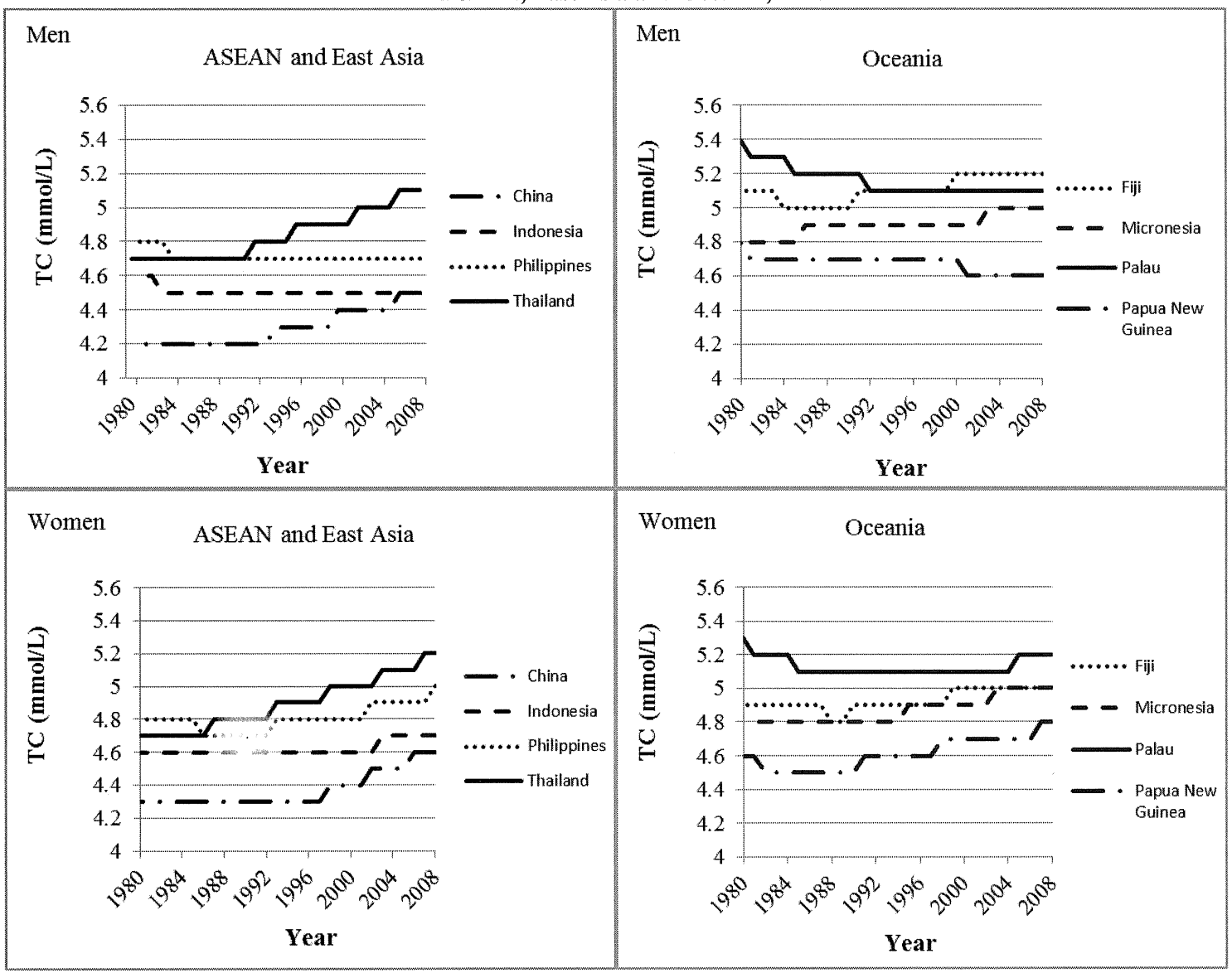
**Figure 12: Trends in the mean blood total cholesterol (age-standardized estimate) of some countries in ASEAN, East Asia and Oceania, 1980-2008**




Source: WHO Global Health Observatory Data Repository, available at: http://apps.who.int/gho/data/?vid=1805#

# 研究成果の刊行に関する一覧表

雑誌

| 発表者氏名 | 論文タイトル名 | 発表誌名 | 巻号 | ページ | 出版年 |
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| 本庄かおり、<br>堤明純 | 公衆衛生研究における社会階層指標構築の重要性 | 公衆衛生 | 76 (11) | 916-919 | 2012 |
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| Honjo K, Iso H, Iwata M, Cable N, Inoue M, Sawada N, Tsugane S, for the JPHC Study Group | Effectiveness of combined approach for assessing social gradients in stroke risk among married women in Japan | J Epidemiol | 22 (4) | 324-330 | 2012 |

研究成果の刊行物・別刷

資料

投稿

# 公衆衛生研究における社会階層指標構築の重要性

本庄 かおり[1)]　堤 明純[2)]

## 背景

近年，日本における社会的・経済的格差に対する関心の高まりとともに，社会階層間の健康格差に関する知見が蓄積されているところである[1)]．例えば，喫煙などの健康行動や冠動脈疾患危険要因[2)]，生活習慣病による死亡[3)]や罹患リスク[4)]などにおいて，社会階層・社会経済状況による格差が存在することが報告されている．疫学研究の多くは教育歴，収入や職業をベースにした指標を用いて社会階層を測定しているが，社会階層指標の妥当性に多くの注意を払ってきたとは言えず，特に女性の社会階層をどのように測定するべきかの議論はなかった．

本稿では，公衆衛生研究における社会階層指標の妥当性を論じ，社会階層指標構築の重要性について考察する．

## 疫学研究における社会階層指標

「社会階層」の指標として教育歴，収入，職業を用いる背景には，社会学的定義が存在する．社会学では社会階層に関して多くの理論が存在するが，疫学研究における社会階層指標は主にウェーバーの社会階層理論を基礎としていると考えられる[5)]．ウェーバーの社会階層理論では，資本家・労働者といった生産関係によってグループ化された階層(Status)の社会的地位は，「人生における機会(Life chance)」(個人の知識，経済機会，資産，スキル，能力など)によって決定されるとし，各々の階層は意識，態度，行動，生活様式，価値観などを共有し，財産，職業，所有，学歴などの点で類似した人々の集合体と定義した[5)]．多くの疫学研究ではこの「人生における機会」と関連があると考えられる教育歴，職業，収入を用いて社会階層を推定しようとしている[5~7)]．

教育歴は将来の社会的成功に関する情報を提供する社会階層の最も基本的な指標の一つとして，疫学研究で頻繁に用いられている指標である[5)]．受けた教育レベルによって生じる知識やライフスキルの違いにより健康格差が生成される可能性のみならず[6)]，高学歴であることによる自己肯定感の上昇などの心理的側面への影響や[8)]，学閥などに代表されるような社会的ネットワークを通した社会心理的な影響による機序も示唆されている．教育歴はすべての人が持つ情報であり，情報の欠損も少ない点で有用な指標であると言える．しかし，教育歴はすべての人に同じ意味を持たず，年齢，世代，性別によってその意味するところが異なる点には注意が必要である[5,9)]．

収入は，個人の生活水準を反映し健康に影響を与える物質的環境と直接的に関連するという意味において，重要な指標である[5)]．また，物質的環境に付随する行動要因(例：禁煙クリニックに通って禁煙する，スポーツクラブに入会して運動する)も捉えることが可能だと考えられている．しかし，収入に関する質問に対しては回答の欠損が

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多く測定誤差が大きい傾向があり，また社会階層の経済的側面をつかむには，一時点の収入だけでなく複数時点の収入や保有財産，消費行動等も含めた情報を用いるべきであるという意見もある．

受けた教育によって選択可能な職業が決定され，就いた職業によって経済的報酬額が決定する．職業は教育歴と収入をつなぐ中間的指標と言える．職業は収入を規定し健康に関連する資源へのアクセスに影響を与えることが想定されるが，同時に社会的地位や権力を推定し把握できる可能性がある．したがって，職業は教育歴や収入と比較して，社会階層の複合的特徴を捉えることが可能な，より総合的な指標であると言える．英国では歴史的に職業階層や職業的地位を社会階層の代表的指標としてきた．たとえば，Registrar General's Classification[10]では，組織内での地位や報酬などから，①専門職，②管理職・技術職，③a技能非肉体労働者，③b技能肉体労働者，④多少の技能あり，⑤技能なし，⑥その他，に分類し，社会階層を推定している．米国にはそれぞれの職業分類をその平均教育歴，平均収入によりランク付けしたNam-Power scaleがある[11]．しかし，日本では，多くの場合，日本標準職業分類大分類[12]から職業をブルーカラー労働者，ホワイトカラー労働者に分類する比較的単純な手法を用いることが多く，上記のような職業を階層化した指標は少ない．職業階層指標の最大の短所は，職に就いていない集団(失業者や主婦)には使用できない点である．

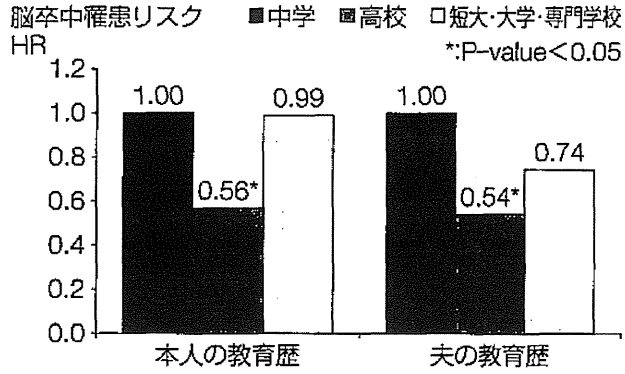
さらに，性によって職業に偏りがあり，主に女性が就いている職業(例：サービス業，販売業，介護・保健医療職等)をどのように扱うかについて問題が残る．日本人有職者6,553名を対象に職業性ストレスと脳卒中発症リスクの関連が職業別に検討された研究では，女性のホワイトカラー職で職業性ストレスと脳卒中発症リスクの関連が強く観察されたが，サービス業と販売業をブルーカラーに分類すると，統計的な有意性が失われた[13]．日本ではホワイトカラー職に就く女性の多くが補助的な役割を担っていることや，女性のホワイトカラー職の多くを占めるサービス業や販売業は収入も低く，不安定で，職業性ストレスが高い傾向があり[14]，ホワイトカラー職が必ずしも社会階層の高いグループを代表するものとは言えないのではないかと考察されている．

これまで見てきたように，社会が階層に層化される複雑な現象を概念化するには，個人の教育歴，収入，職業による測定はかなり限定的であると言わざるを得ない．

## 女性の社会階層指標の妥当性

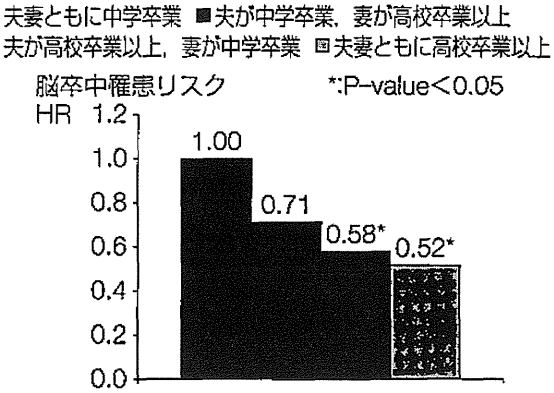
日本における健康の社会階層間格差研究には，欧米では見られない顕著な性差が認められる[2-4,9,13]．たとえば，Nishiら[2]が公務員を対象に教育歴と冠動脈疾患危険因子の関連を検討した結果，男性では教育歴と高脂血症においては関連が見られなかったのに対し，女性では教育歴が低いほど高脂血症有病リスクが高い傾向を認めた．また，糖尿病においては，逆に男性で中学卒業者は大学卒業者に対して3倍のリスクが認められたのに対し，女性では関連が見られなかった．別の研究では等価所得，教育歴と自覚的健康感の関連を横断的に検証した結果，男性では等価所得と自覚的不健康感の関連は認められなかったのに対し，女性では等価所得が低くなるほど，自覚的不健康を訴える人の割合が高いことを認めた[9]．以上のように，健康の社会階層間格差における性差は，用いた社会階層指標やアウトカムによって異なる結果を示している．日本で見られる顕著な性差は，日本社会特有の現象なのだろうか．

女性，特に既婚女性の社会階層を測定することは大変厄介な作業である．欧米の疫学研究では，既婚女性の社会階層指標に関する妥当性検討が実施されている．例えばChandola[15]は，職業を用いて社会階層を最低群(Ⅰ)から最高群(Ⅵ)に分類するケンブリッジスケールを用いて，9,003名の既婚女性の社会階層と心筋梗塞死亡リスクの関連を検討した．女性自身の職業を用いて分類した場合，社会階層が低いほど心筋梗塞死亡リスクが高くなり，社会階層の最低群(Ⅰ)と最高群(Ⅵ)のリスク比は約1.7倍であった．これに対して，夫の




出典：Honjo, et al.: Effectiveness of combined approach for assessing social gradients in stroke risk among married women in Japan. J Epidemiol, 2012; 22(4): 324-330 より引用し作図

**図1 既婚女性の社会階層と脳卒中罹患リスク：本人の教育歴・夫の教育歴を用いた社会階層指標による検討結果**




出典：Honjo et al.: Effectiveness of combined approach for assessing social gradients in stroke risk among married women in Japan. J Epidemiol, 2012; 22(4): 324-330 より引用し作図

**図2 既婚女性の社会階層と脳卒中罹患リスク：本人(妻)と夫の教育歴を合成した社会階層指標による検討結果**

職業を用いて分類した結果，最低群(Ⅰ)と最高群(Ⅵ)のリスク比は約3.4倍であった．どちらの指標においても社会階層が低いほど心筋梗塞死亡リスクが高いという関連は認められたが，夫の職業によって分類した場合の方が，自身の職業を用いた場合と比較してより強い関連が見られた．女性の社会階層を示す指標として，自身の職業よりも世帯レベルの指標，つまり家庭の中で最も主要な稼ぎ手と考えられる夫の職業を用いた方が，より妥当な結果である可能性が示唆されている[15,16]．

同様の検討が日本人既婚女性を対象に実施されている．日本の中高年既婚女性9,317名を対象に，本人教育歴，夫の教育歴，本人と夫の両方の教育歴を合成した3つの指標を用いて，脳卒中罹患リスクとの関連を検証した結果[17]，自身の教育歴を指標として用いた場合，中学と大学卒業はほぼ同じリスクだが，高校卒業グループは他の2つのグループと比較して約45%低く，U型の関連が見られた(**図1左**)．夫の教育歴を指標として用いた場合は，夫の教育歴が大学卒業程度の女性の脳卒中罹患のリスクは，夫の教育歴が中学卒業グループよりやや低い傾向であることが認められた(**図1右**)．これに対し，本人と夫の教育歴を合成した指標では，脳卒中罹患リスクは社会階層が高くなるにつれて低くなるという関連が見られた(**図2**)．これらの指標と脳卒中罹患リスクの関連を比較すると，自身の教育歴を用いた関連が最も弱いという結果であった．

1960年以降，女性の大学・短大進学率が飛躍的に伸びたにもかかわらず，女性の年齢階級別に見た労働市場への参加率は30代で一旦下落し，その後再び上昇するM字型を維持している．復職した女性の多くは非正規雇用者となり，女性の非正規雇用者の割合は男性と比較して高い(総務省統計局労働力調査2011：男性20.1%，女性は54.6%)．雇用形態の男女差は当然ながら収入にも反映され，日本女性の平均給与は男性平均給与の約50%であり，世帯収入は主に夫の収入で構成されていることが報告されている[18]．したがって，これらの社会状況を考慮すると，女性における個人の教育歴，収入，職業といった指標は彼女らの社会における地位というよりは，個人的な資質(リテラシー，自己効力感，自尊心など)を示す傾向が強いのではないかと推察される．

## 日本の公衆衛生研究における妥当な社会階層指標の重要性

現在，世界的な健康格差の拡大が，重要かつ対策が必要な公衆衛生問題として認識されている[19]．国内においても，2011年9月には日本学

術会議基礎医学委員会・健康・生活科学委員会合同パブリックヘルス科学分科会から，「わが国の健康の社会格差の現状理解とその改善に向けて」が報告された[20]．また，日本公衆衛生学会においても公衆衛生モニタリング・レポート委員会から，社会経済状況による健康格差のモニタリングの必要性が報告されている[21,22]．

健康格差のモニタリングに際し，社会階層・社会経済的状況の妥当な指標を使用することは，重要な課題の1つである．また，疫学研究では多くの場合，社会階層・社会経済的状況は交絡要因として統計的な調整をするためモデルに投入されているが，妥当性の低い社会階層指標を交絡要因として用いた場合，正しい調整ができない可能性がある．つまり，社会階層指標の妥当性・信頼性は健康格差研究のみならず，多くの公衆衛生研究に影響を与える重要な事項でもある．

## 結論

本稿では社会階層指標の妥当性について，特に女性の指標に焦点を当てて議論してきた．これまでに見たように，日本社会に沿った妥当な社会階層指標の作成は，日本の公衆衛生において重要かつ緊要な課題の1つである．社会階層の層化メカニズムならびに社会階層による健康格差生成のメカニズムを理解し，より妥当な指標を構築し，使用することが重要である．

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Review Article

# Social Epidemiology and Eastern Wisdom

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## ABSTRACT

Social epidemiology is the field of study that attempts to understand the social determinants of health and the dynamics between societal settings and health. In the past 3 decades, large-scale studies in the West have accumulated a range of measures and methodologies to pursue this goal. We would like to suggest that there may be conceptual gaps in the science if Western research models are applied uncritically in East Asian studies of socioeconomic, gender, and ethnic inequalities in health. On one hand, there are common concerns, including population aging and gendered labor market participation. Further, international comparison must be built on shared concepts such as socioeconomic stratification in market economies. On the other hand, some aspects of health, such as common mental disorders, may have culturally specific manifestations that require development of perspectives (and perhaps novel measures) in order to reveal Eastern specifics. Exploring and debating commonalities and differences in the determinants of health in Oriental and Occidental cultures could offer fresh inspiration and insight for the next phase of social epidemiology in both regions.

***Key words:*** social epidemiology; social science; social determinants of health; interdisciplinary research

Social epidemiology aims to understand the wider determinants of health by using observational studies that measure an enlarged set of exposures. In addition to the usual downstream biomedical and behavioral risk factors, such studies include measurements of upstream factors that can be called "causes of the causes."[1] The growing interest in population research on aging motivates studies of a spectrum of novel age-related health outcomes, including vascular aging, functioning, and functional limitation.[2] This methodology has generated much evidence that socioeconomic circumstances, living and working conditions, and social and psychological factors are strong influences on well-being and health over the life course. In policy terms, the health of a country's population depends more on the ministries of finance, housing, education, employment, and environment than on the ministry of health—which would more accurately be referred to as the ministry of illness.[3,4] Social epidemiology is science that supports the new public health movement[5] and encourages interdisciplinary approaches that move outside the borders of conventional health promotion in search of effective interventions.

Research design is guided by theoretical models of the causes of the causes, and these models can be split into 2 contrasting groups. Materialist models emphasize income, employment, housing, and other "concrete" factors. Their strength is measurability. In contrast, psychosocial models seek explanations for social differences in health and well-being by studying social, family, and working relationships as well as beliefs and emotions. The strength of this level of explanation is that it may lead to a detailed understanding of the human experience of health and health inequality. Many studies have explored whether the materialist or psychosocial model is better at accounting for health inequalities within and between populations, and most of these were published between 1995 and 2005. The debate generated heat as well as light. Both levels of explanation have intellectual and empirical value, and their relative importance depends on the health outcome and context in question.[6,7]

The example of social capital shows that the distinction between materialist and psychosocial explanations can be exaggerated. Social capital has been measured in different studies by using several related components, including degree of social cohesion, number of social ties, and level of social trust.[8] Both material and psychosocial advantage is gained when social capital is relatively high: there may be exchange of goods, loan schemes, and practical support of other kinds.

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There may also be emotional support at difficult times and a sense of belonging that enhances health and quality of life. Research in Japan has revealed such inter-relationships, eg, greater area income inequality was linked to a lower level of social trust and poorer self-rated health.[9]

Most evidence until now has been generated by research groups in the United States, United Kingdom, and mainland Europe, using Western population-scale studies.[6,10,11] These centers have contributed to graduate training for an increasing number of groups of active East Asian researchers with the skills and interests to study the important question of social inequalities in health. It remains uncertain how health inequalities are evolving across East Asia in this new millennium.[12,13] Japan remains at the top of the international life expectancy league table. Perhaps it also maintains low socioeconomic inequalities in health despite 2 decades of economic stagnation and a rate of relative poverty that is now similar to that in the United States and Mexico.[14] If that were the case, Japan would be a prime example of a rich country maintaining excellent population health and managing to do so in a sustainable way.

One challenge for research on the social and economic determinants of health in East Asian countries is to understand how their particular social systems and cultures support or undermine health. In China, the prevalence of overweight doubled in women and tripled in men between 1989 and 2006, and there is evidence of emerging social inequality in this important health determinant.[15] In South Korea, low education level has been linked with increased prevalence of metabolic syndrome in women, and this inequality appears to be growing in successive post-war birth cohorts.[16] On the other hand, Japan's frugal food culture has so far largely protected the population from the long march of the food corporations,[17,18] except in Okinawa, where the dietary pattern is considerably westernized.[19] The diversity in social trends across East Asian countries suggests that comparative studies would improve our understanding of how society influences population and individual health. In other words, there appears to be potential to study the considerable variation both in exposures and outcomes across the region. However, researchers in the region must determine whether there are important conceptual and methodological gaps in the science that has been developed in the Western context.

Some social dynamics are common to East and West. Increasing longevity brings the challenges of a new demographic that is the consequence of life expectancy at birth increasing at the rate of 3 months per year across a large number of countries.[20] Although a great majority of the young old are able to live independently, surveys show the proportion that needs some social care tends to increase rapidly with age.[21] The personal and collective costs in health-related quality of life and economic burden will be serious and difficult to manage if we ignore these at least partially avoidable problems. There is a lot to learn about healthy aging from studies in East Asia, and much would be relevant in the West.

As well as the shared concerns about the health of aging societies, there is another fundamental shift that interests social epidemiologists in the East and West, namely, the continuing trend toward gender equality within the family and in relation to the labor market. Age at first marriage is increasing and fertility is low, in part as a consequence of the desire of young Japanese women to be free of family demands at least until they have established a degree of economic and personal autonomy.[22] An undesirable effect in the Japanese context is the high abortion rate: 22% of all pregnancies ended in induced abortion in 2002.[23,24] One explanation may be that younger generations of women have a sense that the health effects of marriage are different for men and for women, ie, marital partnership results in fewer health benefits for women, whether they live in London or Osaka. The quality of the relationship is probably what matters. Positive psychosocial factors protect physical health, as shown in the inverse relation between social support and cardiovascular disease risk—more support, lower risk—in the East and West.[25]

Some aspects of population health are socially and culturally specific. This is most obvious in the tracking of vital statistics such as birth and death rates by country over time. Evidence on income inequality, life expectancy, and other health outcomes between and within countries suggests that distribution of material and other resources across a given society is a key determinant of health.[26,27] Social stratification is an important issue in this respect because social epidemiology in part builds on the assumption that market economies generate social class hierarchies based on market or economic power, and that these are comparable.[28–30] Further, a country's system of social stratification is fundamental in the assessment of health inequalities and must be appropriately conceptualized and measured to capture the particularities of the society of interest. The labor market is a key dimension of social structure, and social scientists have discussed over several decades whether the Western concept of occupational social class is applicable to Japan.[31,32] A social classification based on employment relations and status was found to detect similar variation and function of social classes in Japan, in comparison with Western countries.[31,33] The research community is increasingly interested in social stratification; however, the Erikson–Goldthorpe classification—the theoretical basis of the UK National Statistics socioeconomic classification (NS-SEC)—has as yet been paid little attention, and the measure has not been applied by social epidemiologists in Japan to assess health inequalities.

With respect to social stratification, international comparison must be built on shared concepts and methods. In contrast, some health determinants would best be studied with culturally specific tools.[34,35] Mental health is a particularly important dimension of health. The conventional,

Western approach has proved to have weaknesses and thus a new understanding would be welcomed. Medication has long been the first-line treatment for depression in Europe and North America. However, it has been suspected for many years that drug treatment does not lead to improved outcomes except among those suffering from major and chronic depression. A recent expert review by the UK National Institute of Clinical Research confirmed this view and concluded that medication should no longer be the primary treatment for depression in the National Health Service (NHS). The headline advice in the detailed 2010 report tells doctors: "Do not use antidepressants routinely to treat persistent sub-threshold depressive symptoms or mild depression because the risk–benefit ratio is poor."[36]

Research in East Asia may help to solve the widespread problem of chronic poor psychological health among adults. A Japanese study using the Beck Depression Inventory (BDI), which was developed in the United States, found that the BDI had similar validity in terms of factor structure in the United States and Japan, which implies that depression is a universal construct with universal symptoms and solutions.[37] However, there is also a view that depressive symptoms may differ between Western and Eastern societies, particularly in their somatic manifestations (Ichiro Kawachi, personal communication). Somatic symptoms measured in the BDI are loss of energy, sleep problems, irritability, appetite problems, lack of concentration, tiredness, and sexual disinterest. Draguns mentions the greater separation between soma and psyche in Western culture.[34] Related to this, there may be a lower level of cultural acceptance of depression as a largely mental disorder in East Asia.

These hypotheses suggest a need for studies using instruments developed by researchers who appreciate Eastern cultures, so as to inspire fresh thinking in the field of mental health. It could be that a difference in the pattern of depressive symptoms between East and West—which is not evident using the BDI—may be detectable using an instrument developed in the East. East Asian practices, perhaps with emphasis on social support networks, may work more effectively with mental distress than current antidepressant medications.[38,39]

If it is accepted that there might be culturally specific aspects of the social determinants of health, then it may be valuable to develop new constructs for use in social epidemiology. Such work would complement the extension of established methods, including measurement of socio-economic position, to facilitate comparison of health inequalities in East Asian countries. It is likely that existing and new approaches are needed—combining development of newly validated psychosocial measures with validation of existing measures in China, Korea, Japan, and other East Asian countries—to understand relationships between social determinants such as strong community structures and levels of well-being in their respective populations.

Models of population health that are rooted in the cultures of East Asian countries may improve on models developed in the United Kingdom, for example, in their explanatory power for social inequalities in health outcomes. This is not to suggest that there is some mystical Oriental secret to health and longevity, but rather that the whole picture of East–West differences in social inequalities in health will not be captured if we favor Occidental constructs of psychosocial factors, well-being, and social position when such constructs are subject to major cultural and philosophical influences. Drawing on existing research models and methods is practical and has been productive during the first phase of social epidemiology in East Asia. Development of newly validated measures of social determinants inspired by East Asian researchers will surely be important for East and West in the second phase.

## ACKNOWLEDGMENTS

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Original Article

# Effectiveness of the Combined Approach for Assessing Social Gradients in Stroke Risk Among Married Women in Japan

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## ABSTRACT

**Background:** Analysis of the effects of social gradients on women's health requires a suitable means of assessing social standing.

**Methods:** We compared social gradients in stroke risk among 9317 married Japanese women from the Japan Public Health Center-based Prospective Study over a 16-year period. Social gradient was estimated by 3 methods of indicating social position: education level derived by using the individual approach (woman's own educational level), the conventional approach (using her partner's educational level), and the combined approach (combining the woman's and her partner's educational levels).

**Results:** As compared with the lowest educational group, stroke risk was similar among women in the highest educational group using the individual approach and lower, but not significantly so, with the conventional approach. With the combined approach, however, the age- and area-adjusted hazard ratio (HR) was significantly lower among the highest education group as compared with the lowest group (HR = 0.52, 95% CI: 0.36, 0.76), and the relative index of inequality was significant (RII = 0.48, 95% CI: 0.32, 0.72). Using the combined approach, the results were similar irrespective of employment status. In the combined highest educational group, stroke risk among unemployed women was significantly reduced by 54%, while stroke risk for employed women was significantly reduced by 46%, as compared with the lowest educational group, with RIIs of 0.42 (95% CI: 0.21, 0.85) and 0.49 (0.30, 0.80), respectively.

**Conclusions:** The results suggest that a combined approach better reflects social standing among married women in Japan.

***Key words:*** social gradient; measure; stroke; women; Japan

## INTRODUCTION

Social gradients in health have been well documented by using various socioeconomic indicators such as educational level, income, occupational position, and area deprivation.[1,2] However, assessment of social gradients in health among women, especially partnered women, has been a considerable challenge.[3–13]

The validity of using the social position of spouses or partners as a measure of a woman's social standing (the conventional approach) has been criticized in light of the increasing number of women entering the labor force.[4,8,10,14] However, use of a woman's own social position appears to underestimate social inequalities in health.[15,16] Other research has assessed the usefulness of the dominant, or gender-neutral, approach (assessing the most dominant social position in the household) and the combined approach (combining the social positions of all working age adults in the household)[8] for measuring social gradients in women's health.[4,8,9,17]

Krieger et al[8] compared the individual, dominant, and combined approaches and found that social gradients in various health outcomes were greatest using the dominant approach and smallest using the individual approach.

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Increasingly large numbers of women in Japan have enrolled in university-level education since 1960.[14] However, women's participation in the labor force, by age group, is represented by an M-shape curve, which reflects their tendency to have a career break during their 20s and then return to the labor force, as part-time employees, in their 40s.[14,18] In addition, a married woman's income is unlikely to be similar to her husband's.[14,18]

A previous study found that women with the highest and lowest educational levels had higher incidences of total stroke in Japan as compared with those in the middle educational level.[19] Another study found no significant association between women's own indicators of social position, such as educational level and occupation, and stroke incidence.[20] However, information on the relationship between social standing and health among married women is limited.

Krieger et al[8] concluded that the combined approach was of little use for measuring social gradients in women's health. However, their findings suggested a need for care in categorizing the social position of married women. Cultural differences might be expected to influence socioeconomic inequalities in women's health,[21] and a comparison of the use of these different approaches in non-Western countries could shed new light on the social gradients in women's health in these countries.

With educational levels as an indicator of social position, we compared social gradients in stroke risk among married women in Japan, using the individual approach (married woman's own educational level), conventional approach (educational level of her partner), and combined approach (combining educational levels of the woman and her partner). We also investigated the role of women's employment status in the relationship between educational level and stroke risk.

## METHODS

### Study population

Participants in the Japan Public Health Center-based Prospective Study (JPHC) have been drawn from 4 public health center (PHC) areas since 1990. The recruited participants were 54 498 individuals aged 40 to 59 years, all of whom were registered in 14 administrative districts within those PHC areas. Of the 54 380 eligible participants, 37 851 (70%) completed and returned the self-administered questionnaires at baseline in 1990 and at follow-up in 2000. The sampling design and procedures for the JPHC study have been described in detail elsewhere.[22] The JPHC study was approved by the institutional review board of the National Cancer Center, Tokyo, Japan.

Women who reported a medical history of cancer, stroke, or myocardial infarction at baseline ($n = 315$) were excluded from the study. We limited inclusion to (1) pairs with an identical surname and address, (2) women with a married partner, and, to eliminate the possibility that an identified pair was a parent and child, (3) pairs with an age difference less than 16 years between the woman and her male partner. A total of 13 292 married couples were identified. Furthermore, to reduce misclassification bias, only women who had remained married for more than 10 years since the baseline survey ($n = 10\,204$) were included. Of these women, those with no valid information on their or their partner's educational level were also excluded ($n = 572$), leaving a total of 9317 married women as our study population.

### Derivation of educational levels using the individual, conventional, and combined approaches

Information on the highest achieved educational level of the married women and their partners was obtained via the baseline questionnaire administered in 1990. Responses were categorized into 3 groups: (1) junior high school (compulsory full-time education in Japan), (2) high school, and (3) college or higher.

Women's own educational levels were used for the individual approach, while their male partners' educational levels were used for the conventional approach. For the combined approach, the educational levels of the women and their partners were first categorized as either compulsory education alone or higher education (high school, college, or higher). Four groups were then created: group I (lowest, both partners with compulsory education only), group II (woman with higher education, partner with compulsory education), group III (woman with compulsory education, partner with higher education), and group IV (highest, both partners with higher education).

### Outcome variable

The outcome variable and endpoint for our study was confirmed incidence of total stroke. All study participants were followed for 16 years, from 1990 (baseline) through 2005.

Stroke was defined by using the criteria of the National Survey of Stroke, namely, a neurologic deficit of sudden or rapid onset persisting 24 hours or longer, or until death.[23] Definitive diagnosis of each stroke subtype, ie, subarachnoid hemorrhage, intraparenchymal hemorrhage, and ischemic stroke (thrombotic or embolic stroke), was established based on clinical findings from computed tomography (CT), magnetic resonance imaging (MRI), or autopsy. A total of 30 hospitals were registered under the 4 PHC areas in the JPHC study. These hospitals were equipped with at least 1 imaging facility (CT or MRI) in a designated clinical cardiology department. The methods used to confirm stroke cases have been described in detail elsewhere.[24]

Residential status and survival were confirmed annually through the residential registry of each PHC area. A total of 645 respondents who moved out of their original area of residence (7%) and 47 married women who were lost to follow-up (0.4%) were treated as censored.

### Covariates

Information on employment status was collected in the baseline survey, and married women were categorized as either employed or unemployed. Information on age, self-perceived psychological status, smoking, physical activity, alcohol use, and existing medical conditions was collected through responses to the baseline questionnaire. Body mass index (BMI) was calculated by using self-reported height and weight at baseline.

Married women were asked to rate their perceived psychological status as low, moderate, or high. Smoking status was recorded as currently smoking, quit smoking, or never smoked. Frequency of leisure time physical activity was recorded as almost none, 1 to 3 times per month, or at least once a week. Alcohol use was categorized as almost none, 1 to 3 times a month, less than 150 g ethanol per week, 151 g to 299 g ethanol per week, and 300 g or more ethanol per week.

Regarding existing health conditions among married women, we identified the presence of hypertension, diabetes, and hypercholesterolemia by examining responses to the relevant questions regarding medical history and/or use of medications to control those conditions. Information on menopausal status was also obtained by examining responses to relevant questions in the baseline questionnaire.

### Statistical analyses

Rates of incident total stroke were calculated during the 16-year follow-up period from 1990 to the endpoint in 2005. Age-adjusted mean values or proportions of cardiovascular risk factors at baseline were calculated based on educational levels derived from the 3 approaches by using multivariate regression for continuous measures and logistic regression for dichotomous measures.

Hazard ratios (HRs) with 95% CIs were calculated using Cox proportional hazards regression after adjusting for age and area, which were regarded as potential confounding variables (Model 1). Further adjustments were made for known conventional cardiovascular risk factors such as smoking, alcohol use, perceived psychological stress, physical activity, BMI, history of hypercholesterolemia, hypertension, diabetes, and menopause, which were considered mediators in this study (Model 2).

A relative index of inequality (RII) was calculated for each model to obtain a quantitative estimate of the overall magnitude of inequalities in the stroke risk of married women. The RII is a regression-based summary measure used in research on social inequalities.[25] Dummy variables for hierarchical categories of social position were given to each individual (low = 0.1, medium = 0.5, high = 0.9 for both the conventional and individual approaches; Q1 = 0.05, Q2 = 0.35, Q3 = 0.65, Q4 = 0.95 for the combined approach). The RII encompasses a range from 0 (lowest) to 1 (highest), weighted by the number of subjects in each category, and represents the ratio of the stroke risk for those at the bottom of the social hierarchy versus those at the top of the hierarchy.[26,27] Further analysis was conducted after stratification according to women's employment status. Married women without information on employment status were excluded from this stratified analysis ($n = 71$). These analyses were applied to all 3 approaches. All analyses were conducted using SAS version 9.2.

## RESULTS

Among our study sample of married Japanese women ($n = 9317$), there were 179 cases of newly diagnosed stroke during 144 655 person-years of follow-up (mean follow-up, 15.5 years). Table 1 shows the distribution of educational levels of male partners by the educational level of the married women. These data suggest that men and women were likely to find partners with the same educational level, though the proportion of such marriages declined with increasing educational level.

Table 2 shows the demographic characteristics of married women according to educational level, as derived from the 3 approaches. Regardless of the approach used, women with the highest educational level were more likely to be young, stressed, and physically active and were less likely to smoke, be obese, have a history of hypertension, or be menopausal than women in the lowest educational group. The proportions of employed women were similar in all educational groups, though slightly more women who were partnered with a college-educated man were not employed.

Table 3 presents the adjusted HRs and 95% CIs for stroke risk among married women according to educational levels derived using the individual and conventional approaches. Analysis using the woman's educational level (individual approach) yielded a U-shaped association. Regarding the compulsory education group, age- and area-adjusted HRs for stroke risk among women in the high school education group and the college/higher education group were 0.56 (95% CI: 0.39, 0.80) and 0.99 (0.61, 1.58), respectively. The calculated RII was not significant for the individual approach.

**Table 1. Numbers of married women ($n = 9317$) at different educational levels according to their partner's educational level**

| | Partner's educational level | | |
|---|---|---|---|
| | Junior high school ($n = 4335$) | High school ($n = 3792$) | College or higher ($n = 1190$) |
| Women's educational level | | | |
| Junior high school ($n = 4429$, %) | 3156 (71) | 1152 (26) | 121 (3) |
| High school ($n = 3763$, %) | 1014 (27) | 2208 (59) | 541 (14) |
| College or higher ($n = 1125$, %) | 165 (15) | 432 (38) | 528 (47) |

**Table 2. Age-adjusted baseline characteristics according to educational level derived from individual, conventional and combined approaches among a cohort of married women ($n$ = 9317)**

| | Individual approach | | | Conventional approach | | | Combined approach | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | JHS | HS | College | JHS | HS | College | Group I (lowest) JHS:JHS | Group II HS/College:JHS | Group III JHS: HS/college | Group IV (highest) HS/college: HS/college |
| No. at risk | 4429 | 3763 | 1125 | 4335 | 3792 | 1190 | 3156 | 1179 | 1273 | 3709 |
| Mean age (year) | 49.2 | 47.4 | 46.3 | 49.0 | 47.5 | 46.9 | 49.5 | 47.9 | 48.8 | 46.9 |
| Employed (%) | 75.5 | 75.9 | 75.8 | 76.9 | 76.7 | 68.1 | 76.6 | 77.4 | 72.9 | 75.3 |
| Perceived high psychological stress (%) | 18.3 | 23.4 | 33.6 | 19.6 | 23.0 | 28.5 | 18.4 | 23.1 | 18.2 | 26.6 |
| Current smoker (%) | 4.1 | 2.9 | 3.1 | 3.9 | 3.2 | 3.0 | 3.8 | 4.0 | 4.7 | 2.7 |
| Ethanol consumption >300 g/week (%) | 0.7 | 0.7 | 0.1 | 0.7 | 0.5 | 0.4 | 0.7 | 0.8 | 0.7 | 0.4 |
| Physical activity more than once a week (%) | 13.3 | 17.5 | 21.3 | 13.3 | 17.6 | 20.6 | 12.4 | 15.6 | 15.6 | 19.3 |
| Mean BMI (kg/m$^2$) | 23.7 | 23.2 | 23.1 | 23.7 | 23.3 | 22.9 | 23.8 | 23.4 | 23.6 | 23.1 |
| BMI ≥27 (%) | 14.0 | 9.6 | 9.0 | 13.6 | 10.7 | 7.6 | 14.5 | 11.2 | 12.7 | 8.9 |
| Hypercholesterolemia (%) | 1.5 | 1.5 | 1.0 | 1.5 | 0.6 | 0.9 | 1.7 | 1.1 | 1.1 | 1.5 |
| Medical history of hypertension (%) | 13.1 | 10.3 | 9.4 | 13.2 | 10.3 | 9.9 | 13.6 | 12.2 | 12.1 | 9.4 |
| Medical history of diabetes mellitus (%) | 2.2 | 1.3 | 1.9 | 1.6 | 1.6 | 1.3 | 1.8 | 1.2 | 2.0 | 1.3 |
| Menopause (%) | 40.2 | 38.7 | 35.2 | 40.5 | 37.9 | 36.6 | 40.6 | 40.6 | 39.2 | 37.1 |

JHS = junior high school; HS = high school.
BMI = Body Mass Index (Kg/m$^2$).

**Table 3. Hazard ratios (HRs) with 95% CIs for stroke risk in married women ($n$ = 9317) according to educational levels derived from individual and conventional approaches**

| | | Individual approach | | | | Conventional approach | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Junior high school | High school | College | RII[a] | Junior high school | High school | College | RII[a] |
| ALL | Person years | 69138 | 58362 | 17155 | 144655 | 67712 | 58865 | 8078 | 144655 |
| | No. of cases | 114 | 44 | 21 | 179 | 115 | 46 | 18 | 179 |
| Model 1 | HR | 1.00 | 0.56 (0.39, 0.80) | 0.99 (0.61, 1.58) | 0.62 (0.34, 1.12) | 1.00 | 0.54 (0.39, 0.77) | 0.74 (0.45, 1.23) | 0.45 (0.25, 0.83) |
| Model 2 | HR | 1.00 | 0.61 (0.43, 0.88) | 1.09 (0.67, 1.76) | 0.73 (0.40, 1.32) | 1.00 | 0.59 (0.41, 0.84) | 0.82 (0.49, 1.36) | 0.53 (0.29, 0.96) |
| Unemployed[b] | Person years | 17576 | 13390 | 3761 | 34728 | 16241 | 13105 | 5381 | 34728 |
| | No. of cases | 40 | 12 | 10 | 62 | 40 | 12 | 10 | 62 |
| Model 1 | HR | 1.00 | 0.47 (0.25, 0.88) | 0.79 (0.33, 1.80) | 0.40 (0.14, 1.19) | 1.00 | 0.43 (0.23, 0.83) | 0.94 (0.46, 1.90) | 0.57 (0.22, 1.48) |
| Model 2 | HR | 1.00 | 0.50 (0.27, 0.96) | 0.81 (0.34, 1.96) | 0.46 (0.16, 1.36) | 1.00 | 0.47 (0.24, 0.91) | 1.03 (0.50, 2.13) | 0.66 (0.25, 1.74) |
| Employed | Person years | 51018 | 44549 | 13233 | 108801 | 50894 | 45338 | 12568 | 108801 |
| | No. of cases | 75 | 34 | 8 | 117 | 75 | 34 | 8 | 117 |
| Model 1 | HR | 1.00 | 0.60 (0.39, 0.93) | 1.11 (0.63, 1.96) | 0.74 (0.36, 1.52) | 1.00 | 0.59 (0.36, 0.89) | 0.55 (0.26, 1.14) | 0.36 (0.16, 0.78) |
| Model 2 | HR | 1.00 | 0.65 (0.42, 1.02) | 1.22 (0.68, 2.18) | 0.86 (0.42, 1.79) | 1.00 | 0.64 (0.42, 0.97) | 0.60 (0.29, 1.27) | 0.42 (0.19, 0.93) |

Model 1: age- and area-adjusted.
Model 2: Model 1 + conventional cardiovascular risk factors (smoking status, alcohol use, perceived psychological stress, physical activity, Body Mass Index, history of hypercholesterolemia, hypertension, diabetes, and menopause).
[a]RII = Relative Index of Inequality; [b]Unemployed = economically inactive women.
HR = Hazard Ratio.

Using the conventional approach, the age- and area-adjusted HR for stroke risk among women in the high school education group was significantly reduced by 46%, relative to those in the lowest educational group (HR = 0.54; 95% CI: 0.39, 0.77), and remained significantly lower even after controlling for hypothesized mediating factors. The age- and area-adjusted stroke risk was also lower among women in the college/higher educational level group, but not significantly so (HR = 0.74; 0.45, 1.23). The age- and area-adjusted RII calculated by using the conventional approach was steeper than that obtained using the individual approach (RII = 0.45; 95% CI: 0.25, 0.83).

We further tested the effect of employment status on the associations between educational levels and stroke risk among married women. The associations between derived educational level and stroke risk differed according to employment status. Using the individual approach, employment status had no effect on the association between educational level and stroke risk: a U-shaped association was identified for both employed and unemployed women. However, employment status did influence the association between stroke risk and partner's educational level (conventional approach): age- and area-adjusted stroke risk was higher in unemployed women with a college level or higher education, as compared with unemployed women with a high school education. There was a U-shaped association between stroke risk and partner's educational level among unemployed women. A different pattern was

**Table 4. Hazard ratios (HRs) with 95% CIs for stroke risk in married women ($n$ = 9317) according to combined (woman:partner) educational level**

| | | Combined approach | | | | RII[a] |
|---|---|---|---|---|---|---|
| | | Group I (lowest) JHS:JHS | Group II HS/college:JHS | Group III JHS:HS/College | Group IV (highest) HS/college:HS/college | |
| ALL | Person years | 49299 | 18413 | 19839 | 57103 | 144655 |
| | No. of cases | 94 | 21 | 20 | 44 | 179 |
| Model 1 | HR | 1.00 | 0.71 (0.44, 1.14) | 0.58 (0.36, 0.95) | 0.52 (0.36, 0.76) | 0.48 (0.32, 0.72) |
| Model 2 | HR | 1.00 | 0.74 (0.46, 1.20) | 0.61 (0.37, 0.99) | 0.59 (0.40, 0.86) | 0.54 (0.36, 0.81) |
| Unemployed[b] | Person years | 12106 | 4135 | 5470 | 13017 | 34728 |
| | No. of cases | 35 | 5 | 8 | 14 | 62 |
| Model 1 | HR | 1.00 | 0.49 (0.19, 1.26) | 0.59 (0.27, 1.27) | 0.46 (0.24, 0.87) | 0.42 (0.21, 0.85) |
| Model 2 | HR | 1.00 | 0.49 (0.19, 1.26) | 0.59 (0.27, 1.30) | 0.51 (0.26, 0.99) | 0.47 (0.23, 0.96) |
| Employed | Person years | 36761 | 14133 | 14257 | 43649 | 108801 |
| | No. of cases | 59 | 16 | 12 | 30 | 117 |
| Model 1 | HR | 1.00 | 0.81 (0.46, 1.42) | 0.56 (0.30, 1.04) | 0.54 (0.34, 0.86) | 0.49 (0.30, 0.80) |
| Model 2 | HR | 1.00 | 0.84 (0.48, 1.49) | 0.58 (0.31, 1.09) | 0.61 (0.38, 0.98) | 0.55 (0.33, 0.92) |

Model 1: age- and area-adjusted.
Model 2: Model 1 + conventional cardiovascular risk factors (smoking status, alcohol use, perceived psychological stress, physical activity, Body Mass Index, history of hypercholesterolemia, hypertension, diabetes, and menopause).
[a]RII = Relative Index of Inequality; [b]Unemployed = economically inactive women.
HR = Hazard Ratio; JHS = junior high school; HS = high school.

observed in employed women, ie, stroke risk decreased among employed women as their partner's educational level increased. The age- and area-adjusted RII was significant (RII = 0.36; 95% CI: 0.16, 0.78).

Using the combined approach, married women's stroke risk was lower in all groups, as compared with the lowest educational group (Table 4). The age- and area-adjusted HRs for stroke risk were 0.71 (95% CI: 0.44, 1.14) for Group II, 0.58 (0.36, 0.95) for Group III, and 0.52 (0.36, 0.76) for Group IV (both with more than compulsory education) as compared with Group I (both with compulsory education only). Adjusting for conventional cardiovascular risk factors slightly attenuated the HRs for those educational groups, but the pattern of association was unchanged, and the effects observed in Groups III and IV remained significant. The age- and area-adjusted RII obtained using this approach was similar to that obtained using the conventional approach and was statistically significant (RII = 0.48, 95% CI: 0.32, 0.72).

Stratification by married women's employment status yielded information on the effect of their employment on the relationship between combined educational levels and their stroke risk. Among highly educated women whose partner was only educated to compulsory level (Group II), stroke risk was reduced by 50% if they were unemployed, but by only 19% if they were employed. When highly educated women were partnered with a man from the same educational background (Group IV), stroke risk was lower in unemployed women (HR = 0.46, 95% CI: 0.24, 0.87) than in employed women (0.54, 0.34, 0.86). The effect of women's employment status on their stroke risk was marginal if they were only educated to compulsory level and were partnered with a highly educated man.

## DISCUSSION

Analysis using educational levels derived from the individual, conventional, and combined approaches gave different views of the association between educational level and stroke risk among married women in Japan. Education level, as ascertained by using the women's own educational levels (individual approach) or their partner's educational levels (conventional approach), was nonlinearly associated with stroke risk in married women, while educational level derived by combining the educational levels of women and their partners (combined approach) identified a significantly lower stroke risk among women in all educational groups as compared with the lowest educational group. The RII obtained via the combined approach was greater than that based on individual educational level and was significantly greater than that based on conventional educational level. These results demonstrate the usefulness of educational level as a measure of social position, when educational level is assessed with the combined approach.

Studies in Europe[6,15,16] and the United States[8,28] showed that social gradients in women's health were likely to be underestimated when women's social position was based on their own standing. Our findings confirmed that the social gradient in married women's stroke risk was smallest when using the individual approach. The nonlinear, U-shaped association between educational level and stroke risk identified in our study was similar to that found in our previous study[19] and suggests that socioeconomic indicators for women such as educational level, occupational position, and earned income may not reflect their place in hierarchal society, thus minimizing the apparent effect of social gradients on the health of women.

The age- and area-adjusted RII was significant for the conventional and combined approaches; however, the combined approach produced a linear social gradient in stroke risk, while the conventional approach did not. Although Krieger et al[8] gave the combined approach little credit because of the consequent reduction in statistical power, the results of the current study strongly suggest the need for careful examination of each combined group before consolidation.

Stratification according to married women's employment status added another dimension to the association between educational level and stroke risk. Analysis using the individual and conventional approaches yielded a U-shaped relationship in unemployed women, while the conventional and combined approaches showed a linear relationship for employed women. This suggests that socioeconomic conditions in each household are likely to be influenced by the partner's educational level, over and above the women's own level. The identification of an effect of social gradient on stroke risk using the combined approach, regardless of employment status, confirms the effectiveness of this approach in reflecting the psychosocial context of stroke risk among married women.

We adjusted for conventional cardiovascular risk factors to determine if those factors could explain the identified social gradient in stroke risk. However, adjustment for cardiovascular risk factors did not materially attenuate the association between social position and risk of stroke, which suggests that these risk factors could not explain the social gradient. Further studies are needed to explore the mechanisms underlying the social gradient in stroke risk.

There were some limitations to the current study. Our findings may be limited to married women living in medium and small cities in Japan. Some variables were measured only once at baseline, and we relied on self-report, which possibly led to misclassification. The findings may also be limited by the criteria we used to establish marital status and identify total stroke cases. To minimize the risk of misclassification, we excluded women who were no longer married 10 years after the baseline survey. In addition, information on the educational levels of partners was obtained from valid responses by the corresponding male partner. The study protocol might have reduced the numbers in the study population, though any potential bias in the results is likely to be small.

In summary, a combined measure of educational level, especially when stratified by women's employment status, could provide a detailed profile of the association between social gradient and stroke risk among married women in Japan. Individual or conventional measures of social position are likely to underestimate the magnitude of social gradients in women's health, thus hampering the development and implementation of relevant policies specific to women.

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