

- 肪蓄積ならびに脂質・糖代謝に及ぼす監視型運動療法の効果. 第 38 回日本動脈硬化学会総・学術集会、東京、2006 年 7 月
- 12) 神崎恒一, 孫輔卿, 飯島勝矢, 江頭正人, 前村浩二, 中野亨, 小島太郎, 大田秀隆, 秋下雅弘, 大内尉義. 血管老化の分子機構 血管石灰化の分子機構. 第 38 回日本動脈硬化学会総・学術集会、東京、2006 年 7 月
- 13) 大内尉義. 加齢と動脈硬化. 第 38 回日本動脈硬化学会総・学術集会、東京、2006 年 7 月
- 14) 秋下雅弘, 橋本正良, 大池裕美子, 飯島勝矢, 江頭正人, 大内尉義. テストステロン濃度の低下は男性の内皮機能障害に関連する. 第 38 回日本動脈硬化学会総・学術集会、東京、2006 年 7 月
- 15) 飯島勝矢, 伊藤友紀, 孫輔卿, 江頭正人, 大池由美子, 小島太郎, 大田秀隆, 野村和至, 秋下雅弘, 大内尉義. プラバスタチンの腎不全ラットモデルにおける大動脈石灰化抑制作用. 第 38 回日本動脈硬化学会総・学術集会、東京、2006 年 7 月
- 16) 野村和至, 秋下雅弘, 中村哲郎, 小島太郎, 飯島勝矢, 荒木厚, 江頭正人, 大内尉義. 高齢者における内臓脂肪面積と他の身体測定値の関連. 第 38 回日本動脈硬化学会総・学術集会、東京、2006 年 7 月
- 17) 野村和至, 秋下雅弘, 中村哲郎, 小島太郎, 飯島勝矢, 荒木厚, 江頭正人, 大内尉義. 高齢者における内臓脂肪面積と危険因子の重複に関する横断研究. 第 38 回日本動脈硬化学会総・学術集会、東京、2006 年 7 月
- 18) 大池裕美子, 秋下雅弘, 橋本正良, 大賀栄次郎, 小島太郎, 飯島勝矢, 江頭正人, 大内尉義. 睡眠時無呼吸症候群の合併はメタボリックシンドローム患者の血管内皮機能を増悪させる. 第 38 回日本動脈硬化学会総・学術集会、東京、2006 年 7 月
- 19) 野村和至, 秋下雅弘, 中村哲郎, 小島太郎, 飯島勝矢, 荒木厚, 江頭正人, 大内尉義. 高齢者における内臓脂肪面積と危険因子の重複に関する横断研究. 第 48 回日本老年医学会総会. 金沢, 2006.6.9-11.
- 20) 江頭正人, 秋下雅弘, 浜達哉, 山田思鶴, 鳥羽研二, 大内尉義. 高齢者における監視型運動療法の内臓脂肪蓄積に及ぼす効果. 第 48 回日本老年医学会総会. 金沢, 2006.6.9-11.
- 21) 橋本寛子, 野村和至, 大池裕美子, 小島太郎, 飯島勝矢, 江頭正人, 秋下雅弘, 大内尉義. 腹部大動脈石灰化は脈圧の上昇と関連する. 第 48 回日本老年医学会総会. 金沢, 2006.6.9-11.
- 22) 山田思鶴, 秋下雅弘, 神崎恒一, 大内尉義, 鳥羽研二. 高齢女性に対する DHEA 補充療法の認知機能改善効果-第 1 報. 第 48 回日本老年医学会総会. 金沢, 2006.6.9-11.塩

- 之入温, 井上聡, 大内尉義. 高齢骨粗鬆症女性患者における転倒者と非転倒者の重心動揺計による評価. 第48回日本老年医学会総会. 金沢, 2006.6.9-11.
- 23) 小島太郎, 大橋靖雄, 桑島巖, 島田和幸, 宗像正徳, 山科章, 大内尉義. 高齢者高血圧治療の実態調査(J-CHEARS研究). 第48回日本老年医学会総会. 金沢, 2006.6.9-11.
- 山口泰弘, 寺本信嗣, 長瀬隆英, 栗原裕基, 大内尉義.  $\beta$ -ディフェンシン過剰発現により惹起される筋線維変性と骨量低下. 第48回日本老年医学会総会. 金沢, 2006.6.9-11.
- 24) 山口潔, 梅田祐美, 山田思鶴, 浜達哉, 秋下雅弘, 鳥羽研二, 大内尉義. 地域在宅高齢者における生活習慣と認知機能, うつとの関係. 第48回日本老年医学会総会. 金沢, 2006.6.9-11.
- 25) 山田思鶴, 園原和樹, 西谷弘美, 神崎恒一, 秋下雅弘, 大内尉義, 鳥羽研二. 軽度認知機能障害を有する高齢女性に対するDHEA補充療法の効果. 第48回日本老年医学会総会. 金沢, 2006.6.9-11.
- 26) 浦野友彦, 白木正孝, 細井孝之, 中村利孝, 大内尉義, 井上聡. Wnt/ $\beta$ -catenin シグナル伝達因子における遺伝子多型が変型性脊椎症に与える影響. 第48回日本老年医学会総会. 金沢, 2006.6.9-11.
- 27) 林秀生, 樋口元, 山田思鶴, 神崎恒一, 秋下雅弘, 大内尉義, 鳥羽研二. 地域在住高齢者の生活習慣病指標に対する転倒予防運動教室の効果. 第48回日本老年医学会総会. 金沢, 2006.6.9-11.
- 28) 大池裕美子, 秋下雅弘, 山本寛, 小島太郎, 飯島勝矢, 江頭正人, 大内尉義. 高齢者における胸痛の頻度と原因疾患の性差. 第48回日本老年医学会総会. 金沢, 2006.6.9-11.
- 29) 東浩太郎, 浦野友彦, 大内尉義, 井上聡. 肝細胞癌におけるステロイドX受容体の機能解析. 第65回日本癌学会学術総会, 2006.9.28-30, 横浜
- 30) 堀江公仁子, 高山賢一, 坊農秀雅, 大内尉義, 岡崎康司, 井上聡. ヒトゲノム応答配列に基づいた新規ステロイドホルモン応答遺伝子の同定. 第79回日本内分泌学会学術総会, 2006.5.19-21, 神戸
- 31) 松川倫子(東京大学 老年病科), 大池裕美子, 多田祐子, 山口泰弘, 渡辺卓郎, 江頭正人, 大内尉義. トロンボポエチンが診断に有用であった免疫性血小板減少性紫斑病の1例. 第533回日本内科学会関東地方会. 2006.2.18, 東京
- 32)
- H. 知的財産権の出願・登録状況  
なし

脂肪細胞由来アディポネクチンのHDLを介した動脈硬化防御機構における役割に関する研究

分担研究者 山下静也（大阪大学大学院 医学系研究科 内科学講座 循環器内科）

#### 研究要旨

近年の我が国における食生活の欧米化により肥満患者が増加し、虚血性心疾患など動脈硬化を基盤とする血管病の急激な増加が社会的にも深刻な問題となっている。冠動脈疾患患者において血清高比重リポ蛋白(HDL)コレステロール値が低値を示すことから、HDLは抗動脈硬化作用を有する重要なリポ蛋白であると考えられている。これまでに、(1)冠動脈疾患患者において、脂肪細胞から分泌されるアディポネクチン(adiponectin: APN)の血中濃度は低く、(2)血清HDLコレステロール値とAPN値は正の相関関係があることが報告されてきたが、そのメカニズムについては明らかではない。本研究では、APNの肝臓でのHDL新生への影響について検討した。APNは肝細胞からのHDLの主要アポリポ蛋白であるapoA-I分泌を促進し、HDL新生に密接に関与するATP-binding cassette transporters (ABCA1)の発現を増加させた。これらの結果から、APNは肝臓でのHDL新生を促進させ、抗動脈硬化的に働くものと考えられた。

#### A. 研究目的

近年の我が国における食生活の欧米化による過食と車社会による運動不足により、糖尿病、高血圧、高脂血症などを伴った肥満患者が増加し、虚血性心疾患など動脈硬化を基盤とする重篤な血管病の急激な増加が社会的にも深刻な問題となっている。冠動脈疾患患者において血清高比重リポ蛋白(HDL)コレステロール値が低値を示すことから、HDLは抗動脈硬化作用を有する重要なリポ蛋白であると考えられている。動脈硬化防御機構として、肝臓で新生されたHDLが動脈硬化巣に集簇する泡沫化マクロファージからコレステロールを引き抜き、最終的に肝臓へと輸送する、いわゆるコレステロール逆転送系が生体内には存在する。しかしながら、HDLコレステロールのみを上昇させる特異的な薬剤は未だ開発されておらず、循環器、代謝研究分野において最大の命題である。

最近、動脈硬化防御機構に関わる重要な分子として、脂肪細胞から分泌されるアディポネクチン(adiponectin: APN)が注目されている。着目すべき臨床データとして(1)虚血性心疾患を有する患者血清のAPN値は低値を示すこと、

(2)血清APN値とHDLコレステロール値の間には正の相関関係があることが挙げられる。血中HDLコレステロール値の上昇のメカニズムとしては、肝臓からのHDLにおける主要アポリポ蛋白であるapoA-I分泌の増加やそれに伴ったHDL新生促進が想定されている。そこで本研究は、APNの肝臓でのHDL新生促進作用について検討し、APNの動脈防御機構における役割について解明することを目的とする。

#### B. 研究方法

- 1) ヒト肝細胞としてHepG2細胞を用い、レコンビナントAPNを培養液中に添加することによるHepG2細胞からのapoA-I分泌、およびapoB-100分泌への影響について検討した。
- 2) 肝臓でのHDL新生反応に関与するATP-binding cassette transporters (ABCA1, ABCG1)とscavenger receptor (SR-BI)の発現量への影響について検討した。

### C. 研究結果

1) APNを培養液中に添加することにより、HepG2細胞からのapoA-I分泌は濃度依存性に増加した。一方、apoB-100分泌は減少した。

2) APNはHepG2細胞におけるapoA-I mRNA量を増加させた。

3) APNはHepG2細胞におけるABCA1発現(mRNA量、蛋白量)を濃度依存性に増加させた。しかしながら、ABCG1およびSR-BIの発現量に変化はなかった。

### D. 考察

これまでの数々の研究報告により、APNは

(1) 様々な炎症性サイトカインの分泌抑制、  
(2) マクロファージにおける変性リポ蛋白の取り込み抑制、(3) インスリン抵抗性改善効果などもたらすことにより抗動脈硬化的に働くものとされてきた。しかしながら、本研究結果により、APNは上記の作用以外にも、肝臓でのapoA-I分泌増加、それに伴ったABCA1を介したHDL新生促進により、コレステロール逆転送系を賦活化させることによる抗動脈硬化作用を持つものと考えられた。

### E. 結論

APNは、肝臓でのapoA-I分泌(HDL新生)を増加させ、抗動脈硬化的に働くものと考えられた。

### F. 健康危険情報

特になし。

### G. 研究発表

特になし。

### H. 知的財産権の出願、登録状況

特になし。

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	発表名誌	巻号	ページ	出版年
Matsuyama A, Sakai N, Hiraoka H, Hirano K, Yamashita S.	Cell surface-expressed moesin-like HDL/apoA-I binding protein promotes cholesterol efflux from human macrophages.	J Lipid Res	47	78-86	2006
Yamashita S, Hirano KI, Kuwasako T, Janabi M, Toyama Y, Ishigami M, Sakai N	Physiological and pathological roles of a multi-ligand receptor CD36 in atherogenesis; insights from CD36-deficient patients	Mol Cell Biochem	-	1-4	2006

ホーチミン市における食物摂取頻度調査票の再現性および妥当性に関する研究

**Reproducibility and Validity of a Food Frequency Questionnaire  
among Vietnamese in Ho Chi Minh City**

分担研究者 山本 茂 (お茶の水女子大学大学院国際栄養学)

要旨) ベトナム、ホーチミン市在住の成人を対象として食物摂取頻度調査票 (FFQ) の再現性および妥当性の検討を行った。116 項目からなる FFQ は、2001 年に行われた 24 時間思い出し法による食事調査 (24HRs) の結果から開発を行った。再現性は、スピアマン相関係数で 0.47 から 0.72 の範囲であった。妥当性は、FFQ と 24HRs の平均値と比較を行った。相関係数はカルシウム 0.16 からフェノール 0.45 であった。本 FFQ は、ベトナム、ホーチミン市の都市部に住む成人において主な栄養素等の習慣的摂取量の測定に関して信頼度が高いことが示唆された。

A. (背景および目的) ベトナム経済は過去10年間で急速に発展し、その結果として生活様式が変わり、健康問題は多様化してきている。現在のベトナムにおける栄養問題は、栄養不足だけではなく生活習慣病についても大きな問題となりつつある。ホーチミン市の糖尿病患者は、1993年に2.5%だったものが、2001年で4.9%と大きく増加している状況である。住民の健康問題とその関連要因を明らかにするためには、栄養調査は不可欠のものである。栄養調査の方法として食物摂取頻度調査法は、対象者の習慣的摂取量の評価をするもので、一度質問票や計算プログラム等が作成されれば、データ処理が容易であるため、調査に必要な労力、費用が小さく、他法(秤量法など)と比較すると対象者の負担も小さいという特徴がある。しかしベトナムにおいて信頼性のある食物摂取頻度調査法の検討は今までなされていなかった。そこで簡便かつ信頼性(再現性および妥当性)のある食物摂取頻度調査票(以下FFQ)を作成するために本研究を実施した。

B. (方法) FFQの開発は、2001年に我々が実施した144名(男性27名、女性117名、年齢範囲45-68歳)を対象とした24時間思い出し法による食事調査の結果から、エネルギーおよび12栄養素摂取量の寄与率をもとめて行った。FFQの妥当性は、2002年に行われた118名(男性56名、女性62名、年齢範囲23-62歳)を対象とした連続しない3回(平日2日、休日1日)の24時間思い出し法による食事調査の結果と比較して検討した。再現性の検討は、FFQを2回繰り返し実施し、その2回の結果を比較し検討した。全ての統計処理はSPSS ver. 9.0を用いた。

(倫理面での配慮)

本研究は、ベトナム政府の倫理委員会の承認を得て実施した。

C & D (結果と考察) 2001年に行われた24時間思い出し法による食事調査の結果(延べ351日分)から414食品および料理がリストアップされ、名称が異なるが同一または栄養素組成が似たものをまとめ196食品

および料理を選択した。最終的にエネルギーおよび 12 栄養素摂取量の寄与率 90% をカバーする 116 食品および料理リストを作成した。FFQ の再現性の検討として、2 回の FFQ のエネルギーおよび栄養素摂取量の差異は 0% (脂質、炭水化物、食物繊維、カウム) ~4% (レチノール) と再現性の高い結果であった。スピアマン相関係数 (エネルギー調整後) は、0.47 (炭水化物) ~0.72 (食物繊維) の範囲であった。重みつきカッパ統計量は、0.42 (脂質) ~0.65 (カウム) であった。妥当性研究においては、FFQ と 24 時間思い出し法による食事調査の結果の平均値と比較を行った。そのスピアマン相関係数 (エネルギー調整後) は 0.16 (カルシウム) ~0.45 (レチノール) であった。重みつきカッパ統計量は、0.13 (カフェイン) ~0.44 (炭水化物) であった。FFQ および 24 時間思い出し法による食事調査の結果において、各栄養素摂取量の結果を 3 分位に分類し比較を行うと、同じ分位に一致する割合は 42% (カフェイン) ~62% (炭水化物) であり、まったく不一致 (3 分位で 1 と 3 に分類) する割合は 1% (炭水化物) ~12% (カルシウム) であった。

E. (結論) 本研究において新規に開発された FFQ は、再現性および妥当性研究の結果からベトナム・ホーチミン市の都市部に住む成人 (もしくは同じような食事パターンを持つ人) において主な栄養素等の習慣的摂取量の評価をするものとして適したものであることが示唆された。

F. (健康危険情報) 主任研究者記載

G. (研究発表)

1. Kusama K, Duc Son LENT, Hanh TTM, Takahashi K, Hung NTK, Yoshiike N and Yamamoto S. Reproducibility and validity of a quantitative food frequency questionnaire among Vietnamese in Ho Chi Minh City. *J Am Coll Nutr*: 24: 466-473, 2005
2. Nhung BT, Khan NC, Hop LT, Lam NT, Khanh NL, Lien DT, Nakamori M, Hien VT, Kassu A, Yamamoto S. Resting Metabolic Rate of Older Vietnamese *Ann Nutr Metab* 2007;51:7-13
3. Pei-Ying Lin, Bui Thi Nhung, Nguyen Cong Khan, Nobuko Sarukura, Daisuke Kuni, Tohru Sakai, A few Kassu and Shigeru Yamamoto, Effect of Vietnamese Common Diet on Postprandial Blood Glucose Level in Adult Females JNSV (in press)
4. Saito K, Sone H, Kawai K, Tanaka S, Kodama S, Miao S, Suzuki E, Kondo K, Yamamoto S, Shimano H, Ohashi Y, Yamada N. Risk imparted by various parameters of smoking in Japanese men with type 2 diabetes on their development of microalbuminuria: Analysis from the Tsukuba Kawai Diabetes Registry. *Diabetes Care*. 2007 Mar 2; [Epub ahead of print] No abstract available.
5. Nhung BT, Khan NC, Hop LT, Lam NT, Khanh NL, Lien DT, Nakamori M, Hien VT, Kassu A, Yamamoto S. Resting metabolic rate of Vietnamese adolescents. *Eur J Clin Nutr*. 2007 Jan 31

## **Reproducibility and validity of a food frequency questionnaire**

### **among Vietnamese in Ho Chi Minh City**

Kaoru Kusama, MSc\*, Le Nguyen Trung Duc Son, MD, PhD\*, Tran Thi Minh Hanh, MD, PhD\*\*, Keiko Takahashi, MSc\*\*\*, Nguyen Thi Kim Hung, MD\*\*, Nobuo Yoshiike, MD\*\*\*\*, and Shigeru Yamamoto, PhD\*

\*Department of Nutrition, School of Medicine, The University of Tokushima, Japan

\*\*Nutrition Center of Ho Chi Minh City, Vietnam

\*\*\*Faculty of Human Life Science, Shikoku University, Japan

\*\*\*\*Division of Health and Nutrition Monitoring, National Institute of Health and Nutrition, Japan

Address correspondence and reprint author requests to:

Professor Shigeru Yamamoto, PhD

Applied Nutrition Laboratory, Department of Nutrition, School of Medicine,  
The University of Tokushima

3 Kuramoto, Tokushima City 770-8503, Japan.

Tel: +81-88-633-7096

Fax: +81-88-633-9427

e-mail: syamamoto@nutr.med.tokushima-u.ac.jp

Running title: Food frequency questionnaire among Vietnamese

Key words: Vietnamese, food frequency questionnaire, FFQ, reproducibility, validity



## Abstract

**Objective:** Our objective was to assess the reproducibility and validity of a food frequency questionnaire (FFQ) among individuals living in Ho Chi Minh City, Vietnam.

**Methods:** A total of 116 food items in our FFQ were selected by ranking food items according to contribution to population intake of nutrients based on multiple 24-hour recalls (24HRs) from 144 participants in July 2001. The FFQ was validated by using three 24HRs among 118 men and women in August 2002. The reproducibility of the FFQ was assessed by repeated administration at 7±3.4 days.

**Results:** In our reproducibility study, Spearman correlation coefficients, adjusted for energy intake, ranged from 0.47 to 0.72, and weighted kappa ranged from 0.42 for lipid to 0.65 for potassium. In the validation study, correlation coefficients, adjusted for energy intake, between the FFQ and the 24HRs ranged from 0.16 (calcium) to 0.45 (retinol). The proportion of subjects classified by the FFQ into the same third determined by the 24HRs was between 42% and 62%.

**Conclusions:** This study suggests that the FFQ can to some degree measure usual intake of major nutrients among Vietnamese adults living in Ho Chi Minh City and its urban area, where dietary patterns are thought to be similar to those of our subjects.

## INTRODUCTION

In general, the major public health problems in developing countries were seen with an infectious diseases and undernutrition in the past. The epidemic of chronic disease has been considered to be a problem limited to an advanced industrialized countries. In recent years, socioeconomic conditions have dramatically changed in developing countries, and consequently lifestyles and dietary habits are also rapidly changing. Thus nutrition related non-communicable diseases have become a problem of emergency in developing countries. It is not surprising that food insecurity and undernutrition persist in the same developing countries where chronic diseases are emerging as a major epidemic (1, 2).

In Vietnam during the last decade, chronic health disorders such as obesity, diabetes and hyperlipidemia have increased (3, 4). In 2001 a screening survey was conducted in Ho Chi Minh City on 2,932 participants aged 15 years and over; the prevalence of diabetes in urban areas was 6.9%, approximately 2.8 times higher than that observed in 1993 (5). A cross-sectional survey was conducted in Ho Chi Minh City on 300 Vietnamese aged 40 to 59 years in 1999; the prevalence of overweight subjects (BMI  $\geq$  25) in urban, suburban and rural areas was 17.8%, 13.0% and 6.1%, respectively (6).

Community-based nutrition surveys are desirable to study health problems and their nutritional correlates. Unfortunately, there have been few studies examining the dietary intake of the Vietnamese population. A major reason for this has been the lack of appropriate tools to assess dietary intake of local foods, especially the intake of an individual over a period of weeks or months. Methods of assessment used in published studies include multiple 24-hour dietary recalls (24HRs), multiple dietary records, dietary history, and food frequency questionnaires (FFQ). The FFQ is a simple tool which ranks individuals according to their intake of selected nutrients, and is now a standard tool in nutritional epidemiology. The FFQ was developed and validated mainly in Western countries and in other parts of Asia (China, Japan, Korea and Singapore) (7-12).

We developed a FFQ for use in an epidemiological study of the relationship between diet and chronic disease in Ho Chi Minh City, Vietnam. This newly-developed

FFQ was validated against multiple 24HRs (dietary reference method). In this study, we describe the process of developing our FFQ and its reproducibility and validity.

## MATERIALS AND METHODS

### Subjects

Employees of a food company (Nutri Food) in Ho Chi Minh City were contacted and asked to participate in the study. They were factory workers, salespersons, cleaners and sedentary office workers, who were at middle level of socio-economic status in urban area. The study population consisted of 120 subjects aged 23 to 62 years, with 63 women and 57 men. After eliminating incomplete records, 118 subjects remained (62 women and 56 men). Mean age  $\pm$  standard deviation (SD) was 38.6  $\pm$ 10.2 years for women and 34.8  $\pm$ 8.6 years for men. The mean  $\pm$  SD of body mass index ( $\text{kg}/\text{m}^2$ ) was 21.3  $\pm$ 2.3 for women and 21.9  $\pm$ 2.5 for men.

### Food Frequency Questionnaire (FFQ)

#### Selection of food items on the questionnaire

Foods items in our questionnaire were selected by a data-based approach, using three 24HRs obtained from the diabetes case-control study conducted in July (rainy season) 2001 in Ho Chi Minh City, Vietnam (the report of this study is now under preparation for publication). From this study, dietary data from 48 newly-diagnosed type 2 diabetes patients, and 96 subjects with normal glucose metabolism (a total of 117 women and 27 men) were used for analysis. Dietary intakes were assessed using 24HRs in three inconsecutive weekdays. We used 24HRs for amounted to 351 days from 144 subjects as data for developing the FFQ (13).

A total of 414 foods and dishes were counted from the 24HRs. After grouping foods and dishes (= 'food items') with different names but similar content, 196 food items remained. All food items were first ranked according to Block's method (14), that is, on the basis of the percentage of nutrients which each food item contributed to the total nutrient intake, until 90% of the intake for each nutrient by the total population was accounted for. The number of food items required to cover 90% of the total population intake for each nutrient were as follows: 57 for energy, 47 for protein, 51 for fat, 53 for carbohydrate, 43 for fiber, 26 for retinol, 18 for carotene, 41 for vitamin B<sub>1</sub>, 36 for vitamin B<sub>2</sub>, 28 for vitamin C, 38 for calcium, 54 for iron, and 43 for potassium. We finally selected 116 food items which between them provided 90% of the total intake of energy and the above nutrients.

#### Structure of the questionnaire

The Vietnamese usually have three daily meals: breakfast, lunch and dinner. For breakfast, people usually eat sandwiches, rice noodles, steamed sticky rice, or rice porridge. For lunch and dinner, they usually take several dishes which are shared with their families. These meals typically consist of three or more different components: steamed plain rice, salty dishes (mainly meat, fish, egg or soybean curd), and soup (mainly with vegetables). In general, these dishes are simply cooked with only one or two raw materials such as meat, fish, egg, soybean curd or vegetable.

The FFQ consists of two parts. The first part consists of questions about breakfast and raw materials for dishes taken at lunch and dinner, and included food items, portion sizes and frequencies of eating. The second part of the questionnaire asked about the use of seasoning for cooking and at the dining table. Standardized amounts of five seasonings (cooking oil, salt, sugar, fish sauce, and soybean sauce) were determined according to selected cooking methods for dishes (see appendix, part 2.). The standardization seasoning ratios according to cooking methods were calculated from the means which 3 home-makers cooked to use weighting scale for 84 dishes, and referred to 25 published cooking books. The average amounts of three seasonings (fish sauce,

salt and soybean sauce) used at the dining table were estimated by direct observation of seven volunteers. We measured the seasonings which they used with a meal three times. Seasonings are very small quantities, put in each small dish and measured use before and after, and calculated it.

#### Frequency and portion sizes of food items

The questions used a 1-10 scale for reporting frequency of consumption; never, less than once per month, 2-3 times per month, 1-2 times per week, 3-4 times per week, 5-6 times per week, once per day, 2-3 times per day, 4-5 times per day, and more than 6 times per day.

In the FFQ, portions were categorized into three sizes; small (about half of the median size), median, and large (1.5 times the median size). The median portion sizes were calculated mainly from the three 24HRs, and partly referred to the composition of commonly prepared foods (15). We also developed a color book with full-sized photographs of all food items which was used during the FFQ interview to improve the accuracy of estimation of portion sizes (15).

#### Calculation of nutrient intake

Nutrient intake for each food item was calculated using the formula for the first part:

[portion size in grams] \* [reported consumption frequency (converted to times per day)] \* [nutrient per gram].

Nutrient intake for each food item was then added up to obtain the total intake per day for each subject.

The formula for the second part was added to the first part:

[standardized amounts of seasoning for cooking] \* [reported consumption frequency (times per day)] and/or [standardized amounts of seasoning at the dining table] \* [reported consumption frequency (times per day)].

#### Validation study

The study was started in August 2002, when the first FFQ (FFQ1) was distributed to subjects. Subjects were asked to complete the FFQ at the beginning and at the end of study period, and then conducted at a mean interval of 7±3.4 days. After the final 24HR the subjects were asked to complete the second FFQ (FFQ2). The FFQs were administered by interviewers. The interviewers were seven medical doctors who were specifically trained for this study. For each of the food items listed in the questionnaire, the participants were asked about the average consumption frequency and portion size taken during the previous three months.

#### 24-hour dietary recalls (24HRs)

We conducted three 24HRs during the period between the first and the second FFQ, covering two weekdays and one weekend day, and three days were independent (non-consecutive). The mean values of nutrient intake from three 24HRs were used as the reference values to compare the results from the FFQ.

The 24HRs were administered by the same interviewers who administered the FFQ. They recorded all foods and beverages consumed by subjects. For measures of quantity they used common utensils, such as rice bowls, noodle bowls, glasses and spoons. They also used a food scale picture book developed by the University of Texas - Houston School of Public Health (16). They used this book particularly for estimating food portions in shared dishes.

Nutrient intakes were computed from the records using the dietary assessment system, Vietnam EIYOKUN (17). The nutrient database was based on a Vietnamese food composition table (18), supplemented by food composition tables from Thailand,

ASEAN, Japan and United States (19-22).

### Statistical Analysis

Responses to the FFQ1 and the FFQ2 were compared to assess reproducibility, and the questionnaire was validated by referring to the intake data from three 24HRs as the standard reference. Reproducibility and validity of the FFQ were assessed by comparing the median nutrient, and calculating correlations between these intakes derived from the FFQ1 with the FFQ2 and the FFQ1 with average of the 24HRs. The t-test was performed to test if the daily nutrient intakes were statistically significantly different between the methods.

Agreement between methods was assessed using correlation coefficients and cross-classification. Before calculating the Pearson correlation coefficient, the distribution of each nutrient intake was checked for normality. The nutrient intakes with a positively skewed distribution were log-transformed. Energy-adjusted nutrient intakes were calculated as the residuals from the regression of nutrient intake as the dependent variable on energy as the independent variable (7, 23). Spearman rank correlation coefficient was also calculated for energy-adjusted nutrient intakes.

The ability of the FFQ to categorise subjects into equal thirds of energy-adjusted nutrient intake was assessed by calculating the percentages of subjects categorised into the same third and the extreme opposite third of intake by the FFQ1 and average of the 24HRs. The weighted kappa statistic (Kw) was calculated for each nutrient from the observed and expected proportions on the 3×3 table of frequencies.

All analyses were carried out with the Statistical Package for the Social Sciences (SPSS) version 9.0 (SPSS, Inc., Chicago, IL, USA).

## RESULTS

Table 1 presents the median nutrient intake derived from the FFQ1, FFQ2 and average of the 24HRs as well as percentage of differences in these assessments, which did not include intake from dietary supplements. The median nutrient intakes assessed by the FFQ1 and FFQ2 agree considerably well, with the differences in median intakes between the two assessments ranged from 0% for lipid, carbohydrate, fiber, vitamin B2 and potassium. There is also a good agreement for macronutrients between nutrient intakes assessed by the FFQ1 and by average of the 24HRs. Differences in median intake were ranged from 2% for carbohydrate to 9% for protein. However, Differences in median intake for micronutrients were grossly overestimated, ranged from 17% for vitamin B1 to 55% for caroten. Compared to the 24HRs, FFQ tends to overestimate intake of all nutrients.

Table 2 shows Pearson and Spearman correlation coefficients, percentages of subjects classified into the same and opposite thirds of intake, and weighted kappa (Kw) from the FFQ1 and FFQ2. We computed Pearson and Spearman correlation coefficients for unadjusted and energy-adjusted daily nutrients between intakes assessed by the two questionnaires. The Spearman correlation coefficients to indicate validity of the unadjusted nutrients from the two methods ranged from 0.47 for carbohydrate to 0.72 for fiber. Pearson correlation tended to be higher than Spearman correlation coefficients. The cross-classification for nutrient intake using thirds by the two methods, which were estimated from FFQ1 and the FFQ2. The percentage of subjects classified into the same third ranged from 62% for carbohydrate to 77% for potassium. The number of subjects classified into opposite third ranged from 0% for carotene, vitamin B<sub>2</sub>, vitamin C and calcium to 4% for retinol. Weighted kappa ranged from 0.42 for lipid to 0.65 or potassium.

Table 3 shows the Pearson and Spearman correlation coefficients, percentages of subjects classified into the same and opposite thirds of intake, and weighted kappa (Kw) from the FFQ 1 and average of the 24HRs. We computed Pearson and Spearman

correlation coefficients for unadjusted and energy-adjusted daily nutrients between intakes assessed by the two methods. The Spearman correlation coefficients to indicate validity of the unadjusted nutrients from the two methods ranged from 0.16 for calcium to 0.45 for retinol. The cross-classification for nutrient intake using thirds by the two methods, which were estimated from FFQ1 and average of 24HRs. The percentage of subjects classified into the same third ranged from 42% for lipid to 62% for carbohydrate. The number of subjects classified into opposite third ranged from 1% for carotene to 12% for calcium. Weighted kappa ranged from 0.13 for lipid to 0.44 for potassium.

## DISCUSSION

### Developing FFQ

To develop the food list for our FFQ, we used Black's method (14) to select the food items. The foods and dishes, which were selected on the basis of their percent contribution to the population intake of energy and nutrients, could be decreased from 196 to 116 food items. The food list for the FFQ in this study was finally reduced to 116 items; this is comparable with other studies (7-12) with a range of 97-159 items. A FFQ with a smaller number of food items is not always better. Clarity and ease of administration may compensate for the length of the questionnaire (24, 25).

Portion sizes in the FFQ were based on data from 24HRs in 2001 and the composition of commonly prepared foods in Ho Chi Minh City (15).

We tried to calculate the intake of selected seasonings used in dishes by asking about cooking methods in the second part of the questionnaire. As for this trial, some improvement was observed regarding validity of the questionnaire. However, a previous study reported that it is difficult to assess quantities of cooking oil and salt added for cooking and at the table, even using the food record method (26).

Our calculations of nutrient intake excluded vitamin and/or mineral supplements, because we were primarily interested in assessing the reproducibility and validity of nutrients from food. However, use of vitamin and/or mineral supplements was reported by 53.2% of women and 46.4% of men, which could not be disregarded in a future study.

### Reproducibility

An important factor influencing reproducibility is the time period between the two questionnaires. If the period between the two measurements is too short, at re-interview the respondent may remember what he or she reported in the first interview. Therefore, the two measurements will not be independent, and reproducibility will be overestimated. However, if this period is too long, the dietary intake of the respondent might change, and reproducibility will be underestimated. In the present study, we only analyzed reproducibility of our FFQ to avoid any change in the diet of our subjects, since the questionnaire asked about the usual intake over a period of three months (7).

In other reproducibility studies, the correlation coefficients have varied from 0.5 to 0.7 for nutrient intakes (7). Our study showed a good reproducibility, with Spearman correlation coefficients ranging from 0.47 to 0.72. A published report with the same time interval between two questionnaires showed a similar correlation coefficient ranged from 0.28-0.78 (9).

### Validity

In our study, energy-adjusted Spearman correlation coefficients between the FFQ 1 and average of the 24HRs ranged from 0.16 to 0.45, more than 50% of subjects were correctly classified into the same third of intake for 5 nutrients and 10% or less were grossly misclassified into the opposite third of intake for 10 nutrients, and weighted kappa values ranged from 0.13-0.44. Masson et al suggest for studies designed

to establish the validity of a dietary assessment tool for a range of future epidemiological studies, Spearman correlation coefficients above 0.5, more than 50% of subjects correctly classified and less than 10% of subjects grossly misclassified into thirds, and weighted kappa values above 0.4 are desirable for nutrients of interest between diet and disease in epidemiological studies (27). Our validation study for the FFQ could not reach the level of Masson's guideline. However, the range of correlation coefficients obtained in the present study was similar to the ranges reported by several research groups (28, 29), but lower than those reported by others (8-12).

The correlation coefficient of 0.16 for calcium was lower in our study than the range of 0.2-0.8 obtained by a number of researchers (7, 9-11, 29). We suspect that this low correlation is a result of the high consumption of fresh water crab in Vietnam, which accounts for 20% of total calcium intake, which is the highest figure among all the foods in average of the 24HRs. This food is mainly used for soup and noodle dishes after crushing the hard shell. The quantity of crab and/or shell used in the soup may have been difficult for participants to quantify, which may help to explain the weak correlation coefficient for calcium we observed.

In our study, nutrient intakes calculated by the FFQ tended to be higher than those calculated by the average of 24HRs, which is consistent with the results of most other studies (9, 10). FFQs in these trials gave an estimate of nutrient intake higher than dietary records. The possible reason is that in the FFQs the subjects may have responded to the some food items more than once when they ate the foods in a mixed dish. Consumption of rice could be overestimated, because it was difficult to standardize the portion size of steamed plain rice. Our FFQ listed three serving sizes for steamed plain rice (small, medium and large serving in a rice bowl). We confirmed the estimates of portion sizes of rice in an experiment. We prepared full-size colour photographs of rice that we had developed for the food items of the FFQ, and several real bowls of rice containing different quantities of rice. Ten volunteers as subjects were shown the photographs and the bowls of rice, and asked to match the bowls with the photographs. It was observed that the subjects of the experiment tended to underestimate the amount of rice in the photographs. As a result of the experiment, we considered a possibility of the subjects of the FFQ study in Vietnam was overestimating their consumption of rice. A clear description of portion sizes, including full-sized pictures, is required to estimate rice consumption more precisely (10).

There are no data about consideration of variation and error in dietary intake in Vietnam. Ogawa et al reported that three days food records with approximately 100 subjects could estimate major nutrients except to retinol and carotene from the result of intra- and inter- individual variance in middle-aged Japanese (30). In this study, although 3 24 HRs may not be a sufficient method as a reference for the FFQ, our study setting at an initial stage allowed only three days' dietary data collection in a Vietnamese community, which would be a potential limitation of this paper.

The newly developed FFQ was designed to assess dietary intake for previous three months, roughly covering one season in a year. Our data collection for initial 24 HRs for the development of FFQ, and the validation study on the FFQ were both conducted in rainy season. The data of seasonal variation in dietary intake in Vietnam are very scanty to discuss the influence of seasonality on the nutrient intake. However, our data collected in rainy season for this study was not different from the nutrient intake in a previous survey conducted in dry season in the same area (6).

As for the validation in nutrient intake by area, the national nutrition survey data suggest that there were differences in nutrient intakes in eight regions throughout the country (31). An availability of the FFQ in other areas, it needs further validation study.

## CONCLUSION

We demonstrated that the newly-developed FFQ was a tool for the assessment of dietary intakes of major nutrients among adult Vietnamese. To our knowledge, this is the first FFQ specifically developed and validated for Vietnamese adults. This study suggests that the FFQ can measure usual intake of major nutrients to some degree among Vietnamese adults living in Ho Chi Minh City and its urban area, where dietary patterns are thought to be similar those of our subjects. The next step in assessing the validity of the FFQ that we developed in this study will be to test whether this instrument can assess diet-disease associations among Vietnamese adults.

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#### REFERENCES

1. Joint WHO/FAO Expert Consultation. Diet, Nutrition, and the prevention of chronic diseases. Technical Report Series 916. WHO, Geneva, 2003.
2. Caballero B, Popkin BM. The nutrition transition. Academic Press, California, USA, 2002
3. Khoi HH, Chuyen NV, Kawakami M, Lien DTK and Ninh NX. Actual Nutrition Problems of Vietnam and Japan. Medical Publisher, Hanoi, Vietnam, 1998.
4. Khan NC and Khoi HH. Current nutrition situation and challenge in Vietnam. National Scientific Symposium on Nutrition, Hanoi, Vietnam, pp41-56, 2002.
5. Son LNTD, Kusama K, Hung NTK, Loan TTH, Chuyen NV, Kunii D, Sakai T and Yamamoto S. Prevalence and risk factors for diabetes in Ho Chi Minh City, Vietnam. *Diabetic Medicine* 21:371-376, 2004.
6. Hanh TTM, Komatsu T, Hung NT, Chuyen VN, Yoshimura Y, Tien PG, Yamamoto S. Nutritional status of middle-aged Vietnamese in Ho Chi Minh City. *J Am Coll Nutr* 20(6):616-622, 2001.
7. Willett W. Nutritional epidemiology. 2nd ed. Oxford University Press, NY, USA, 1998.
8. Shu XO, Yang G, Jin F, Liu D, Kushi L, Wen W, Gao Y-T and Zheng W. Validity and reproducibility of the food frequency questionnaire used in the Shanghai Women's health Study. *Eur J Clin Nutr* 58:17-23, 2004.
9. Date C, Yamaguchi M and Tanaka H. Development of a Food Frequency Questionnaire. *J Epidemiol* 6(3):S131-S136, 1996.
10. Wakai K, Egami I, Kato K, Lin Y, Kawamura T, Tamakoshi A, Aoki R, Kojima M, Nakayama T, Wada M and Ohno Y. A Simple Food Frequency Questionnaire for Japanese Diet-Part 1 Development of the Questionnaire, and Reproducibility and Validity for Food Groups. *J Epidemiol* 9(4):216-226, 1999.
11. Kim J, Kim DH, Anh YO, Tokudome Y, Hamajima N, Inoue M and Tajima K. Reproducibility of a Food Frequency Questionnaire in Koreans. *Asian Pacific J Cancer*

Prev 4:253-257, 2003.

12. Deurenberg-Yap M, Li T, Tan WL, van Staveren WA, and Deurenberg P. Validation of a semiquantitative food frequency questionnaire for estimation of intakes of energy, fats and cholesterol among Singaporeans. *Asia Pacific J Clin Nutr* 9(4):282-288, 2000.

13. Son LNTD, Hanh TTM, Kusama K, Kunii D, Sakai T, Hung NTK and Yamamoto S. Anthropometric characteristics, dietary patterns and risk of Type 2 diabetes in Vietnamese. *J Am Coll Nutr*, (in press).

14. Block G, Dresser CM, Hartman AM, Carroll MD, Gannon J, and Gardner L. A data based approach to diet questionnaire design and testing. *Am J Epidemiol* 124:453-469, 1986.

15. Hung NTK, Loan TTH, Hanh TTM, Phi DTY, Le TT, Nhan TT, Binh PNT, Vu HA. The composition of commonly prepared foods in Ho Chi Minh City. *Nha Xuat Ban Y Hoc, Ho Chi Minh City, Vietnam*, 2001.

16. Thompson FE, Byers T and Khohlmeire L. 4 Examples of dietary assessment tools. In *Dietary Assessment Resource Manual*, *J Nutr* 124 (suppl.):2269S, 1994.

17. Hanh TTM, Yoshimura Y, Takahashi K, Kusama K, Chuyen NV, Hung NTK and Yamamoto S. Nutrition survey software 'Vietnam EIYOKUN'. *Nha Xuat BSN Thanh Publishing, Ho Chi Minh City, Vietnam*, 2004.

18. Ministry of Public Health, National Institute of Nutrition. Nutritive composition table of Vietnamese food. *Medical Publisher, Hanoi, Vietnam*, 2000.

19. Institute of Nutrition, Mahidol University (INMU), THAILAND ASEANFOODS Regional Database Centre of INFOODS. *Thai Food Composition Tables*. Paluk Tai Co.,Ltd, Bangkok, Thailand, 1999.

20. Institute of Nutrition, Mahidol University (INMU), THAILAND ASEANFOODS Regional Database Centre of INFOODS. *ASEAN Food composition Tables*. Paluk Tai Co.,Ltd, Bangkok, Thailand, 2000.

21. Committee on Resources, Science Bureau of Japan. *Standard tables of food composition in Japan*, 4th ed. Printing Office, Ministry of Finance, Tokyo, Japan, 1995.

22. U.S. Department of Agriculture Agricultural Research Service Beltsville Human Nutrition Research Center Nutrient Data Laboratory. *USDA Nutrient Database for Standard Reference*, Release 15. *USDA Nutrient Data Laboratory home page*, <http://www.nal.usda.gov/fnic/foodcomp> 2002

23. Kabagambe EK, Baylin A, Allan DA, Siles X, Spiegelman D, Campos H. Application of the Method of Triads to Evaluate the Performance of Food Frequency Questionnaire and Biomarkers as Indicators of Long-term Dietary Intake. *Am J Epidemiol* 154:1126-35, 2001.

24. Subar AF, Ziegler RG, Thompson FE, Johnson CC, Weissfeld JL, Reding D, Kavounis KH, Hayes RB; Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial Investigators. Is shorter always better? Relative importance of questionnaire length and cognitive ease on response rates and data quality for two dietary



questionnaires. *Am J Epidemiol* 153(4):404-9, 2001.

25. Takatsuka N, Kurisu Y, Nagata C, Owaki A, Kawakami N and Shimizu H. Validation of simplified diet history questionnaire. *J Epidemiol* 7(1):33-41, 1997.

26. Sasaki S, Yanagibori R, Amano K. Self-administered diet history questionnaire developed for health education: relative validation of the test-version by comparison with 3-day diet record in women. *J Epidemiol* 8:203-15, 1998.

27. Masson LF, McNeil G, Tomany JO, Simpson JA, Peace HS, Wei L, Grubb DA and Bolton-Smith C. Statistical approaches for assessing the relative validity of a food-frequency questionnaire: use of correlation coefficients and the kappa statistic. *Public Health Nutr* 6(3): 313-321, 2003.

28. Coates RJ, Monteilh CP. Assessment of food frequency questionnaires in minority population. *Am J Clin Nutr* 65 (suppl.):S1108-15, 1997.

29. MacIntyre UE, Venter CS, Vorster HH. A culture-sensitive food frequency questionnaire used in an African population: 2. Relative validation by 7-day weighted records and biomarkers. *Public Health Nutr* 4(1): 63-71, 2001.

30. Ogawa K, Tsubono Y, Nishino Y, Watanabe Y, Ohkubo T, Watanabe T, Nakatsuka H, Takahashi N, Kawamura M, Tsuji I, and Hisamichi S. Inter- and intra-individual variation of food and nutrient consumption in a rural Japanese population. *Eur J Clin Nutr* 52, 781-785, 1999.

31. Ministry of Health, National Institute of Nutrition. 2000 General Nutrition Survey. Medical Publishing House, Hanoi, Vietnam, 2003

Appendix. List of food items (Part 1) and seasoning and cooking methods (Part 2) for the food frequency questionnaire for Vietnamese adults

Part 1.

Cereals

- 1 Steamed plain rice
- 2 Bread (French type)
- 3 Bread (Sandwich type)
- 4 Bread (French type) with pork meat
- 5 Bread (French type) with canned fish
- 6 Bread (French type) with pemecant (smoke-dried pork, shaved)
- 7 Bread (French type) with fried egg
- 8 Sandwich
- 9 Rice noodle (thick type) with pork
- 10 Rice noodle with beef and pork
- 11 Rice noodle with crab
- 12 Rice noodle with duck and bamboo shoots
- 13 Rice noodle with pork, fish, squid and shrimp
- 14 Rice noodle with pork and pork products
- 15 Rice noodle with crab and pork products
- 16 Rice noodle (flat type) with pork
- 17 Rice noodle with beef
- 18 Rice noodle with chicken
- 19 Rice noodle with beef curry
- 20 Fred rice noodle with pork and entrails
- 21 Rice noodle and Chinese noodle with pork
- 22 Rice noodle with pork and pork entrails
- 23 Soup of noodle
- 24 Rice with pork skin
- 25 Rice with omelet
- 26 Rice with grilled pork
- 27 Pork and vegetable rolled cake
- 28 Fried rice with vegetable
- 29 Rice gruel with pork blood
- 30 Rice gruel with pork entrails
- 31 Glutinous rice with black bean
- 32 Glutinous rice with black bean
- 33 Glutinous rice with peanut
- 34 Glutinous rice with meat

Vegetables and potatoes

- 35 Amaranth, Jute potherb
- 36 Swamp cabbage, Sweet potato leaves
- 37 Mustard green, Chinese cabbage
- 38 Malabar nightshade
- 39 Crown-daisy
- 40 Chinese leek
- 41 Wort, India penny
- 42 Cabbage
- 43 French bean
- 44 Green pepper
- 45 Tomato
- 46 Carrot
- 47 Ash gourd, wax gourd
- 48 Bitter gourd

	49	Pumpkin squash
	50	Gourd
	51	Cucumber
	52	Broccoli
	53	White potato
	54	Chinese yam
	55	Sweet potato
Meat		
	56	Pork lean
	57	Pork upper leg
	58	Pork medium fat
	59	Pork rib
	60	Pork lower leg
	61	Pork fat
	62	Beef
	63	Chicken
	64	Duck
	65	Pork blood
Fish and shellfish		
	66	Scad, anchovy
	67	Snake head fish
	68	Mullet
	69	Goby
	70	Tuna
	71	Fat fish
	72	Tilapia
	73	Mackerel
	74	Shrimp
	75	Squid
	76	Fresh water crab
Eggs		
	77	Hen egg
	78	Duck egg
Tofu (soybean curd)		
	79	Tofu (soybean curd) fried
	80	Tofu (soybean curd), raw
Dairy foods		
	81	Fresh milk without sugar
	82	Fresh milk with sugar
	83	Soybean milk
	84	Milk powder, whole
	85	Skim milk
	86	Yogurt
	87	Condensed milk
Fruits		
	88	Dragon fruit
	89	Banana
	90	Papaya
	91	Pomelo
	92	Longan
	93	Orange
	94	Water melon
	95	Pear
	96	Grape

97	Guava
98	Apple
Beverages	
99	Beer
100	Soft drink
101	Fruit shake juice
102	Lemon juice
103	Green leaves juice
104	Orange juice
105	Coconut juice with kernel
106	Coffee
107	Instant coffee
108	Instant coffee with milk & sugar
Sweets and dessert	
109	Glutinous rice cake with mungobean and pork fat
110	Steamed rice cake
111	Baked sweet Vietnamese style
112	Sponge cake
113	Sweetened maize, banana, yam and sweet potato
114	Sweetened bean and glutinous soup
115	Sweetened bean soup
116	Tofu (soybean curd) with sweet syrup

## Part 2.

### Cooking methods for dishes

1	boiled with seasoning
2	fried
3	sauted
4	boiled
5	soup
6	grilled
7	salted
8	salad

### Table seasoning

1	Fish sauce
2	Salt
3	Soybean sauce