecticut, Hawaii, Iowa, New Mexico and Utah, as well as the metropolitan areas of Atlanta (GA), Detroit (MI), San Francisco-Oakland (CA) and Seattle-Puget Sound (WA). We selected cases diagnosed with lung or bronchus cancer from 1973 through 2005 for the US data and from 1975 through 2003 for the Japanese data. Morphology codes indicating lung cancer cell type were grouped into eight major categories according to the WHO scheme[23]: (*i*) SQ (International Classification of Disease for Oncology version 3 (ICD-O-3) codes 8050–8078, 8083–8084); (*ii*) AD (8140, 8211, 8230–8231, 8250–8260, 8323, 8480–8490, 8550–8551, 8570–8574, 8576); (*iii*) small cell carcinoma (8041–8045, 8246); (*iv*) large cell carcinoma (including giant cell, clear cell and large cell undifferentiated carcinoma 8010–8012, 8014–8031, 8035, 8310); (*v*) other specified carcinoma; (*vi*) sarcoma (8800–8811, 8830, 8840–8921, 8990–8991, 9040–9044, 9120–9133, 9150, 9540–9581); (*vii*) other specified malignant neoplasm and (*viii*) unspecified malignant neoplasm (8000–8005). The percentages of cases with unspecified morphology in the United States and Japan differed by an order of magnitude: only 3.9% of the US cases had morphology codes of 8000–8005, indicating "unspecified malignant neoplasm," whereas 33.6% of case reports in Japan were coded 8000–8005. In accordance with Devesa *et al.*,[10] we proportionally allocated the cases with unspecified morphology 8 to the other seven categories on a registry-, year at diagnosis-, sex- and age-specific basis.

US age-standardized incidence rates (ASR) were calculated for the years 1973–2005 and Japanese ASR for the years 1975–2003, by major morphological type, namely SQ, AD and small cell carcinoma. Age standardization incorporated the Segi world standard.[24] All incidence rates were expressed as newly diagnosed cases of malignant neoplasm per 100,000 person-years.

The trends in ASR were also characterized by the widely used joinpoint regression analysis, as described in detail elsewhere.[25] Briefly, joinpoint regression is a statistical technique that describes changing trends over successive segments of time and the magnitude of an increase or decrease within each segment after identifying the best fitting model. Essentially, within each time segment, the log of the ASR is modeled as a linear function of time (calendar year), thereby yielding annual exponential rates of change in ASR. The technique identifies the timepoint(s), also referred to as joinpoint(s), at which there is a statistically significant change in the incidence trend. A maximum of three joinpoints in the model was allowed in the model fitting. The resulting trend segments, as delimited in time by joinpoints, were described by the annual percentage change (APC), that is, the slope of the line segment.[25] The calculation assumes that rates increase or decrease at a constant rate over time, although the validity of this assumption has not been tested. APC is calculated based on the following regression model:

$$\log(R_y) = b_0 + b_1 y$$

where $\log(R_y)$ is the natural log of the rate in year y

The APC from year y to $y+1$

$$= \left(\frac{R_{y+1} - R_y}{R_y}\right) \times 100$$

$$= \left(\frac{e^{b_0+b_1(y+1)} - e^{b_0+b_1(y)}}{e^{b_0+b_1(y)}}\right) \times 100$$

$$= \left(e^{b_1} - 1\right) \times 100$$

In describing the trends, the terms "increase" or "decrease" were used when the slope (APC) of the trend was statistically significant ($p < 0.05$); otherwise, the terms "stable" or "level" were used.

Data on cigarette consumption were based on the market share of nonfilter and filter cigarettes sale in each year. These data were obtained from the US Federal Trade Commission,[26] the Ministry of Health, Labour and Welfare, Japan,[27] the Ministry of Finance, Policy Research Institute, Japan,[28] Japan Tobacco and Salt Co. and the Tobacco Institute of Japan.

To assess whether the incidence rates of SQ and AD of the lung were correlated to annual nonfilter and filter cigarette consumption per capita, we used a multiple regression framework.[29] For a specific subpopulation (*i.e.*, Japanese), we let $Y^{AD}(t)$ represent the ASR (per 100,000 person-years) of AD at time t, and $Y^{AD}(t^+)$ represent the ASR of AD at one time point ahead of time t. For example:

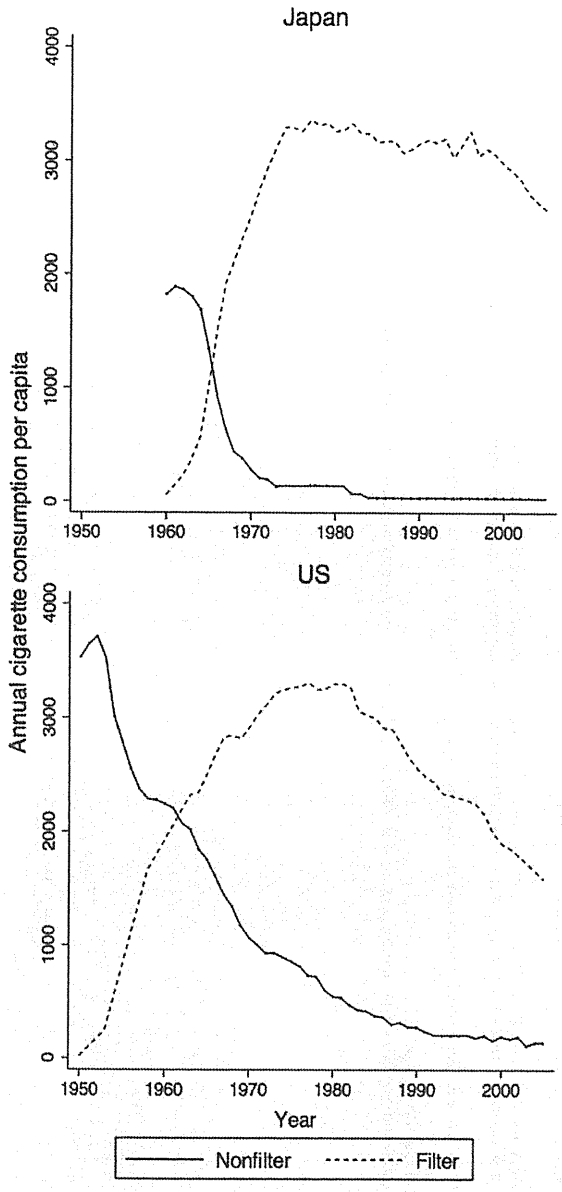

Figure 1. Japan and US nonfilter and filter cigarette consumption. Data for annual consumptions of nonfilter (solid line) and filter (dashed line) cigarettes per capita are presented. The shift from nonfilter to filter cigarettes occurred in the 1960s and the 1950s in Japan and the United States, respectively.

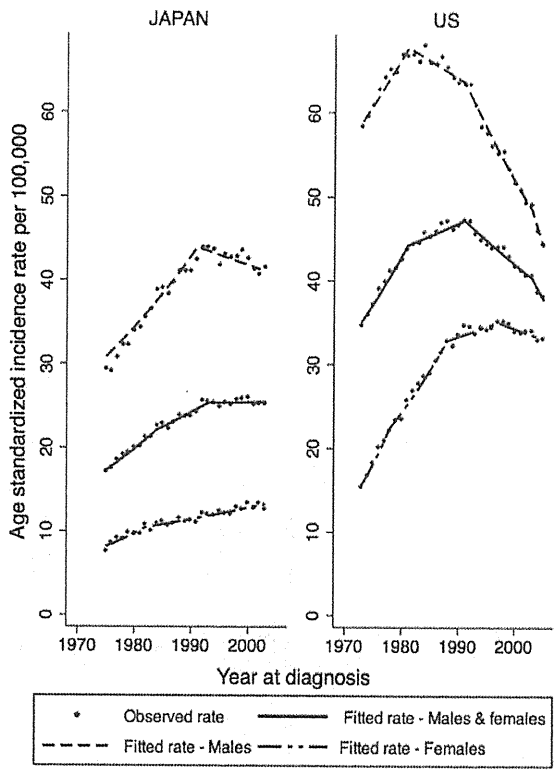

Figure 2. Joinpoint analysis of the overall age-standardized incidence rates (ASR) of lung cancer among individuals in Japan and the United States.

$$Y^{AD}(t) = [Y^{AD}(1), Y^{AD}(2), \ldots, Y^{AD}(T-1)]$$
$$Y^{AD}(t^+) = [Y^{AD}(2), Y^{AD}(3), \ldots, Y^{AD}(T)]$$

Likewise, we let $Y^{SQ}(t)$ represent the ASR (per 100,000 person-years) of SQ at time t and $Y^{SQ}(t^+)$ represent the ASR of SQ at one time point ahead of time t. Additionally, we let $X(t^+ - \tau)$ represent the nonfilter or filter cigarette consumption at time $t^+ - \tau$, where τ is the appropriate time lag. Thus, for each subpopulation, we have the following models:

$$Y^{SQ}(t^+) = \beta_0^{SQ} + \beta_1^{SQ} Y^{SQ}(t) + \beta_2^{SQ} X(t^+ - \tau) + \varepsilon^{SQ} \quad (1)$$
$$Y^{AD}(t^+) = \beta_0^{AD} + \beta_1^{AD} Y^{AD}(t) + \beta_2^{AD} X(t^+ - \tau) + \varepsilon^{AD} \quad (2)$$

We set τ from 5 to 30 years according to the epidemiological evidence: in this regard, because the incidence of lung cancer does not appear to be lower among ex-smokers who quit smoking within 5 years than current smokers,[30,31] the sum of the induction period and latent period of lung cancer caused by tobacco smoking is likely longer than 5 years.

We then examined the adjusted R^2 in the model with different time lags τ among subpopulations and cigarette designs to find the best fitting models (1) and (2) for nonfilter and filter cigarettes among Japanese and Americans. R^2 value was interpreted to mean that for every unit increase in annual nonfilter or filter consumption per capita, we expect a β_2 point increase in the ASR of AD or SQ, holding all other variables constant.

Table 1. Trends of overall age-standardized incidence rates of lung cancer with joinpoint analyses in Japan and the United States

	Trend 1		Trend 2		Trend 3		Trend 4	
	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)
Japan (1975–2003)								
Males & females	1975–1984	2.8† (2.0, 3.6)	1984–1993	1.5† (1.0–2.1)	1993–2003	0.0 (−0.3, 0.3)		
Males	1975–1992	2.2† (1.9, 2.5)	1992–2003	−0.6† (−0.9, −0.2)				
Females	1975–1982	3.6† (1.5, 5.8)	1982–2003	1.1† (0.9, 1.4)				
USA (1973–2005)								
Males & females	1973–1981	2.9† (2.4, 3.4)	1981–1991	0.7† (0.3, 1.0)	1991–2003	−1.3† (−1.5, −1.1)	2003–2005	−3.1† (−6.2, 0.0)
Males	1973–1981	1.8† (1.3, 2.2)	1981–1991	−0.6† (−1.0, -0.3)	1991–2003	−2.2† (−2.5, −2.0)	2003–2005	−4.5† (−8.0, 0.9)
Females	1973–1978	7.5† (5.6, 9.5)	1978–1988	3.9† (3.3, 4.4)	1988–1997	0.7† (0.2, 1.2)	1997–2005	−0.7† (−1.2, −0.3)

Source: SEER-9 areas covering about 10% of the US population (States of Connecticut, Hawaii, Iowa, Utah, and New Mexico, and the metropolitan areas of San Fransisco-Oakland, Detroit, Atlanta, and Seattle-Puget Sound), and Japanese nine areas covering about 10% of the Japanese population (Prefectures of Yamagata, Niigata, Fukui, Shiga, Osaka, Okayama, Saga and Nagasaki, Hiroshima City and Nagasaki City).

Joinpoint analyses with up to three joinpoints were based on rates (per 100,000 persons) and were age adjusted to the world population. Joinpoint analysis used the Joinpoint Regression Program, version 3.3. April 1, 2008, National Cancer Institute.

APC is based on rates that were age standardized to the world population.

†APC is statistically significantly different from zero (two-sided $p < 0.05$, calculated using a *t*-test.)Abbreviations: APC: annual percent change; CI: confidence interval.

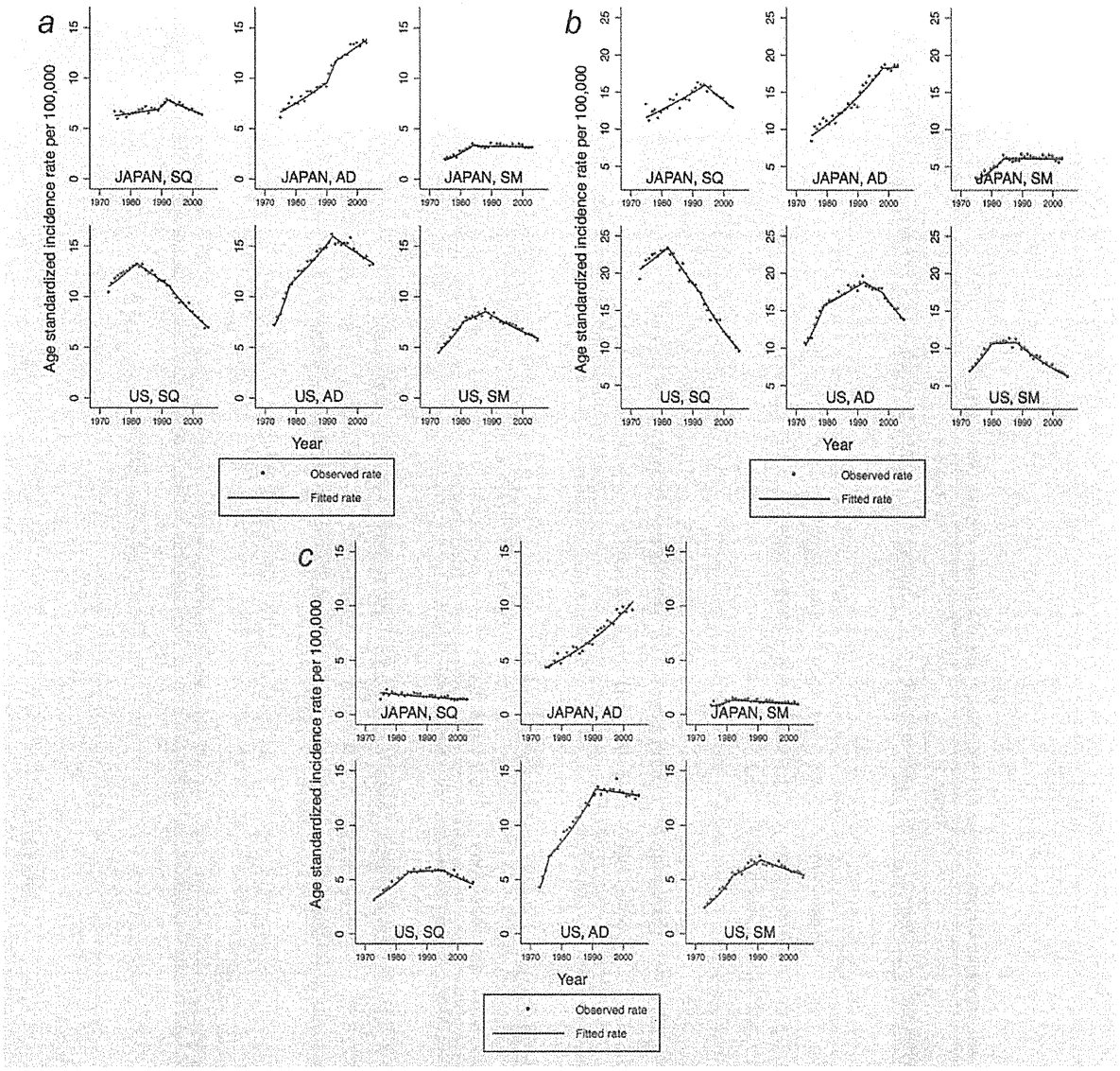

Figure 3. Joinpoint analysis of the age-standardized incidence rates (ASR) of lung cancer by histologic type among individuals in Japan and the United States. (*a*) Males and females combined Joinpoint analyses of the histology-specific ASR of lung cancer among individuals in Japan and in the United States are presented for (*a*) males and females combined, (*b*) males, (*c*) females. SQ, AD and SM indicate squamous cell carcinoma, adenocarcinoma and small cell carcinoma, respectively.

We used STATA version 10.1 (STATA Corporation, College Station, TX) for all analyses except the joinpoint regression analysis, for which we used the Joinpoint Regression Program version 3.3 (US National Cancer Institute, Bethesda, MD).

The Brown University Research Protections Office ruled that this study did not involve human subjects.

Results

Figure 1 illustrates temporal trends in annual nonfilter and filter cigarette consumption per capita in Japan and the United States. The sharp increase in filter cigarette consumption and sharp decrease in nonfilter consumption began in the 1960s and 1950s in the United States and Japan, respectively. Compared with the United States, the shift in consumption from nonfilter to filter cigarettes occurred more rapidly in Japan, with the share of filter cigarettes during this period rapidly reaching 99%. Further, the sharp increase in total consumption owed largely to increasing filter cigarette consumption. Filter cigarette consumption then generally continued to be flat until the late 1990s, when it began to

Table 2. Trends of age-standardized rates of lung cancer with joinpoint analyses by sex and histological group in Japan and the United States

Histology	Trend 1		Trend 2		Trend 3		Trend 4	
	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)
Males & Females combined								
Japan (1975–2003)								
Squamous cell carcinoma	1975–1989	0.7† (0.2, 1.2)	1989–1992	4.4 (−3.3, 12.7)	1992–2003	−1.9† (−2.3, −1.4)		
Adenocarcinoma	1975–1990	2.4† (1.8, 3.0)	1990–1993	7.1 (−1.1, 15.9)	1993–2003	1.7† (1.1, 2.2)		
Small cell carcinoma	1975–1984	6.7† (4.2, 9.2)	1984–2003	0.2 (−0.6, 0.2)				
USA (1975–2003)								
Squamous cell carcinoma	1973–1982	2.1† (1.4, 2.8)	1982–1992	−1.7† (−2.4, −1.1)	1992–2005	−3.6† (−4.0, −3.2)		
Adenocarcinoma	1973–1978	9.4† (6.6, 12.3)	1978–1992	2.5† (2.4, 3.0)	1992–2005	−1.4† (−1.8, −1.0)		
Small cell carcinoma	1973–1981	6.4† (5.3, 7.6)	1981–1988	1.8† (0.4, 3.1)	1988–2005	−2.2† (−2.4, −1.9)		
Males								
Japan (1975–2003)								
Squamous cell carcinoma	1975–1994	1.7† (1.3, 2.1)	1994–2003	−2.4† (−3.1, −1.6)				
Adenocarcinoma	1975–1998	3.0† (2.7, 3.4)	1998–2003	0.2 (−1.6, 1.9)				
Small cell carcinoma	1975–1984	7.4† (4.4, 10.6)	1984–2003	−0.0 (−0.5, 0.5)				
USA (1973–2005)								
Squamous cell carcinoma	1973–1982	1.5† (0.7, 2.3)	1982–1992	−2.8† (−3.5, −2.1)	1992–2005	−4.5† (−4.9, −4.0)		
Adenocarcinoma	1973–1979	7.2† (5.7, 8.8)	1979–1992	1.4† (1.0, 1.8)	1992–1998	−1.3† (−2.6 – −0.0)	1998–2005	−3.3† (−4.1, −2.6)
Small cell carcinoma	1973–1980	6.2† (4.7, 7.7)	1980–1988	0.2 (−0.9, 1.3)	1988–2005	−3.1† (−3.4, −2.8)		
Females								
Japan (1975–2003)								
Squamous cell carcinoma	1975–2003	−1.4† (−1.8, −1.0)						
Adenocarcinoma	1975–2003	3.2† (2.9, 3.5)						

decrease. In the United States, filter cigarette consumption peaked in the late 1970s.

Figure 2 and Table 1 provide the long-term trends in overall lung cancer incidence in Japan and the United States using the joinpoint regression analyses. For males and females combined, while the peak incidence has already occurred in the United States, with a downward trend beginning in 1991, the incidence for Japanese continues to be flat, followed by an upward trend until 1993. While the peak incidence for Japanese males occurred in 1992, the incidence for Japanese females continues to increase. Rates among Japanese males decreased by 0.6% per year from 1992 to 2003, after increasing by 2.2% annually from 1975 to 1992, and rates among Japanese females increased by 3.6% annually from 1975 to 1982 and by 1.1% after 1982. In the United States, peak incidence has already occurred in females in 1988, 7 years later than that in males. Among American males, rates decreased by 0.6% per year from 1981 to 1991 and by 2.2% per year from 1991 to 2005, after increasing by 1.8% annually from 1973 to 1978.

Figure 3 illustrates temporal patterns in ASR for selected histological types of lung cancer in Japan and the United States. For males and females combined (Fig. 3*a*), the peak incidence of SQ in Japanese occurred in 1992, 10 years later than that in the United States. In the United States, the rate of decline in SQ incidence significantly increased after 1992. While the incidence of AD continues to increase in Japan, peak incidence has already occurred in Americans, with a downward trend beginning in 1992. The incidence of AD in Japanese and Americans overtook the incidence of SQ in 1984 and 1976, respectively. For males (Fig. 3*b*), the peak incidence of SQs has already occurred in Japanese, with a downward trend beginning in 1994, 12 years later than that in the United States. While the incidence of AD for Japanese males leveled in 1998 after an upward trend, the peak incidence occurred in the US males, with a downward trend beginning in 1992. For females, the trends of SQ and AD in Japanese are different to those in Americans (Fig. 3*c*). In Japanese, the incidence for SQ continues to decrease and that for AD continues to increase. In contract, the peak incidences of SQ and AD have already occurred in 1982 and 1991 in the United States, respectively.

Table 2 provides the long-term trends in different histological groups of lung cancer incidence using the joinpoint regression analyses. For SQ, rates among Japanese increased by 0.7% annually from 1975 to 1989, were stable from 1989 to 1992, and then decreased by 1.9% from 1992 to 2003. Among Americans, rates increased by 2.1% annually from 1973 to 1982, then decreased by 1.7% from 1982 to 1992 and by 3.6% from 1992 to 2005. For AD, rates among Japanese increased by 2.4% annually from 1975 to 1990, were stable from 1990 to 1993 and then increased by 1.7% from 1993 to 2003. In contrast, rates among Americans increased by 9.4% annually from 1973 to 1978 and by 2.5% from 1978 to 1992 and then decreased by 2.2% from 1992 to 2005. In Japan,

Table 2. Trends of age-standardized rates of lung cancer with joinpoint analyses by sex and histological group in Japan and the United States (Continued)

Histology	Trend 1		Trend 2		Trend 3		Trend 4	
	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)
Small cell carcinoma	1975–1982	8.7† (2.0, 15.7)	1982–2003	−1.6† (−2.3, −0.9)				
USA (1973–2005)								
Suamous cell carcinoma	1973–1984	5.3† (4.2, 6.3)	1984–1995	0.2 (−0.6, 1.1)	1995–2005	−2.5† (−3.3, −1.7)		
Adenocarcinoma	1973–1976	19.1† (9.5, 29.5)	1976–1991	4.2† (3.7, 4.7)	1991–2005	−0.3 (−0.7, 0.1)		
Small cell carcinoma	1973–1982	9.0† (7.2, 10.9)	1982–1991	2.7† (1.3, 4.1)	1991–2005	−1.6† (−2.1, 1.1)		

Source: SEER-9 areas covering about 10% of the US population (States of Connecticut, Hawaii, Iowa, Utah, and New Mexico, and the metropolitan areas of San Fransisco-Oakland, Detroit, Atlanta, and Seattle-Puget Sound), and Japanese nine areas covering about 10% of the Japanese population (Prefectures of Yamagata, Niigata, Fukui, Shiga, Osaka, Okayama, Saga and Nagasaki, Hiroshima City and Nagasaki City).
Joinpoint analyses with up to three joinpoints were based on rates (per 100,000 persons) and were age adjusted to the world population. Joinpoint analysis used the Joinpoint Regression Program, version 3.3.April 1, 2008, National Cancer Institute.
APC is based on rates that were age standardized to the world population.
†APC is statistically significantly different from zero (two-sided $p < 0.05$, calculated using a *t*-test.)
Abbreviations: APC: annual percent change; CI: confidence interval.

Table 3. The relationship between cigarette consumption and lung cancer incidence by histologic type in Japan and the United States

	SQ			AD		
Type of cigarette	Lag time τ^*	$\hat{\beta}_2^{SQ}$ ($\times 10^{-3}$)†	95% CI ($\times 10^{-3}$)	Lag time τ^*	$\hat{\beta}_2^{AD}$ ($\times 10^{-3}$)†	95% CI ($\times 10^{-3}$)
Japan						
Nonfilter	30	0.464‡	(0.164, 0.764)	24	−1.099‡	(−1.767 to −0.431)
Filter	30	−0.340‡	(−0.518, −0.162)	25	1.946‡	(1.297–2.594)
United States						
Nonfilter	20	0.455‡	(0.319, 0.591)	17	0.353	(−0.020 to 0.757)
Filter	25	−0.268‡	(−0.383–0.152)	15	3.183‡	(1.955–4.411)

*τ is defined as the lag between lung cancer incidence and cigarette consumption; CI, confidence interval. $^\dagger\beta_2$ is the coefficient for cigarette consumption in the model of $Y(t^+) = \beta_0 + \beta_1 Y(t) + \beta_2 X(t^+ - \tau) + \varepsilon$ ‡Statistically significantly different from zero (two-sided $p < 0.05$, calculated using a *t*-test).

rates for small cell carcinoma increased by 6.7% annually from 1975 to 1984, then leveled off thereafter. In contrast, rates in the United States increased by 6.4% annually from 1973 to 1981 and by 1.8% from 1981 to 1988, and then began to decrease thereafter.

Because sex-specific data on cigarette consumption by cigarette design were not available on public, we examined the relationship between cigarette consumption and lung cancer incidence by histologic type in males and females combined. Table 3 summarizes the statistical relationship between them using multiple regression analyses. The models in Table 3 did not violate assumptions of normality and uncorrelatedness. Among Japanese, the trend in nonfilter consumption was positively associated with the incidence of SQ ($\hat{\beta}_2^{SQ}$, 0.464×10^{-3}, 95% confidence interval (CI), [0.164×10^{-3}, 0.764×10^{-3}], $p = 0.006$) with the appropriate time lag of 30 years, and the trend in filter cigarette consumption was positively associated with AD incidence ($\hat{\beta}_2^{AD}$, 1.946×10^{-3}, 95%CI, [1.297×10^{-3}, 2.594×10^{-3}], $p < 0.001$) with the appropriate time lag of 25 years. Similarly, among Americans, the trend in nonfilter consumption was positively associated with SQ incidence ($\hat{\beta}_2^{SQ}$, 0.364×10^{-3}, 95%CI, [0.109×10^{-3}, 0.619×10^{-3}], $p = 0.008$) with the appropriate time lag of 20 years, while the trend in filter consumption was positively associated with AD incidence ($\hat{\beta}_2^{AD}$, 3.142×10^{-3}, 95%CI, [1.923×10^{-3}, 4.361×10^{-3}], $p < 0.001$) with the appropriate time lag of 15 years. The negative association between trends in nonfilter cigarette consumption and AD and between trends in filter consumption and SQ among Japanese and Americans reflect the shift in market share from nonfilter to filter cigarettes.

Discussion

AD has replaced SQ as the most frequent histologic type of lung cancer in both Japan and the United States. This increase in AD incidence in both the countries is also associated with the introduction of filtered cigarettes and the substantial increase in filter cigarette consumption. The decrease in nonfilter cigarette consumption due to the shift in market share from nonfilter to filter cigarette is associated with the decrease in the incidence of SQ. To our knowledge, these empirical observations, using population-based data from two distinct countries, are the first to support the long-held hypothesis that smoking filtered *vs.* nonfiltered cigarettes leads to separate presentations of lung cancer. These results are consistent with previous epidemiological study obtained using data at the individual level.[32–34]

Another possible explanation for the change in trends for AD of the lung is changes in exposure to air pollution. Long-term exposure to some components of polluted air, particularly NO*x*, might play a role in the development of AD.[12] Given that air pollution can be considered a general phenomenon, this possibility is not contradicted by the similarity in trends in AD incidence in US males and females but is contradicted by the difference in gender-specific trends in Japanese males and females. In addition, compared with current smokers, the lung cancer rate is very low among never smokers.[35] A prospective cohort study in Norway suggested that although air pollution is one of the causes of lung cancer, it may still much less than cigarette smoking that causes lung cancer.[36,37] A second possible explanation for this AD trend might be related to underlying trends in exposure to environmental tobacco smoke (ETS). Recent regulations have strictly reduced ETS exposure in the United States.[38] The consequent decrease in exposure to ETS might explain the recent decrease in incidence of ADs of the lung in the United States, at least, in part. Although this point should be examined in the future with more detailed exposure and outcome evaluation, it is clear that ETS has much less impact on the risk than active smoking.

Reflecting the wide-scale adoption of filter cigarettes beginning in the 1960s, the United States observed a sharp increase in ADs in the early 1970s, with 9.4% increases annually from 1973 to 1979. Interestingly, although filter cigarettes penetrated the Japanese market more rapidly in the 1970s, the increase in ADs in Japan has not been as sharp as in the United States. There are two explanations for this. First, the greater use of charcoal-containing cigarette filters in Japan (70 *vs.* 1% in the United States) may have had a beneficial effect, perhaps by trapping a greater load of fine particulates

than other filters or by removing a greater load of volatile toxic agents, such as hydrogen cyanide, N-nitrosamines and volatile aldehydes known to act as inhibitors of lung clearance.[19] In this regard, Muscat *et al.* found no association between charcoal filters and an attenuated risk of lung cancer in a Japanese population.[39] Second, it is of course also possible that the differences between the Japanese and US experience may have been affected by the assumptions used in allocating specific morphologies to cases of unknown morphology. Additional analyses focused on this issue may clarify the observed differences.

It is considered paradoxical that a proportion of Japanese who smoke is higher than American males but have a lower incidence of lung cancer.[19] Several factors acting either alone or in combination may explain this lower rate in Japan,[19,40] including age at onset of cigarette smoking, specific personal smoking (*i.e.*, manner of smoking, particularly shallow inhalation), and the contents and construction of cigarettes. Despite the higher smoking prevalence in Japan, total cigarette consumption per capita was lower than in the United States until 1987, suggesting that Japanese smokers smoked fewer cigarettes per day than their American counterparts. Other differences may explain the lower lung cancer rates in Japan: *e.g.*, because consumption of filter cigarettes increased rapidly around the same time that smoking became popular in Japan, Japanese smokers were less exposed to unfiltered cigarettes. Additionally, the Japanese diet may have a protective effect against lung cancer, owing to its relatively high consumption of soybeans,[41,42] which contain the strong tumor inhibitor genistein, and fish[41] and relatively low intake of dietary fat.[43] Frequent consumption of green tea[44] may also have a protective effect. Finally, Americans may have a greater genetic susceptibility to tobacco carcinogens than Japanese. In this regard, the lower relative risks by smoking in epidemiological studies conducted in Japan *versus* the United States is well known.[19,45] In this study, we found a shorter lag time of τ in Americans than in Japanese, which represents the shorter sum of induction and latent period in Americans than in Japanese (*e.g.*, lag times for AD after the advent of filter cigarettes were 25 years in Japan *vs.* 15 years in the United States). This might be a reflection of a difference in patterns of smoking behavior, life styles and susceptibility to lung cancer between Japan and the United States.

Our findings suggest that the trends of incidence of lung cancer by histologic type differ in males and females as well as the associations between changes in the incidences and in filter/nonfilter cigarettes differ among males and females, in both Japan and in the United States. That may be due to the differences in patterns of smoking behavior and the susceptibility to lung cancer in cigarette smokers among males and females. Smoking rate is significantly lower for females than for males in both the countries (11.0 and 39.4% in males and females in Japan, respectively, and 17.4 and 23.4% in the United States).[27,46] Females were more likely than men to smoke filter cigarettes (89.0–90.6% *vs.* 75.0–79.3% in the 1970s,[47,48] and 92.9–94.6% *vs.* 87.0–90% in the 1980s). Females with lung cancer are more likely to be never smokers or less intense smoking history, and have AD subtypes.[49] Therefore, the sex-specific analysis for cigarette types and incidence patterns by histology subtype would sharpen the findings. However, unfortunately, the data on filter/nonfilter cigarette consumption are not available both in Japan and the United States so that we could not analyze the sex specific relationships between the trend in lung cancer incidence by histologic type and consumptions of filter or nonfilter cigarettes. Therefore, the analyses in males and females combined may weaken a true relationship between the increased trend in AD and filter cigarette consumption. Nevertheless, we could obtain the statistically significant relationship between them using the data for males and females combined.

Molecular examinations of lung cancer might give us an insight to interpret different patterns of change in histology-specific incidence by sex and ethnicities discussed above. It has been reported that epidermal growth factor receptor (*EGFR*) mutations commonly present in female, never-smoker and Asian ethnicity.[50] Potential differences in several risk factors including smoking by *EGFR* mutational status have been reported to date.[51,52]

Several limitations of this study warrant mention. First, as an ecological study, it possesses all the limitations inherent to ecological analyses. Aggregate data on exposure and disease—data obtained from population aggregates—cannot be linked to individuals. Although estimated consumption of cigarettes was based on nationally averaged levels for the respective countries, consumption may in fact vary by area (rural *vs.* metropolitan), race/ethnicity, sex, age and education. The increased consumption of filter cigarettes may have played different roles in the increase in AD incidence in males and females, but the present data lacked the sensitivity to detect changes at this level. Second, the data collected from Japanese prefectural population-based cancer registries have major quality issues and fail to meet international data quality standards for the proportion of death-certificate-only cases, incidence-to-mortality ratio and proportion of histologically verified cases.[53] Based on mathematical modeling, true incidence may be underestimated by as much as 20%.[54] Moreover, because one-third of the Japanese cases in this study were of unknown morphology, the data may not adequately reflect the true changes in lung cancer incidence by histologic type. Nevertheless, we do not consider that our allocation methodology biased the results, and reanalysis of the data without the proportional reallocation of cases with unspecified morphology returned virtually identical results. Finally, another limitation may be change over time in the definition of AD[55] or in diagnostic practice,[56] although we consider that these themselves cannot account for the increase in AD incidence. For example, major diagnostic advances such as bronchoscopy, thin-needle aspiration, computed tomography scans

and improved stains for mucin were all introduced in the 1980s,[56] after the increases in the incidence of AD were observed.

While the decreased incidence of SQ among Japanese and Americans is encouraging in terms of cancer prevention and control, it is counterbalanced by the increases in AD, especially among Japanese. As realization of the detrimental health effects of cigarette smoking initially grew, the tobacco industry strove to develop filtered cigarettes as less harmful cigarettes, but subsequent scientific evidence has failed to demonstrate any benefit from changes in cigarette design or manufacturing.[57] Despite the tobacco industry became well aware of the fact that filtered cigarettes were not less harmful, it has been advertised filtered or low-tar cigarettes to intend to reassure smokers and were meant to prevent smokers form quitting since the early 1950s in the United States[58] and later in Japan.[59] The false reassurances provided by marketing strategies of filtered/low-tar cigarettes might be related to the rising incidence of ADs of the lung.

The present results suggest that the shift from nonfilter to filter cigarettes may have had the result of replacing one cancer type with another. These findings emphasize the importance of tobacco control programs, namely programs that prevent the initiation of smoking, hasten the rate of smoking cessation or limit exposure to ETS, have been associated with a decrease in both cigarette consumption and smoking rates, and subsequently with a decrease in lung cancer incidence.[4,60]

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References

1. Wynder EL, Graham EA. Tobacco smoking as a possible etiologic factor in bronchiogenic carcinoma; a study of 684 proved cases. *J Am Med Assoc* 1950;143: 329–36.
2. Bray F, Tyczynski JE, Parkin DM. Going up or coming down? The changing phases of the lung cancer epidemic from 1967 to 1999 in the 15 European Union countries. *Eur J Cancer* 2004;40:96–125.
3. Parkin DM, Bray FI, Devesa SS. Cancer burden in the year 2000. The global picture. *Eur J Cancer* 2001; 37:S4–66.
4. Jemal A, Thun MJ, Ries LA, Howe HL, Weir HK, Center MM, Ward E, Wu XC, Eheman C, Anderson R, Ajani UA, Kohler B, et al. Annual report to the nation on the status of cancer, 1975–2005, featuring trends in lung cancer, tobacco use, and tobacco control. *J Natl Cancer Inst* 2008; 100:1672–94.
5. Jemal A, Ward E, Thun MJ. Contemporary lung cancer trends among U.S. women. *Cancer Epidemiol Biomarkers Prev* 2005;14: 582–5.
6. Janssen-Heijnen ML, Coebergh JW. The changing epidemiology of lung cancer in Europe. *Lung Cancer* 2003;41:245–58.
7. Vincent RG, Pickren JW, Lane WW, Bross I, Takita H, Houten L, Gutierrez AC, Rzepka T. The changing histopathology of lung cancer: a review of 1682 cases. *Cancer* 1977;39:1647–55.
8. Anton-Culver H, Culver BD, Kurosaki T, Osann KE, Lee JB. Incidence of lung cancer by histological type from a population-based registry. *Cancer Res* 1988; 48:6580–3.
9. Wingo PA, Ries LA, Giovino GA, Miller DS, Rosenberg HM, Shopland DR, Thun MJ, Edwards BK. Annual report to the nation on the status of cancer, 1973–1996, with a special section on lung cancer and tobacco smoking. *J Natl Cancer Inst* 1999; 91:675–90.
10. Devesa SS, Bray F, Vizcaino AP, Parkin DM. International lung cancer trends by histologic type: male:female differences diminishing and adenocarcinoma rates rising. *Int J Cancer* 2005;117:294–9.
11. Chen F, Bina WF, Cole P. Declining incidence rate of lung adenocarcinoma in the United States. *Chest* 2007;131: 1000–5.
12. Chen F, Cole P, Bina WF. Time trend and geographic patterns of lung adenocarcinoma in the United States, 1973–2002. *Cancer Epidemiol Biomarkers Prev* 2007;16:2724–9.
13. Sobue T, Ajiki W, Tsukuma H, Oshima A, Hanai A, Fujimoto I. Trends of lung cancer incidence by histologic type: a population-based study in Osaka, Japan. *Jpn J Cancer Res* 1999;90:6–15.
14. Toyoda Y, Nakayama T, Ioka A, Tsukuma H. Trends in lung cancer incidence by histological type in Osaka, Japan. *Jpn J Clin Oncol* 2008;38:534–9.
15. Yoshimi I, Ohshima A, Ajiki W, Tsukuma H, Sobue T. A comparison of trends in the incidence rate of lung cancer by histological type in the Osaka cancer registry, Japan and in the surveillance, epidemiology and end results program, USA. *Jpn J Clin Oncol* 2003;33:98–104.
16. Peto R. Overview of cancer time-trend studies in relation to changes in cigarette manufacture. *IARC Sci Publ* 1986:211–26.
17. Thun MJ, Lally CA, Flannery JT, Calle EE, Flanders WD, Heath CW, Jr. Cigarette smoking and changes in the histopathology of lung cancer. *J Natl Cancer Inst* 1997;89: 1580–6.
18. Stellman SD, Muscat JE, Thompson S, Hoffmann D, Wynder EL. Risk of squamous cell carcinoma and adenocarcinoma of the lung in relation to lifetime filter cigarette smoking. *Cancer* 1997;80:382–8.
19. Wynder EL, Hoffmann D. Smoking and lung cancer: scientific challenges and opportunities. *Cancer Res* 1994;54:5284–95.
20. Wynder EL, Muscat JE. The changing epidemiology of smoking and lung cancer histology. *Environ Health Perspect* 1995; 103:143–8.
21. Wynder EL, Hoffmann D. Re: cigarette smoking and the histopathology of lung cancer. *J Natl Cancer Inst* 1998;90: 1486–8.
22. Djordjevic MV, Hoffmann D, Hoffmann I. Nicotine regulates smoking patterns. *Prev Med* 1997;26:435–40.
23. Curado M, Edwards B, Shin HR, Storm H, Ferlay J, Heanue M, Boyle P. Cancer incidence in five continents, 160 edn., vol. IX. Lyon: IARC Scientific Publications, 2007.
24. Bray F, Guilloux A, Sankila R, Parkin DM. Practical implications of imposing a new world standard population. *Cancer Causes Control* 2002;13:175–82.
25. Kim HJ, Fay MP, Feuer EJ, Midthune DN. Permutation tests for joinpoint regression with applications to cancer rates. *Stat Med* 2000;19:335–51.
26. Federal Trade Commission. Cigarette report for 2004 and 2005. Table 1, Table 4 and Table 6, 2007. Available at http://www.ftc.gov/reports/tobacco/2007cigarette2004–2005.pdf. Accessed on August, 2008.
27. Ministry of Health, Labour and Welfare, Japan. Tobacco or heatlh. Available at http://www.health-net.or.jp/tobacco/menu02.html. Accessed on February 13, 2009.

28. Ministry of Finance, Policy Research Institute. Monthly finance statistics, Monophony enterprise, 1976. Available at http://www.mof.go.jp/kankou/hyou/g287/287.htm. Accessed on December 27, 2008.
29. Shumway RH, Stoffer DS. Time series analysis and its applications: With R Examples. (2nd ed.) New York: Springer, 2006.
30. Pohlabeln H, Jockel KH, Muller KM. The relation between various histological types of lung cancer and the number of years since cessation of smoking. *Lung Cancer* 1997;18:223–9.
31. Wakai K, Seki N, Tamakoshi A, Kondo T, Nishino Y, Ito Y, Suzuki K, Ozasa K, Watanabe Y, Ohno Y. Decrease in risk of lung cancer death in males after smoking cessation by age at quitting: findings from the JACC study. *Jpn J Cancer Res* 2001;92:821–8.
32. Marugame T, Sobue T, Nakayama T, Suzuki T, Kuniyoshi H, Sunagawa K, Genka K, Nishizawa N, Natsukawa S, Kuwahara O, Tsubura E. Filter cigarette smoking and lung cancer risk; a hospital-based case--control study in Japan. *Br J Cancer* 2004;90:646–51.
33. Wynder EL, Kabat GC. The effect of low-yield cigarette smoking on lung cancer risk. *Cancer* 1988;62:1223–30.
34. Stellman SD, Muscat JE, Hoffmann D, Wynder EL. Impact of filter cigarette smoking on lung cancer histology. *Prev Med* 1997;26:451–6.
35. Wakelee HA, Chang ET, Gomez SL, Keegan TH, Feskanich D, Clarke CA, Holmberg L, Yong LC, Kolonel LN, Gould MK, West DW. Lung cancer incidence in never smokers. *J Clin Oncol* 2007;25:472–8.
36. Nafstad P, Haheim LL, Wisloff T, Gram F, Oftedal B, Holme I, Hjermann I, Leren P. Urban air pollution and mortality in a cohort of Norwegian men. *Environ Health Perspect* 2004;112:610–5.
37. Nafstad P, Haheim LL, Oftedal B, Gram F, Holme I, Hjermann I, Leren P. Lung cancer and air pollution: a 27 year follow up of 16 209 Norwegian men. *Thorax* 2003;58:1071–6.
38. Levy DT, Romano E, Mumford EA. Recent trends in home and work smoking bans. *Tob Control* 2004;13:258–63.
39. Muscat JE, Takezaki T, Tajima K, Stellman SD. Charcoal cigarette filters and lung cancer risk in Aichi Prefecture, Japan. *Cancer Sci* 2005;96:283–7.
40. Takahashi I, Matsuzaka M, Umeda T, Yamai K, Nishimura M, Danjo K, Kogawa T, Saito K, Sato M, Nakaji S. Differences in the influence of tobacco smoking on lung cancer between Japan and the USA: possible explanations for the 'smoking paradox' in Japan. *Public Health* 2008;122:891–6.
41. Takezaki T, Hirose K, Inoue M, Hamajima N, Yatabe Y, Mitsudomi T, Sugiura T, Kuroishi T, Tajima K. Dietary factors and lung cancer risk in Japanese: with special reference to fish consumption and adenocarcinomas. *Br J Cancer* 2001;84:1199–206.
42. Shimazu T, Inoue M, Sasazuki S, Iwasaki M, Sawada N, Yamaji T, Tsugane S. Isoflavone intake and risk of lung cancer: a prospective cohort study in Japan. *Am J Clin Nutr* 2010;91:722–8.
43. Ozasa K, Watanabe Y, Ito Y, Suzuki K, Tamakoshi A, Seki N, Nishino Y, Kondo T, Wakai K, Ando M, Ohno Y. Dietary habits and risk of lung cancer death in a large-scale cohort study (JACC Study) in Japan by sex and smoking habit. *Jpn J Cancer Res* 2001;92:1259–69.
44. Tang N, Wu Y, Zhou B, Wang B, Yu R. Green tea, black tea consumption and risk of lung cancer: a meta-analysis. *Lung Cancer* 2009;65:274–83.
45. Stellman SD, Takezaki T, Wang L, Chen Y, Citron ML, Djordjevic MV, Harlap S, Muscat JE, Neugut AI, Wynder EL, Ogawa H, Tajima K, et al. Smoking and lung cancer risk in American and Japanese men: an international case-control study. *Cancer Epidemiol Biomarkers Prev* 2001;10:1193–9.
46. Cigarette smoking among adults—United States, 2007. Centers for Disease Control and Prevention (CDC). *MMWR Morb Mortal Wkly Rep* 2008;57:1221–6.
47. Wynder EL, Goodman MT, Hoffmann D. Demographic aspects of the low-yield cigarette: considerations in the evaluation of health risk. *J Natl Cancer Inst* 1984;72:817–22.
48. Schuman LM. Patterns of smoking behavior. *NIDA Res Monogr* 1977:36–66.
49. Harichand-Herdt S, Ramalingam SS. Gender-associated differences in lung cancer: clinical characteristics and treatment outcomes in women. *Semin Oncol* 2009;36:572–80.
50. Shigematsu H, Lin L, Takahashi T, Nomura M, Suzuki M, Wistuba, II, Fong KM, Lee H, Toyooka S, Shimizu N, Fujisawa T, Feng Z, et al. Clinical and biological features associated with epidermal growth factor receptor gene mutations in lung cancers. *J Natl Cancer Inst* 2005;97:339–46.
51. Matsuo K, Hiraki A, Ito H, Kosaka T, Suzuki T, Hirose K, Wakai K, Yatabe Y, Mitsudomi T, Tajima K. Soy consumption reduces the risk of non-small-cell lung cancers with epidermal growth factor receptor mutations among Japanese. *Cancer Sci* 2008;99:1202–8.
52. Matsuo K, Ito H, Yatabe Y, Hiraki A, Hirose K, Wakai K, Kosaka T, Suzuki T, Tajima K, Mitsudomi T. Risk factors differ for non-small-cell lung cancers with and without EGFR mutation: assessment of smoking and sex by a case-control study in Japanese. *Cancer Sci* 2007;98:96–101.
53. Sobue T. Current activities and future directions of the cancer registration system in Japan. *Int J Clin Oncol* 2008;13:97–101.
54. Kamo K, Kaneko S, Satoh K, Yanagihara H, Mizuno S, Sobue T. A mathematical estimation of true cancer incidence using data from population-based cancer registries. *Jpn J Clin Oncol* 2007;37:150–5.
55. Travis DW, Linder J, Mackay B. Classification, histology, cytology and electron micrscopy. In: Pass H, Mitchell J, Johnson D, eds. Lung cancer: principles and practice, 3rd edn. Philadelphia: Lippincott Williams & Wilkin, 2000. 451–502.
56. Charloux A, Quoix E, Wolkove N, Small D, Pauli G, Kreisman H. The increasing incidence of lung adenocarcinoma: reality or artefact? A review of the epidemiology of lung adenocarcinoma. *Int J Epidemiol* 1997;26:14–23.
57. Burns DM, Major JM, Shanks TG, Thun MJ, Samet JM. Chapter 04: Smoking low yield cigarettes and disease risks. Monograph 13: Risks associated with smoking cigarettes with low tar machine-measured yields of tar and nicotine. Smoking and Tobacco Control Monographs, NIH: Bethesda, MD, USA 1996;65–146.
58. Polly RM, Dewhirst T. Chapter 07: Marketing cigarettes with low machine-measured yields. Monograph 13: Risks associated with smoking cigarettes with low tar machine-measured yields of tar and nicotine. Smoking and Tobacco Control Monographs, NIH: Bethesda, MD, USA 1996;199–236.
59. Postscript B: The tobacco industry and its activities in Japan. Tobacco free Japan: recommendations for tobacco control policy, Mochizuki Y., Samet JM., Yamaguchi N, eds. 2004; 326–376. URL: http://www.tobaccofree.jp/index.html
60. Stewart SL, Cardinez CJ, Richardson LC, Norman L, Kaufmann R, Pechacek TF, Thompson TD, Weir HK, Sabatino SA. Surveillance for cancers associated with tobacco use—United States, 1999–2004. *MMWR Surveill Summ* 2008;57:1–33.

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Short Communication

Perceptions and Practices of Japanese Nurses Regarding Tobacco Intervention for Cancer Patients

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ABSTRACT

Background: We investigated the perceptions and practices regarding tobacco intervention among nurses, as improvement of such practices is important for the management of patients who smoke.

Methods: Self-administered questionnaires were delivered by hospital administrative sections for nursing staff to 2676 nurses who were working in 3 cancer hospitals and 3 general hospitals. Of these, 2215 (82.8%) responded.

Results: Most nurses strongly agreed that cancer patients who had preoperative or early-clinical-stage cancer but continued to smoke should be offered a tobacco use intervention. In contrast, they felt less need to provide tobacco use intervention to patients with incurable cancer who smoked. Most nurses felt that although they assessed and documented the tobacco status of cancer patients, they were not successful in providing cessation advice, assessing patient readiness to quit, and providing individualized information on the harmful effects of tobacco use. In multivariate analysis, nurses who received instruction on smoking cessation programs during nursing school were more likely to give cessation advice (odds ratio, 1.61; 95% confidence interval, 1.15–2.26), assess readiness to quit (1.73, 1.09–2.75), and offer individualized explanations of the harmful effects of tobacco (1.94, 1.39–2.69), as compared with nurses who had not received such instruction.

Conclusions: The perceptions of Japanese nurses regarding tobacco intervention for cancer patients differed greatly by patient treatment status and prognosis. The findings highlight the importance of offering appropriate instruction on smoking cessation to students in nursing schools in Japan.

Key words: smoking cessation; intervention; nurses; perception

INTRODUCTION

Smoking cessation reduces the risk of developing tobacco-related cancer.[1] In addition, preoperative abstinence from cigarette smoking can reduce pulmonary and wound-related complications among patients with cancer[2–4] and patients undergoing orthopedic surgery.[5] Smoking cessation also prevents recurrence in patients with a potentially curable tobacco-related cancer,[6,7] reduces the risk of developing a secondary tobacco-related cancer,[8,9] decreases the risk of treatment side effects,[10] and improves cancer survival.[11] These findings demonstrate the importance of tobacco intervention practices for cancer patients who smoke.

During screening, diagnosis, treatment, rehabilitation, and supportive care, nurses have many opportunities to intervene with smokers and recent quitters at risk for relapse, and evidence shows that nurses can provide effective tobacco cessation interventions.[12,13] However, attitudes toward such interventions might differ according to the characteristics of nurses and patient health status. Little is known about the perceptions and practices of nurses regarding tobacco intervention for cancer patients in Japan. Thus, we administered a questionnaire survey to examine the perceptions and practices of Japanese nurses working in cancer hospitals and general hospitals regarding tobacco intervention for cancer patients.

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