Journal of the National Institute of Public Health 2013 Vol.62 No.1 p.13－30

Topics：Strategic management of evidence-based health and medical care policy: How to use new Digital Big Data in health care system

＜Review＞

Evaluation of the health check up and guidance program through linkage with health insurance claims

Etsuji OKAMOTO, Yoshimune HIRATSUKA, Koichi OTSUBO, Toshiro KUMAKAWA

National Institute of Public Health, Department of Health & Welfare Service Research

Abstract

Objectives: To evaluate the health check up and guidance program of Mishima City's National Health Insurance program by analyzing how health risks, lifestyles and health guidance are related with the cumulative incidence and outpatient medical charges of metabolic syndrome.

Methods: The health check up and guidance data provided in fiscal 2008 were linked with health insurance claims submitted between June 2008 and October 2012 on an individual basis. Items evaluated were (1) health risks detected by health checks, (2) lifestyles factors obtained from questionnaires and (3) health guidance provided to recipients at risk for metabolic syndrome. Outcomes were defined as the incidence and outpatient medical charges related to metabolic syndrome. Comparison was performed between groups categorized by health risks, lifestyles and reception of health guidance using the outcomes accumulated for 53 months since June 2008.

Results: Health risks and reception of health guidance were good predictors of cumulative incidence and outpatient medical charges for metabolic syndrome. However, lifestyles factors obtained from questionnaires were not clearly related with expected outcomes. For smoking and drinking, the outcomes were opposite expectations: smokers and drinkers showed lower incidence and outpatient medical charges related to metabolic syndrome.

Discussion: Counter-intuitive results were found by linking health check up and guidance data with health insurance claims. Evaluation of health check ups and guidance should be analyzed by outcomes obtained from health insurance claims.

keywords: metabolic syndrome, health check up and guidance, health insurance claims, lifestyle, proportional distribution method (PDM)

(accepted for publication, 30th January 2013)

I. Introduction

After five years of the first health care cost containment plans (HCCCP) has elapsed, evaluation of the health check up and guidance (HC&G) program targeting metabolic-related syndromes will be conducted in fiscal 2013, pursuant to the requirement of the Elderly Health Care Security Act (EHCSA) [1]. Since the HC&G program is intended to control health care expenditure in the medium-long term, it is necessary for health insurers to evaluate how the HC&G program affected the utilization of health care services as well as the incidence of metabolic-related diseases. To achieve these goals, it is necessary to link the HC&G data to health insurance claims (HIC) data on an individual basis. Online submission of HICs has developed dramatically during the last five years and HICs provide detailed information on patients' diagnoses, medications and utilization [2]. However, such linkage of HC&G data and HICs data has not been routinely conducted because of

Corresponding author: Etsuji Okamoto
2-3-6, Minami, Wako-shi, Saitama, 351-0197, Japan.
Fax: +81-48-468-7985
E-mail: atoz@niph.go.jp

technical difficulties and complexities of HICs data.

The authors evaluated the outcome of the HC&G program of Mishima City in Shizuoka prefecture, by linking the HC&G data and HIC data on an individual basis and report on the relationship between the HC&G program and the incidence and outpatient medical charges related to metabolic syndrome obtained from HICs data.

II. Data and methods

1. Outline of Mishima City's NHI program

Mishima city had a population of 111,773 (46,304 households) at the end of fiscal 2010, of whom 32,310 (18,431 households) were insured by the City's NHI program (39.6% of households). Of the NHI beneficiaries, a total of 22,948 were aged 40 to 74, the target age for HC&G. The number of elderly people aged over age 75 who were insured by the Health Care System for the Late Elderly (HCSLE) was 11,612 as of March 2012.

2. Outline of Mishima City's HC&G program

HC&G is provided to beneficiaries aged 40 to 74 by the insurers pursuant to the national uniform requirements set forth by the EHCSA. Recipients of health check ups were categorized into (1) normal (information provision only), (2) motivational intervention and (3) aggressive intervention pursuant to the national standard [3]. Those categorized into (2) or (3) are considered to be at risk of metabolic syndrome and were invited for health guidance. However, those aged 65 and over will not be categorized for "aggressive intervention" and all those identified to be at risk of metabolic syndrome will be categorized for "motivational intervention". Also, those who answered that they are taking any medications for diabetes, hypertension or hyperlipidemia were also excluded from health guidance [4].

A total of 12,304 beneficiaries received health check ups for metabolic syndrome in the fiscal 2008. Of them, 8,616 (70.4%) answered a questionnaire and 3,344 (27.2%) were aged 65 and over in 2008. The number of recipients who were categorized for "motivational" and "aggressive" intervention was 694 and 249, respectively (166 and 249, respectively for those aged 65 or less). The small number of those categorized for "motivational" and "aggressive" intervention may be explained by a considerable number of those already under medical treatment (N=1554) and an inability to categorize (N=5733) because of insufficient preparation in the first year.

3. Health insurance claims

HIC data were obtained from Mishima City's NHI program and HCSLE. The contents of the data is divided into the following two phases.

(a) Abbreviated data for 41 months from June 2008 to October 2011

In this phase, selected items (diagnoses, date of diagnosis, number of days per claim, charges in points in a claim, flag of primary diagnoses, flag of rule-out diagnoses, etc) were input from all claims, including those submitted in paper form. Online submission was not fully achieved in and around 2008 but there were no biases from the omission of computerized claims because all claims including paper forms were included. Although the data did not include detailed items such as medication or clinical procedures, they recorded all diagnoses and the were suitable for estimation of disease-specific charges using proportional distribution method (PDM) [5].

(b) Computerized data for 12 months from November 2011 to October 2012

In this phase, the entire contents of computerized HIC data were available. The same items as in (a) were extracted and the two phases were combined as consecutive data covering 53 months.

Disease-specific charges were estimated by the first two digits of the ICD10. "Metabolic-related diseases" were defined as E1 (diabetes), E7 (hyperlipidemia) and I1 (hypertension). Estimation of disease-specific charges was conducted using PDM after excluding rule-out diagnoses (rule-out diagnoses were included only when ALL of the diagnoses in a claim were rule-out diagnoses). Charges were obtained from the number of points (at =10 yen per point) claimed in HICs.

Cumulative medical charges were counted by calendar month. Cumulative incidence of a disease was counted by date of diagnosis because each diagnosis in a HIC contains the date of diagnosis. The cumulative incidence was counted by the ***first*** date of diagnosis after June 2008 for every recipient of a health check up in fiscal 2008. If a recipient of a health check up on July 10, 2008 visits clinic A on July 20 and was then referred to hospital B on 30th July, one case is counted on the 20th day since June 2008 and no more counts will be added even if the recipient visited more hospitals or clinics later on.

Also, it should be noted that the date of diagnosis in a HIC is the date when the hospital or clinic started the treatment, and it may or may not be the date when the patient was first diagnosed as having the disease. The cumulative incidence and medical charges evaluated in this study are the accumulation of newly diagnosed metabolic-related diseases after June 2008 and may overestimate the real incidence and medical charges of disease detected by health check ups.

4. Modeling of evaluation and outcome measures

Evaluation was performed in three dimensions: (a) how health risks detected in health checks are related with the outcome, (b) how lifestyle factors obtained from questionnaires is related with the outcome and (c) how health guidance affects the outcome. Figure 1 illustrates

which portion of the health check up data in fiscal 2008 was used for each dimension.

Outcome was measured in two dimensions: (a) incidence of newly diagnosed metabolic related diseases and (b) outpatient medical charges of both all diseases and metabolic related diseases. Both outcomes were measured by cumulative incidence and charges for 53 months starting from June 2008. Inpatient claims, as well as DPC and pharmacy claims were not included in the outcome measures. Inclusion of inpatient claims may bias the outcome because a small number of claims may involve high charges and are not theoretically appropriate for evaluation of primary prevention [6]. Pharmacy claims were not included in the first phase of claims data (June 2008-October 2011), making the continuous comparison impossible.

(a) Health risks evaluated:

(i) Blood pressure:

Comparison was made among three groups: normal (systolic blood pressure (SBP)<=129mmHg AND diastolic blood pressure (DBP)<=84mmHg), in need of guidance (SBP=130-139mmHg or DBP=85-89mmHg) and in need of treatment (SBP>=140mmHg or DBP>=90mmHg). Outcome was measured by cumulative incidence and outpatient medical charges for hypertension (code I1 in ICD10).

(ii) LDL cholesterol:

Comparison was made among three groups: normal (LDL<120mg/dl), in need of guidance (LDL=120-139mg) and in need of treatment (LDL>=140mg). Outcome was measured by cumulative incidence and outpatient medical charges of hyperlipidemia (code E7 in ICD10).

(iii) HbA1c:

Comparison was made among three groups: normal (HbA1c<5.1%), in need of guidance (HbA1c:5.2-6.0%) and in need of treatment (HbA1c>=6.1%). Outcome was measured by cumulative incidence and outpatient medical charges of diabetes (code E1 in ICD10).

(iv) creatinine:

Comparison was made between two groups: normal (creatinine<1.04mg/dl for men, 0.79mg/dl for women), in need of guidance or treatment (creatinine>=1.04mg/dl for men, 0.79mg/dl for women). Outcome was measured by cumulative incidence and outpatient medical charges for renal failure (code N1 for ICD10).

(b) Lifestyle foctors evaluated:

(i) Smoking:

Comparison was made between smokers and non-smokers.

(ii) Exercise:

Comparison was made among three groups: active (exercising for 30 minutes/day at least two days/week for at least one year), moderate (walking for at least one hour/day) and no exercise.

(iii) eating fast:

Comparison was made among three groups: fast eaters, normal eaters and slow eaters.

(iv) eating late at night:

Comparison was made between those who eat dinner within two hours of going to bed three times or more per week and those who act otherwise.

(v) eating snacks:

Comparison was made between those who eat snacks after dinner for three or more times per week and those who act otherwise.

(vi) skipping breakfast

Comparison was made between those who skip breakfasts three or more times per week and those who act otherwise.

(vii) Drinking:

Comparison was made among three groups: heavy drinkers (drinking everyday), moderate drinkers (drinking occasionally) and non-drinkers.

Outcome was measured by cumulative incidence and outpatient medical charges for all metabolic related diseases (code E1, E7 and I1 in ICD10:).

(c) Evaluation of health guidance:

Comparison was made between those who received health guidance and those who did not among those were categorized into “motivational” or “aggressive” intervention in health check in 2008. The comparison was limited to

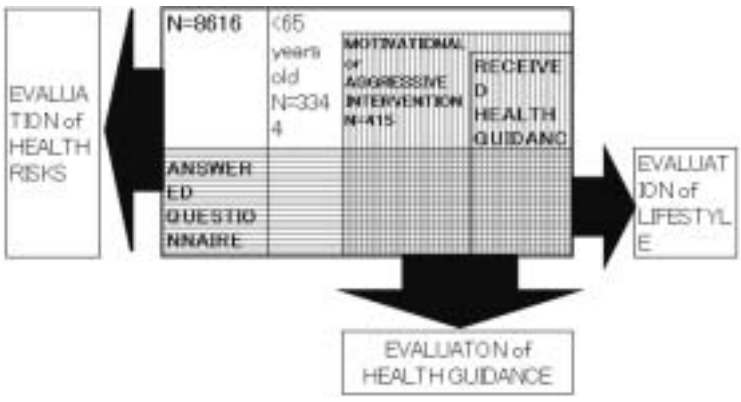

Figure 1 Structure of health check recipients in FY2008 and the portion used for evaluation

those aged <65 in 2008 (born in 1944 or later) to allow an unbiased comparison. Outcome was measured by cumulative incidence/outpatient medical charges of all metabolic related diseases (ICD10:E1, E7 and I1).

(d) Ethical considerations

This study was conducted by contract with Mishima city in accordance with its Privacy Protection Ordinance. Personal identifiers were coded by the city and released to the authors under security agreement.

III. Results

1. Health risks

The results of four risks detected from health check ups (blood pressure, HbA1c, LDL and creatinine) and the corresponding outcomes (cumulative incidence and medical outpatient charges) are presented in Figures 2-9. In all four risk categories, a consistent tendency was observed: the cumulative incidence and outpatient medical charges were highest in the group in need of treatment, followed by the group in need of guidance and lowest in the normal group. The most conspicuous was with creatinine, a risk factor for renal failure. Even if the difference in cumulative incidence between those at risk and normal individuals was narrow, it brings about a large difference in cumulative charges, as shown in Figure 9 suggesting high charges for treatment of renal failure, such as dialysis.

2. Lifestyles

The results of seven lifestyle foctors obtained from questionnaires and outcomes are presented in Figure 10-23. As a sharp contrast to health risks, the relationship between lifestyle and outcomes was not so clear. One might imagine that those with unhealthy lifestyles are more likely to have the disease they are at risk for and incur corresponding medical charges. However, such presumptions do not hold.

As for smoking, smokers showed lower cumulative incidence and outpatient medical charges than non-smokers. The difference between them was narrow when medical charges were limited to metabolic-related diseases as shown in Figure 11. At least it is not likely that smoking cession will lead to savings in health care expenditure. The same holds for drinking. Contrary to expectation, non-drinkers showed the highest cumulative incidence of metabolic-related diseases among three groups, although the difference was small for cumulative medical charges for metabolic-related disease.

The difference is less clear for eating habits. Breakfast skippers showed higher cumulative incidence of metabolic-related disease particularly after 800 days since June 2008 (see fig. 20). Their difference in cumulative outpatient medical charges consistently widened as months passed by Figure 21.

3. Health guidance

The results of the outcomes of health guidance are presented in Figure 24-25. The outcomes unequivocally show lower cumulative incidence and outpatient medical charges for those who received health guidance.

IV. Discussion

Five years after the introduction of the HC&G in April 2008, evaluation results of HC&G by linking HC&G data with HIC data began to be reported. One of the strengths of the HC&G program was the standardized health check up and questionnaire items. These standardized items assure the comparability among results obtained from different insured populations.

Suzuki-Saito studied a total of 29,490 recipients of HC&G in fiscal 2008 with an almost similar analytical modeling to this study: (1) health risks of three metabolic related diseases detected in health checks and (2) lifestyle factors obtained from the questionnaire [7]. She first compared the median outpatient medical charges among groups stratified by body mass index (BMI) and confirmed obesity was associated with higher median outpatient medical charges. However, as she further analyzed the relationship with health risks and lifestyle factors stratified by BMI, unexpected outcomes emerged. While health risks were significantly associated with medical charges, the relationship with lifestyle factors was either non-significant (exercise and eating) or even negative (smoking and drinking). Actually, groups of lower medical charges showed higher prevalence of smoking and drinking in all BMI stratifications.

Suzuki-Saito's results were consistent with the results of this study. Health risks detected by health check ups served as good predictors of cumulative incidence and outpatient medical charges for metabolic related diseases but lifestyle factors obtained from the questionnaire did not. Lifestyle factors such as exercise and eating habit were not clearly related with these outcomes. Smokers and drinkers tend to have lower incidence and outpatient medical charges for metabolic related diseases. Suzuki-Saito explains the observed counter-intuitive results by “The reason for the difference in medical charges cannot be clarified because disease-specific analysis was not possible in our study. The significantly lower prevalence of drinkers and smokers in high medical charge groups might be due to the intervention of hospitals and clinics”. In comparison, the results of this study have the strength that disease-specific medical charges were objectively estimated by PDM. It may be that exercise and eating are not related with incidence and outpatient medical charges, and unhealthy lifestyles such as smoking and drinking are negatively related with incidence and outpatient medical charges for metabolic-related diseases.

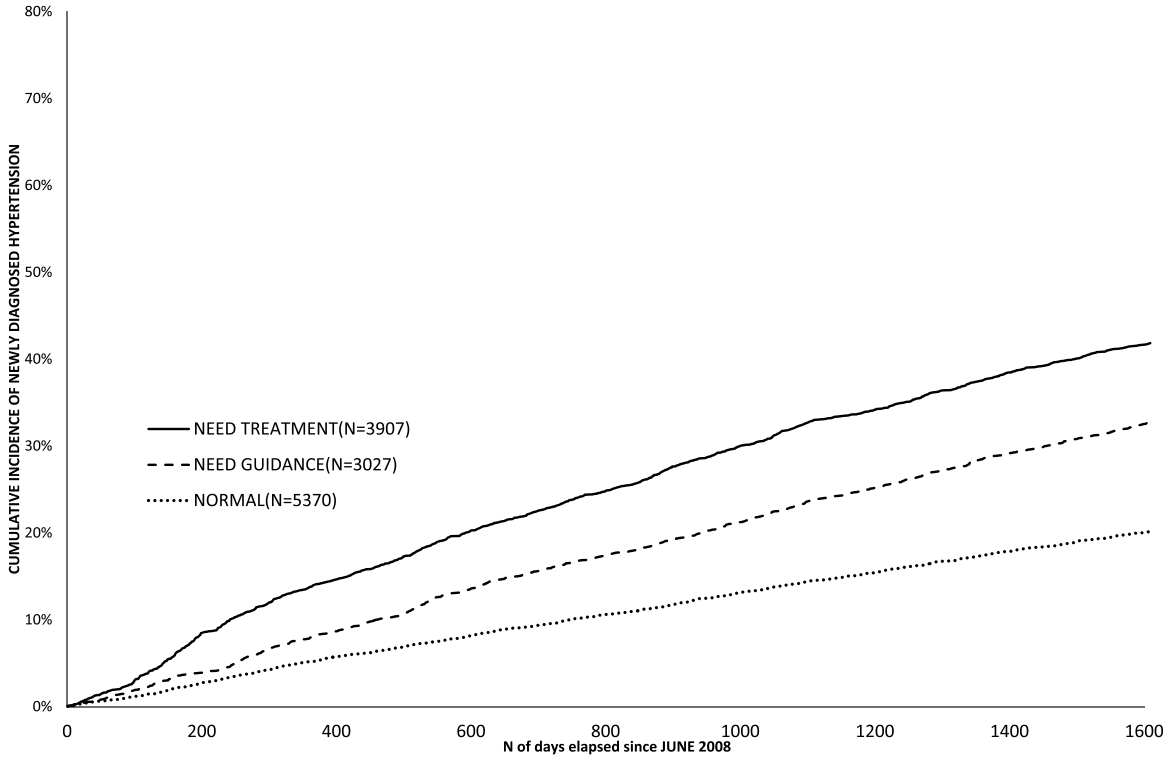

Figure 2 CUMULATIVE INCIDENCE of NEWLY DIAGNOSED HYPERTENSION (ICD10:I1)
stratified by BP in health check in 2008
(both sexes, all ages>=40, rule-out diagnoses excluded)

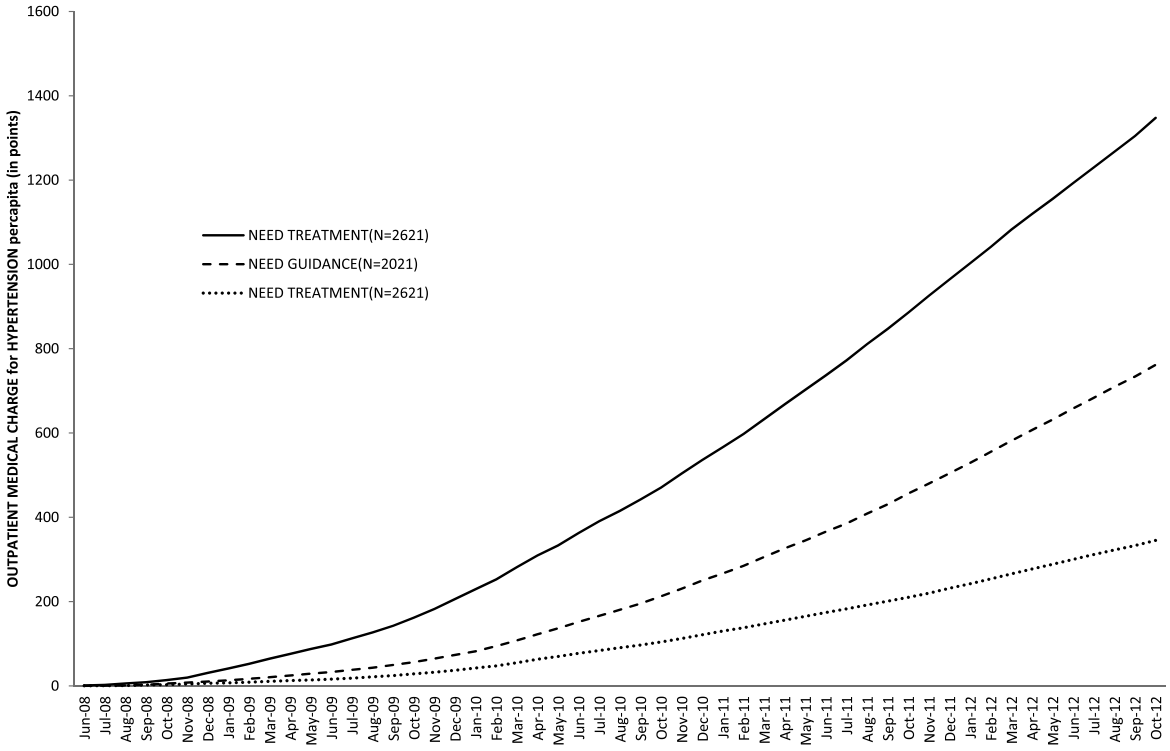

Figure 3 CUMULATIVE OUTPATIENT MEDICAL CHARGE percapita for hypertension (ICD10:I1) newly diagnosed after June 2008
stratified by BP in health check in 2008
(both sexes, all ages>=40, rule-out diagnoses excluded)

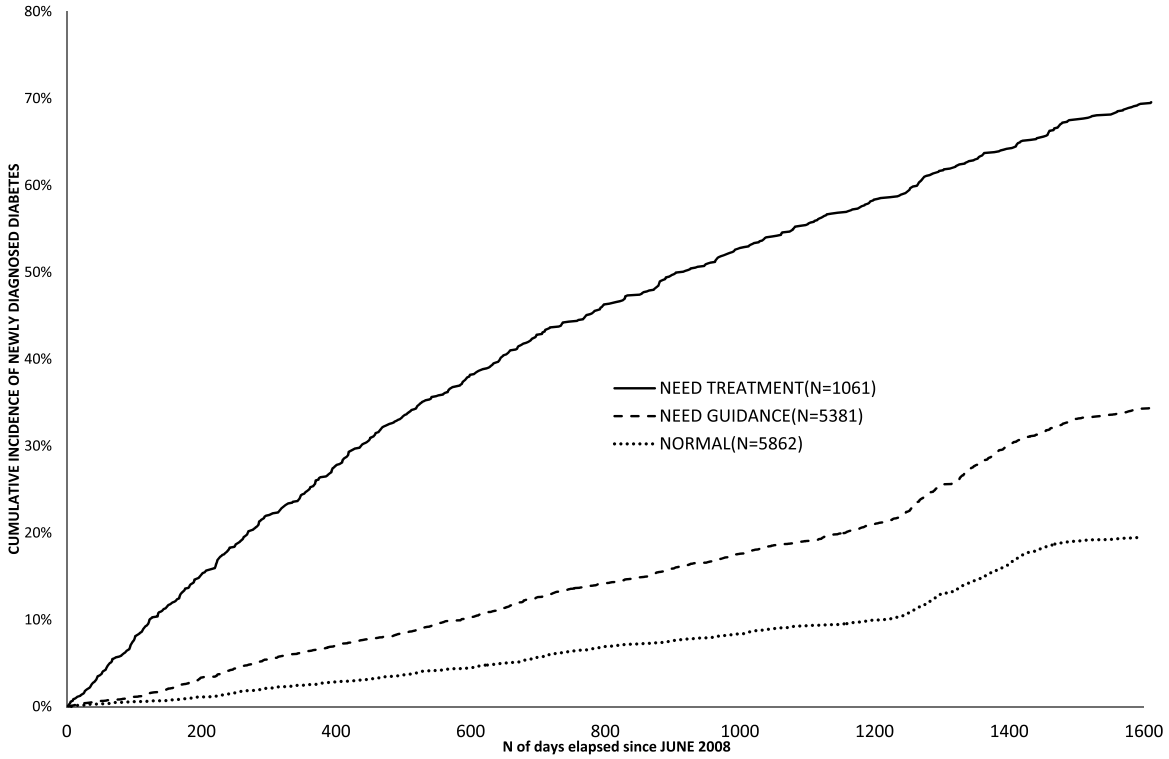

Figure 4 CUMULATIVE INCIDENCE of NEWLY DIAGNOSED DIABETES (ICD10:E1)
stratified by HbA1c in health check in 2008
(both sexes, all ages>=40, rule-out diagnoses excluded)

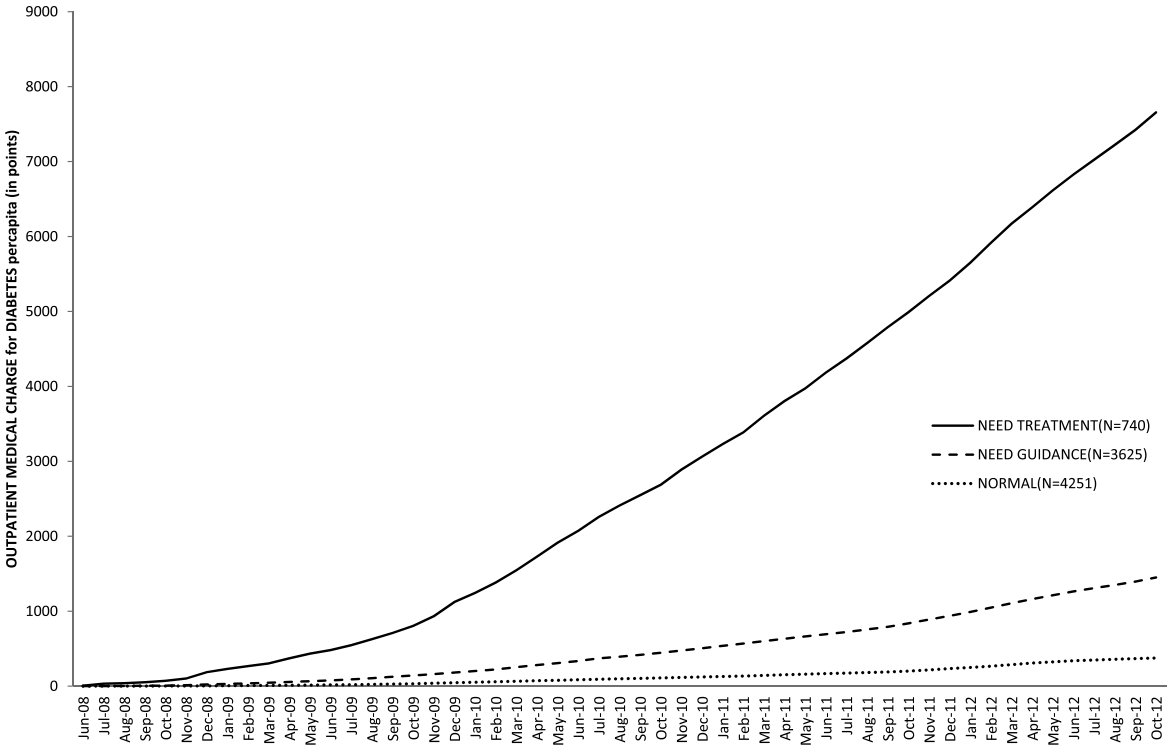

Figure 5 CUMULATIVE OUTPATIENT MEDICAL CHARGE percapita for diabetes (ICD10:E1) newly diagnosed after June 2008
stratified by HbA1c in health check in 2008
(both sexes, all ages>=40, rule-out diagnoses excluded)

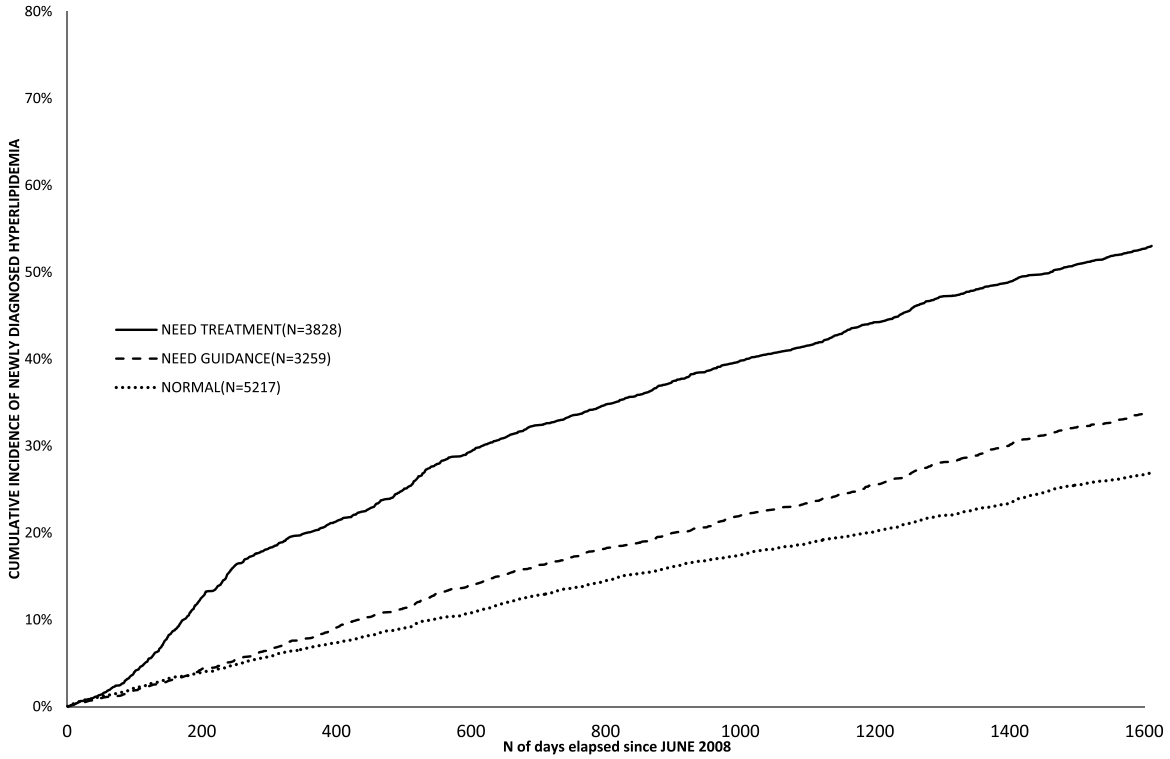

Figure 6 CUMULATIVE INCIDENCE of NEWLY DIAGNOSED HYPERLIPIDEMIA (ICD10:E7)
stratified by LDL in health check in 2008
(both sexes, all ages>=40, rule-out diagnoses excluded)

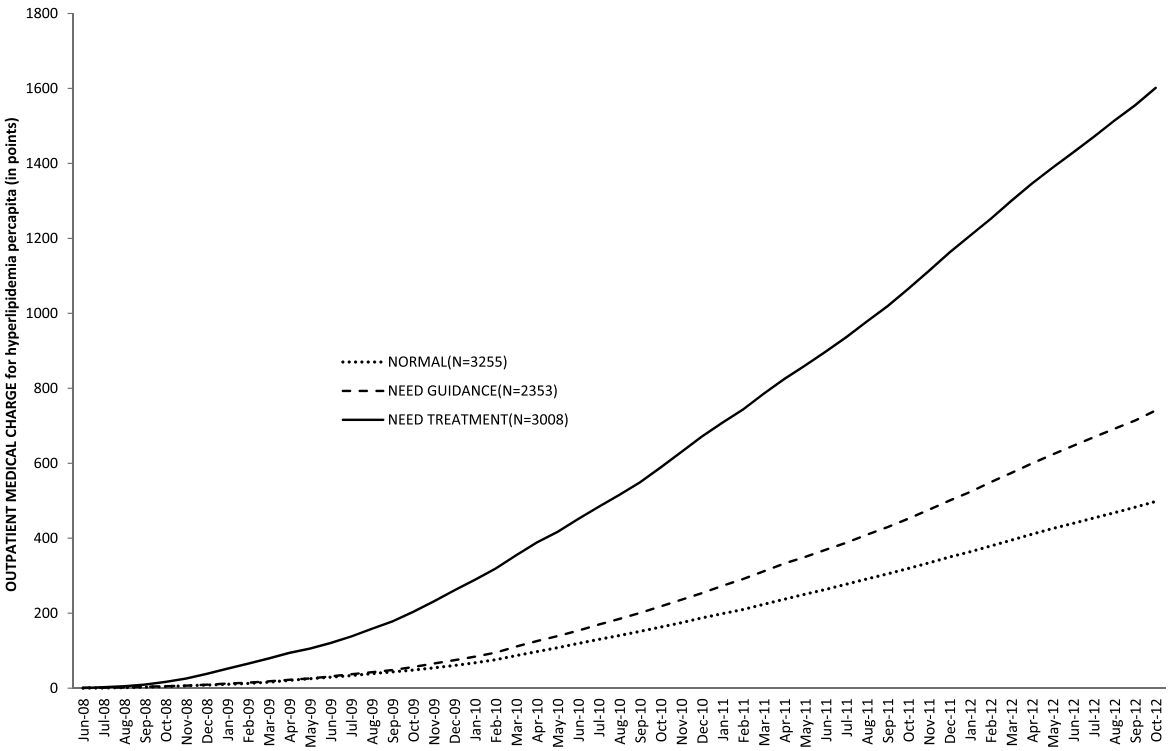

Figure 7 CUMULATIVE OUTPATIENT MEDICAL CHARGE percapita for hyperlipidemia (ICD10:E7) newly diagnosed after June 2008
stratified by LDL in health check in 2008
(both sexes, all ages>=40, rule-out diagnoses excluded)

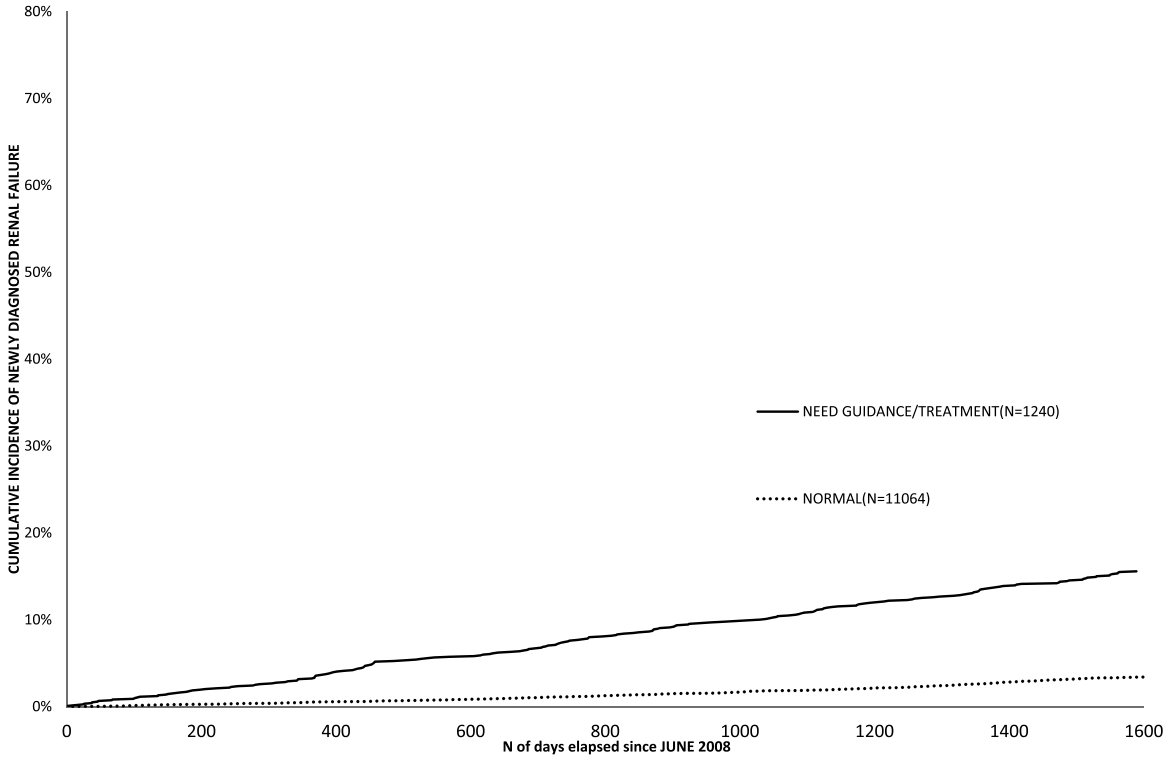

Figure 8 CUMULATIVE INCIDENCE of NEWLY DIAGNOSED RENAL FAILURE (ICD10:N1)
stratified by creatinine in health check in 2008
(both sexes, all ages>=40, rule-out diagnoses excluded)

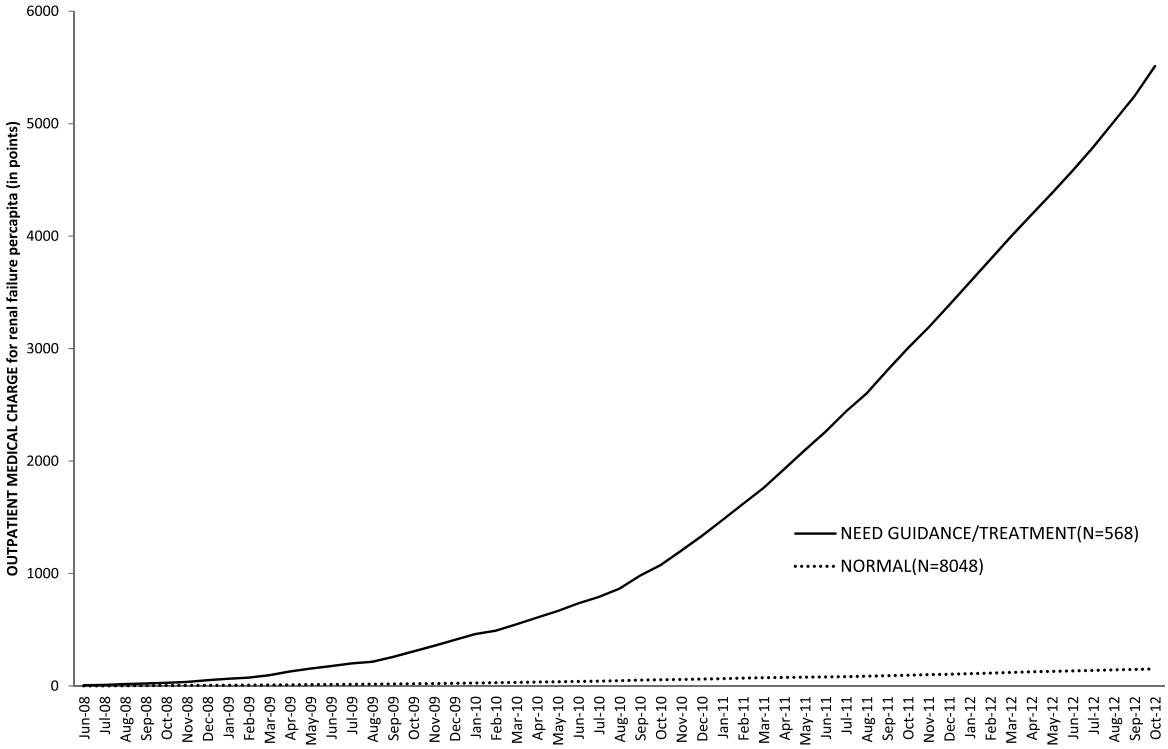

Figure 9 CUMULATIVE OUTPATIENT MEDICAL CHARGE percapita for renal failure (ICD10:N1) newly diagnosed after June 2008
stratified by creatinine in health check in 2008
(both sexes, all ages>=40, rule-out diagnoses excluded)

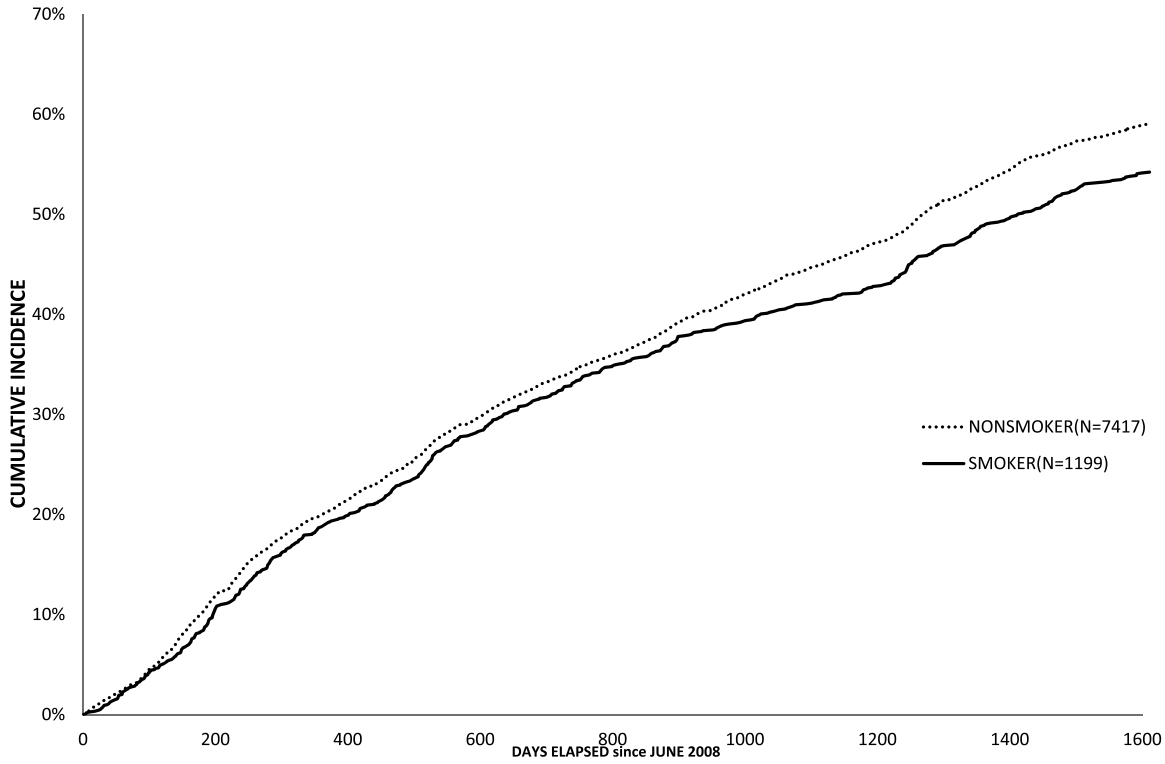

Figure 10 CUMULATIVE INCIDENCE of metabolic syndrome (E1, E7, I1)
between smokers and non smokers of recipients of health-check in FY2008
rule-out diagnoses excluded

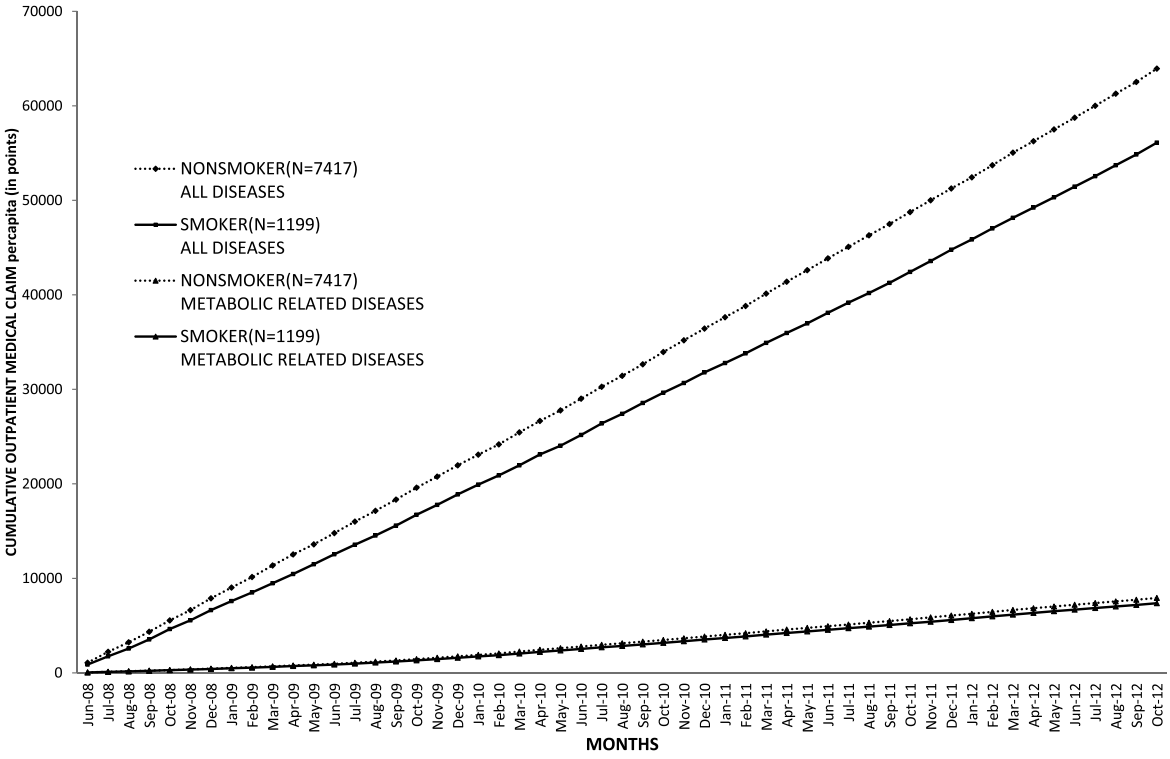

Figure 11 CUMULATIVE OUTPATIENT MEDICAL CHARGES
between smokers and nonsmokers

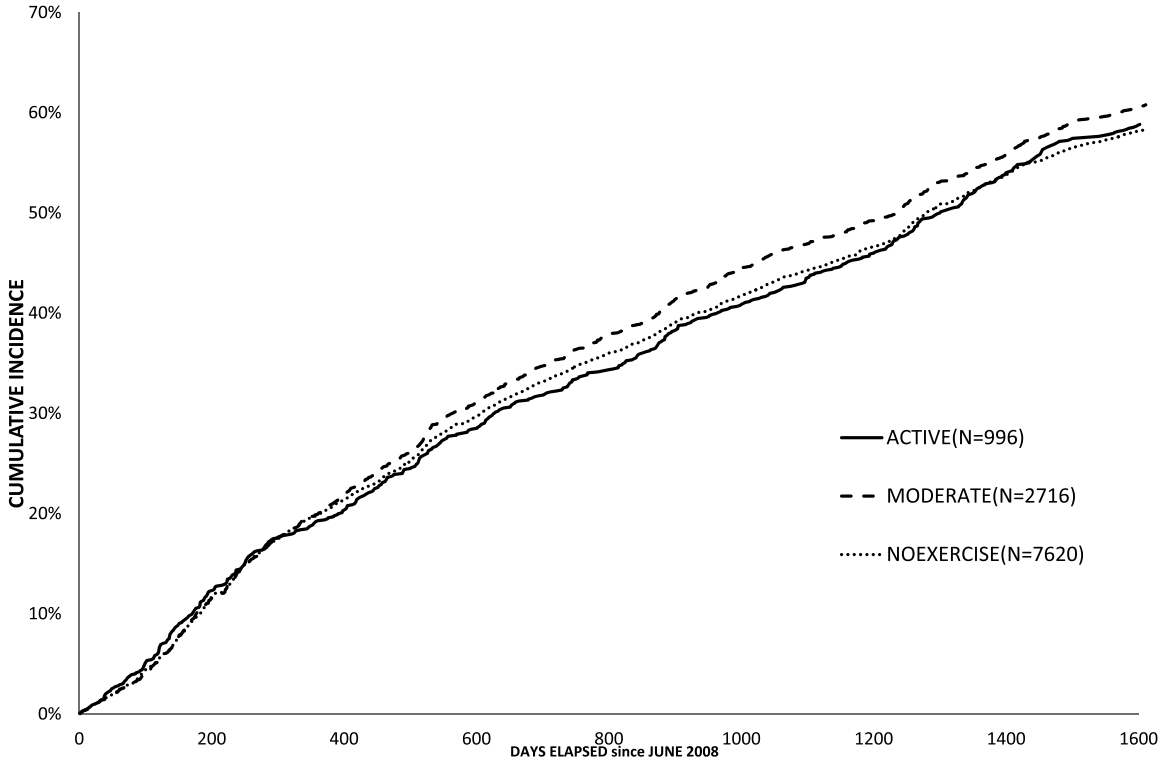

Figure 12 CUMULATIVE INCIDENCE of metabolic syndrome (E1, E7, I1)
between exercisers and non exercisers of recipients of health-check in FY2008
rule-out diagnoses excluded, some of mederate exercisers overlap with nonexercisers

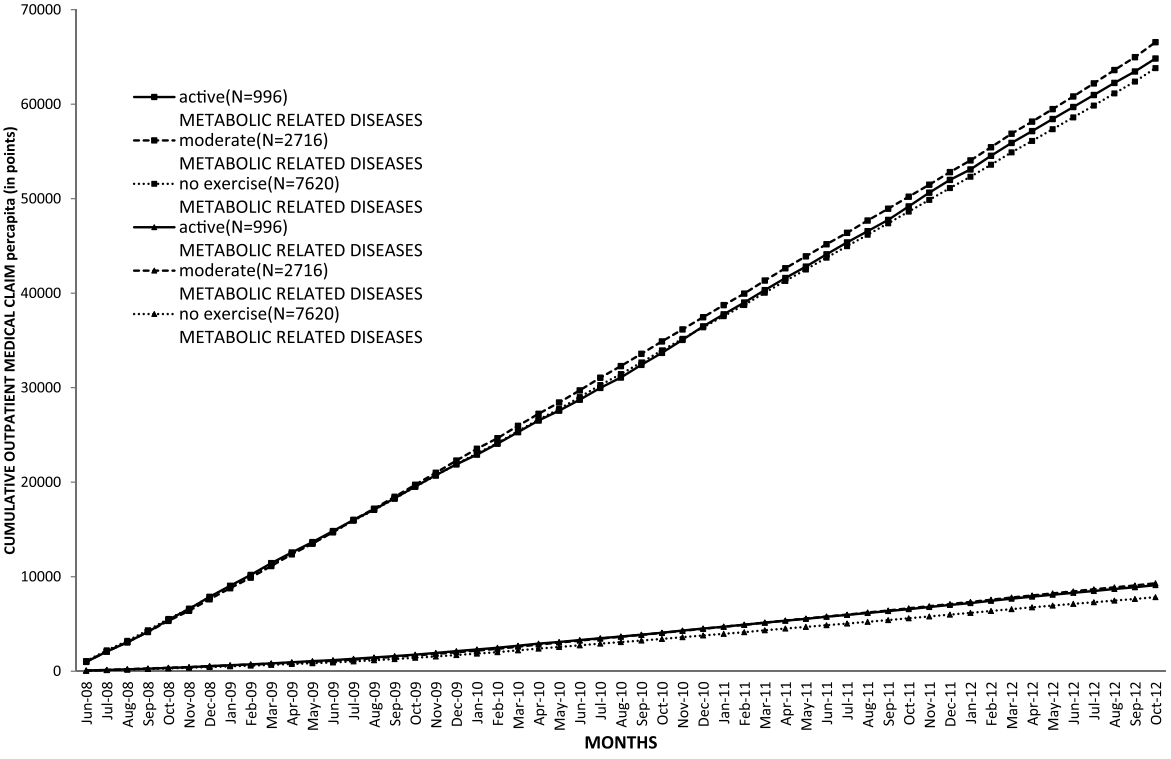

Figure 13 CUMULATIVE OUTPATIENT MEDICAL CHARGES
between exercisers and nonexercisers

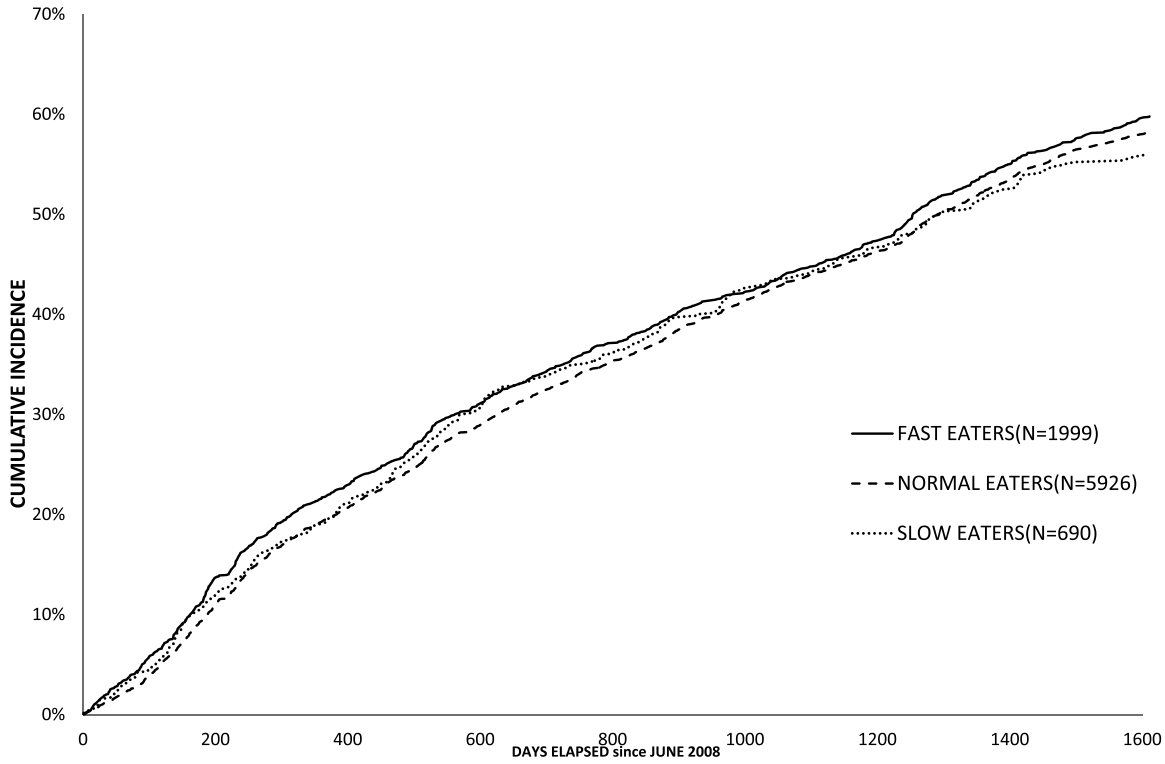

Figure 14 CUMULATIVE INCIDENCE of metabolic syndrome (E1, E7, I1)
between fast eaters and slow eaters of recipients of health-check in FY2008
rule-out diagnoses excluded

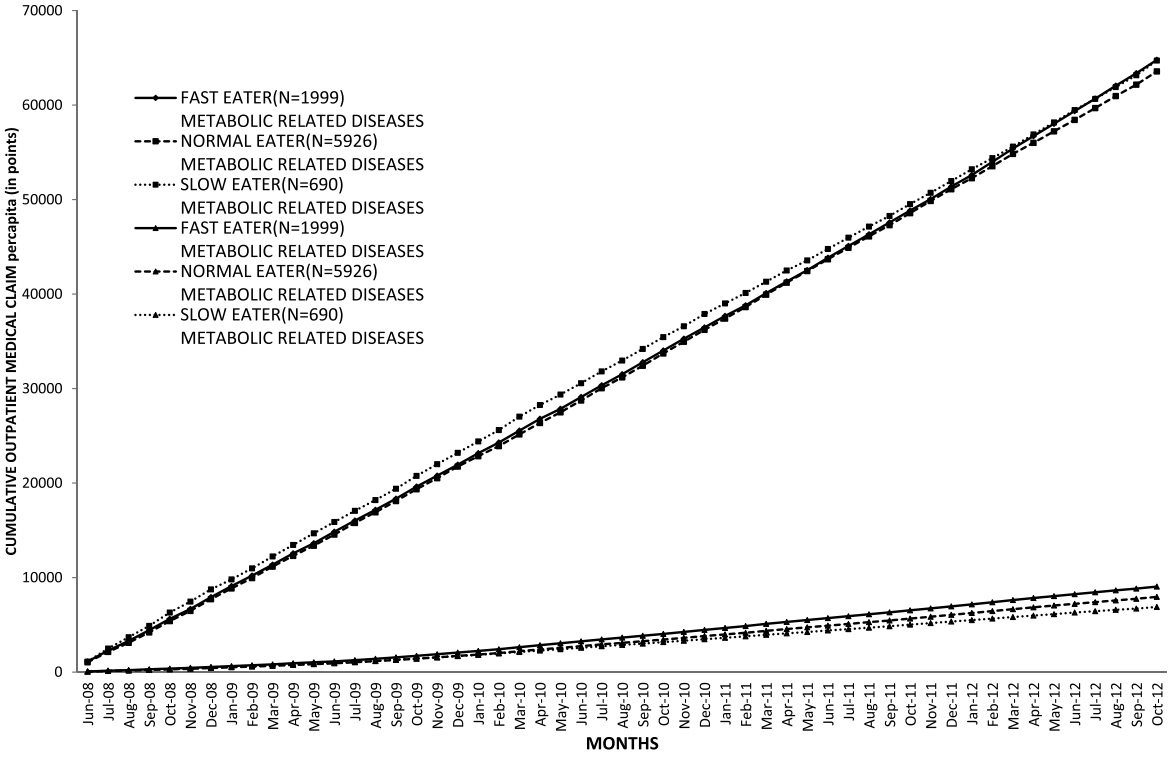

Figure 15 CUMULATIVE OUTPATIENT MEDICAL CHARGES
between fast eaters and slow eaters

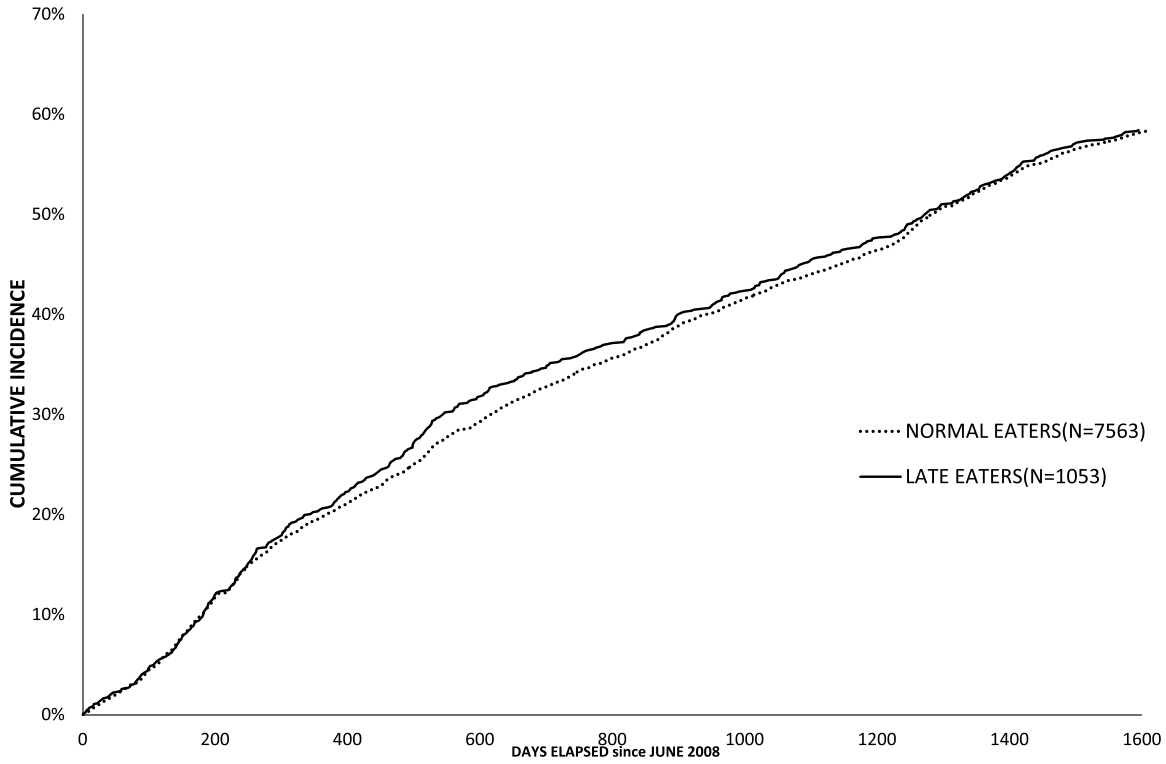

Figure 16 CUMULATIVE INCIDENCE of metabolic syndrome (E1, E7, I1)
between late eaters and normal eaters of recipients of health-check in FY2008
rule-out diagnoses excluded

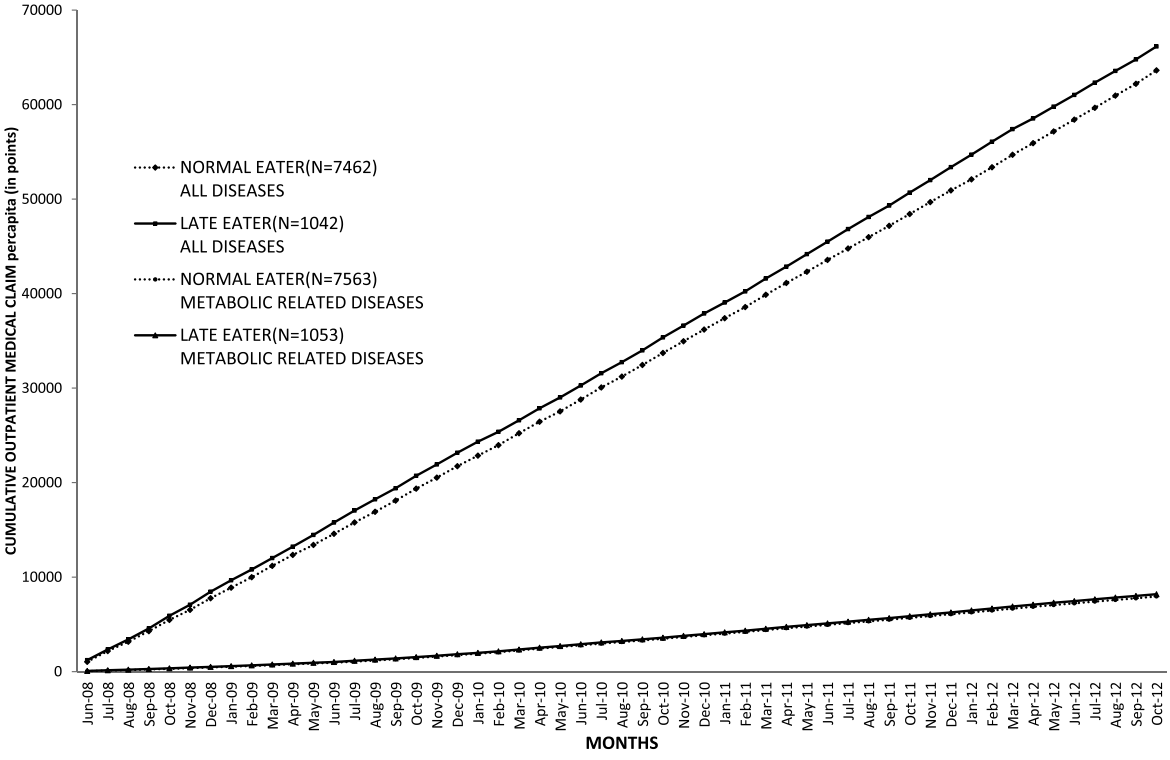

Figure 17 CUMULATIVE OUTPATIENT MEDICAL CHARGES
between late eaters and normal eaters

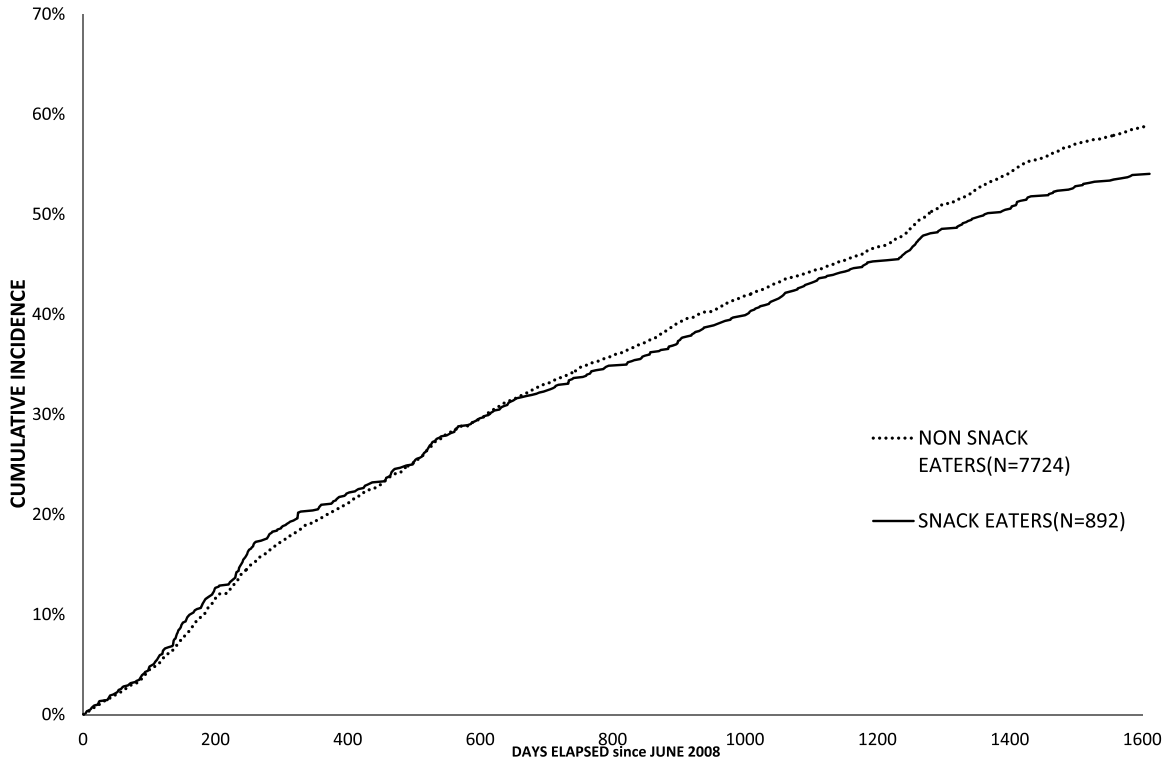

Figure 18 CUMULATIVE INCIDENCE of metabolic syndrome (E1, E7, I1)
between snack eaters and non eaters of recipients of health-check in FY2008
rule-out diagnoses excluded

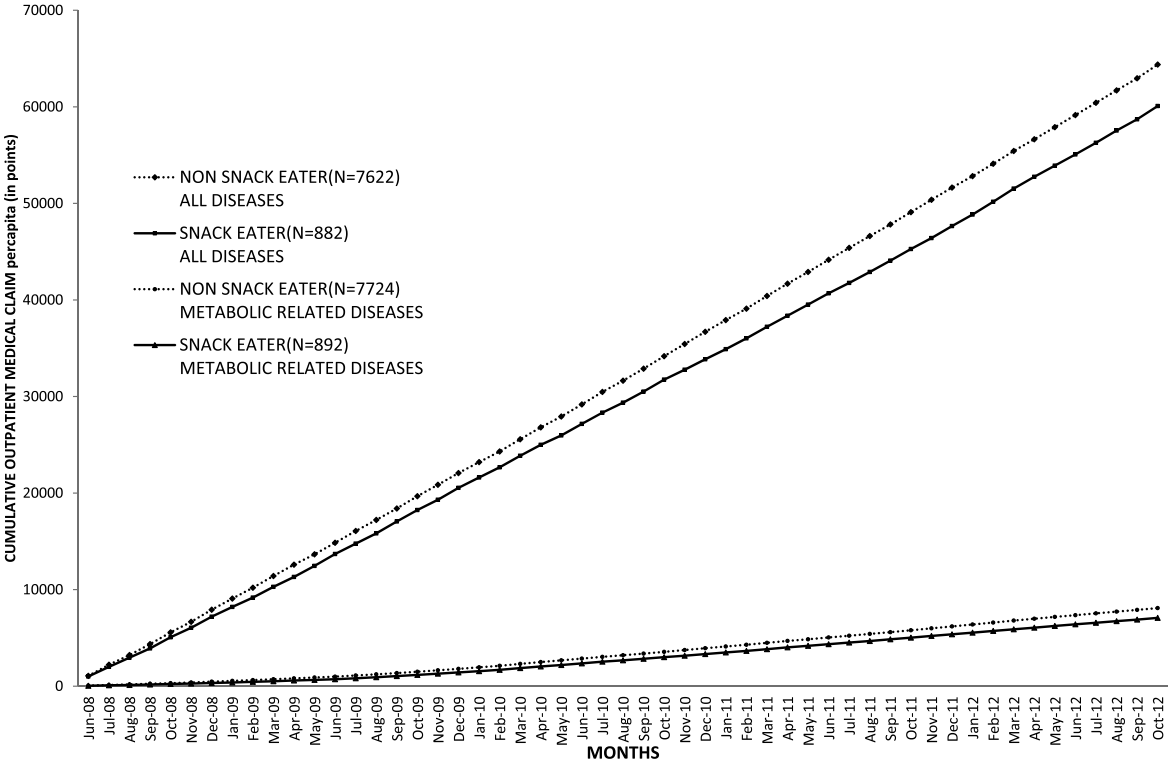

Figure 19 CUMULATIVE OUTPATIENT MEDICAL CHARGES
between snack eaters and non snack eaters

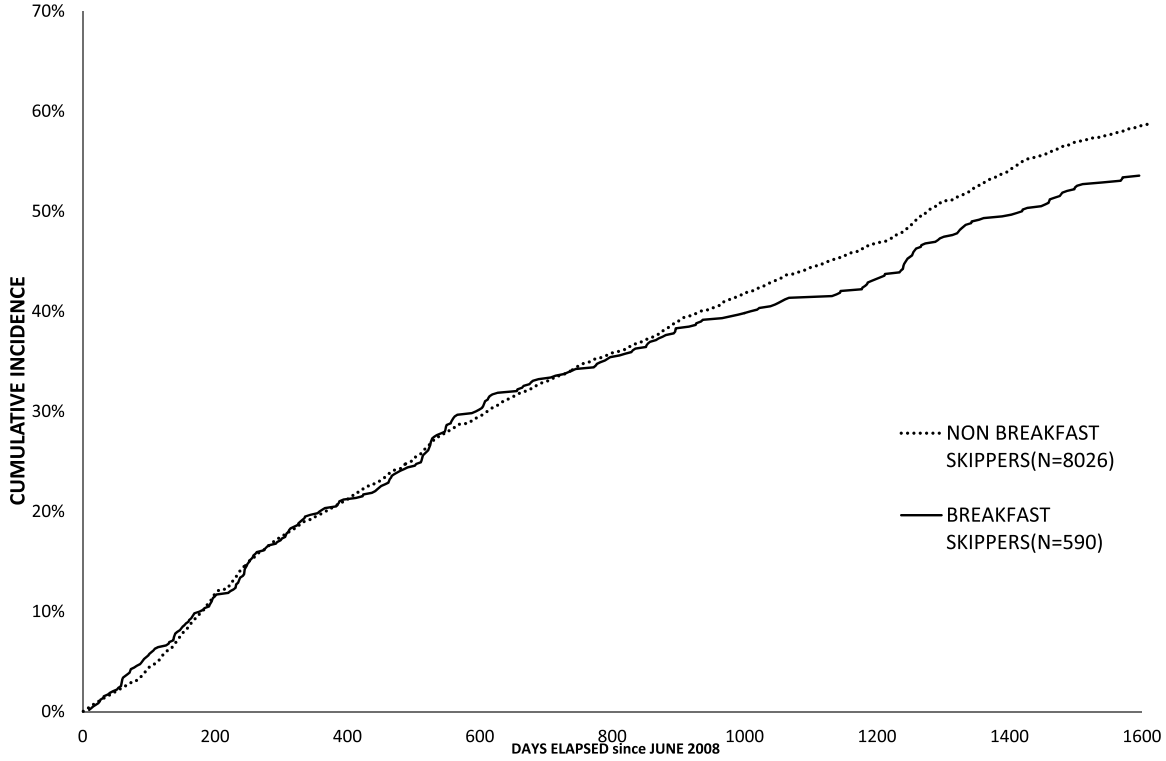

Figure 20 CUMULATIVE INCIDENCE of metabolic syndrome (E1, E7, I1)
between breakfast skippers and normal eaters of recipients of health-check in FY2008
rule-out diagnoses excluded

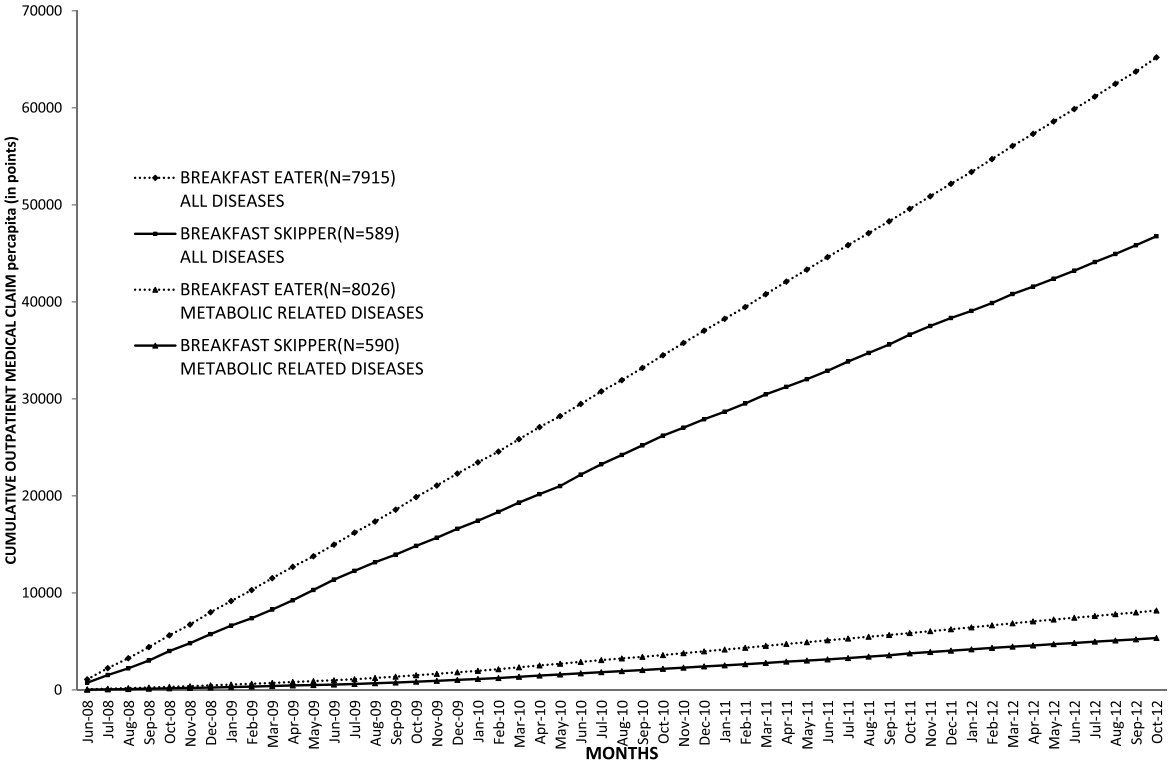

Figure 21 CUMULATIVE OUTPATIENT MEDICAL CHARGES
between breakfast skippers and nonskippers

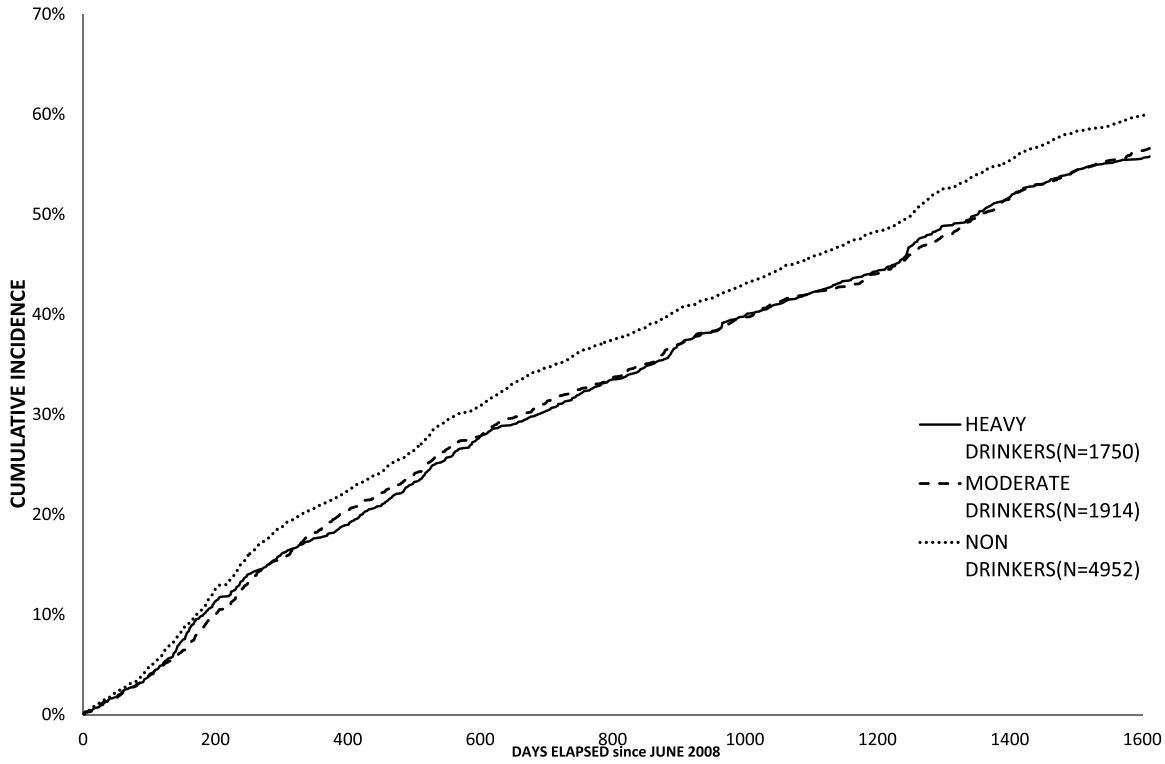

Figure 22 CUMULATIVE INCIDENCE of metabolic syndrome (E1, E7, I1)
between drinkers and non drinkers of recipients of health-check in FY2008
rule-out diagnoses excluded

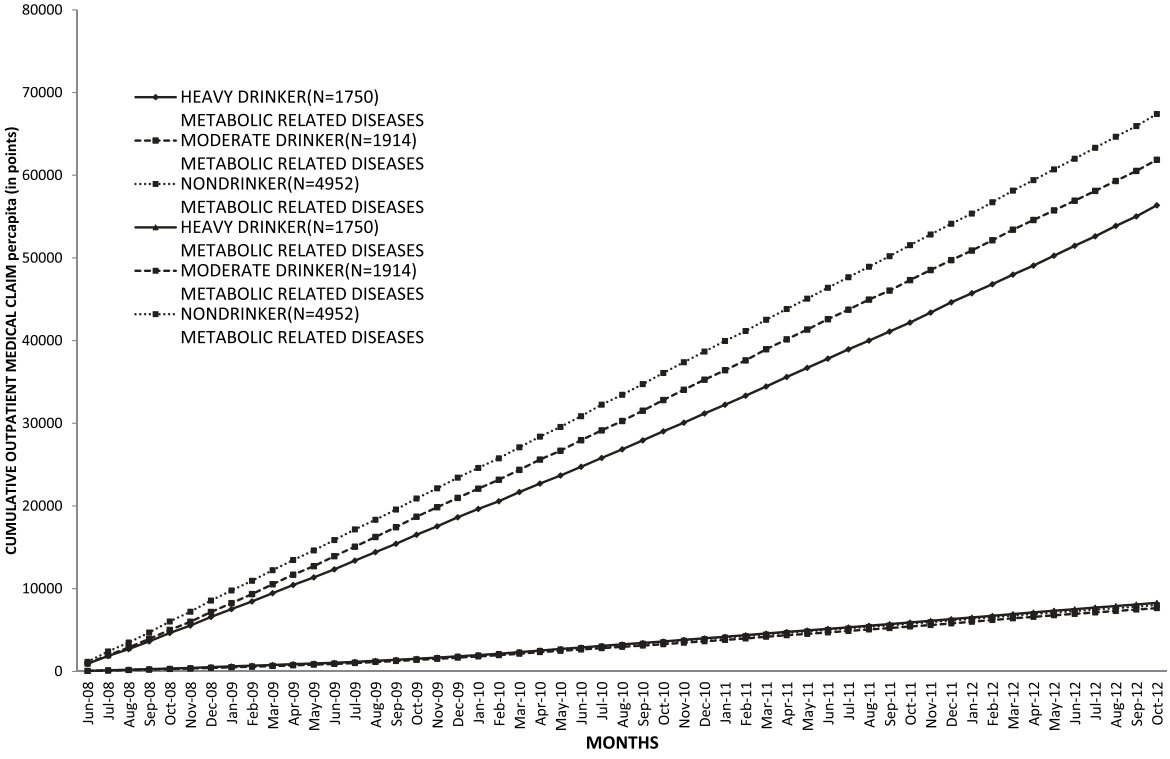

Figure 23 CUMULATIVE OUTPATIENT MEDICAL CHARGES
between drinkers and nondrinkers

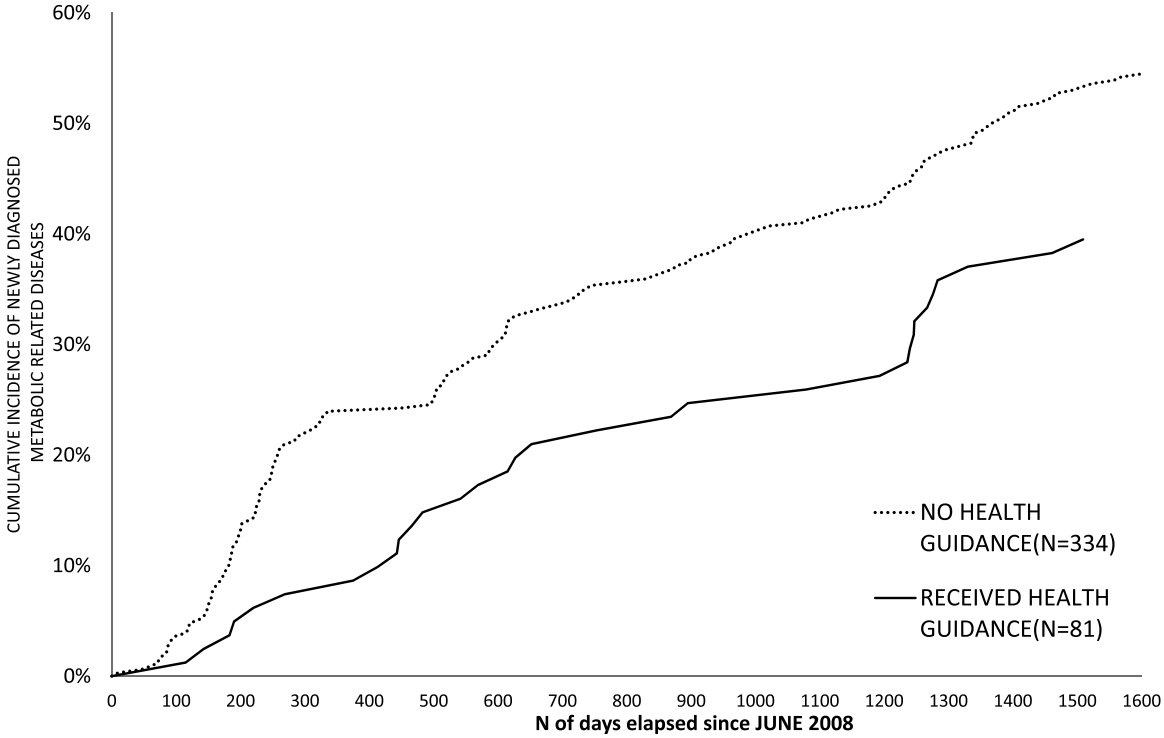

Figure 24 CUMULATIVE INCIDENCE OF NEWLY DIAGNOSED METABOLIC RELATED DISEASES (ICD10:E1, E7, I1)
between those who received health guidance and those who did not among those categorized into
" aggressive " or " motivational " intervention in health checks in FY

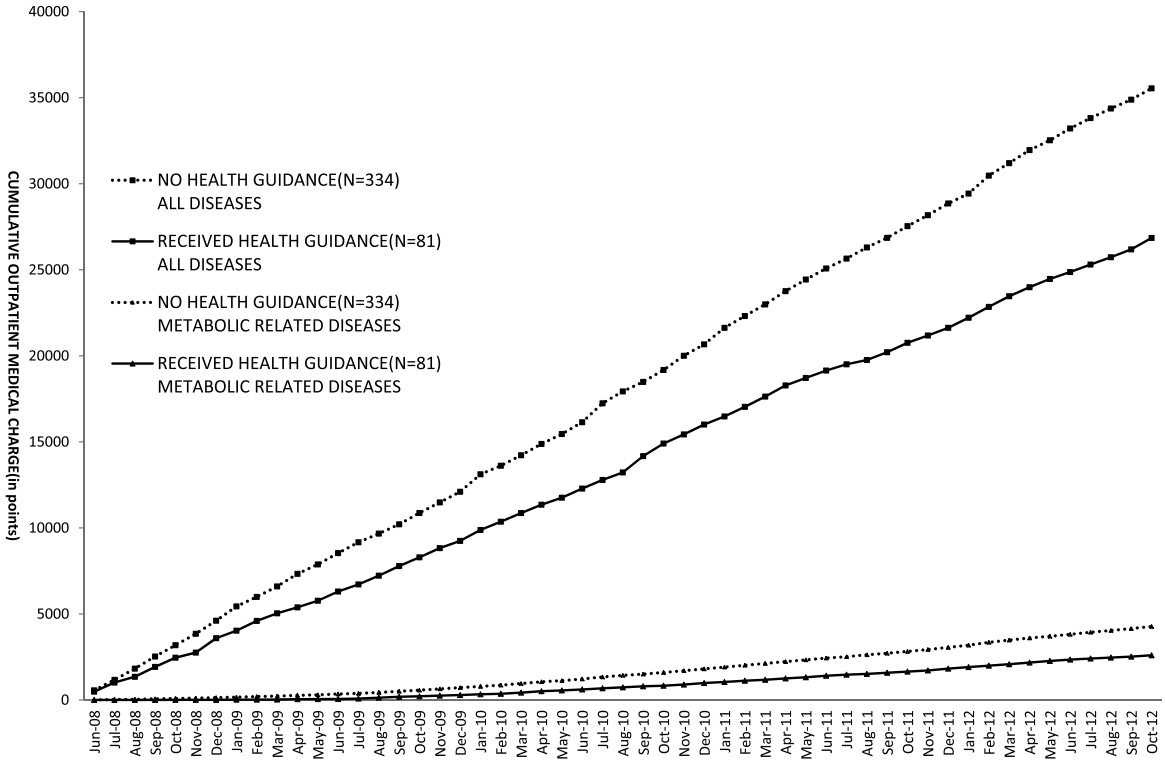

Figure 25 CUMULATIVE OUTPATIENT MEDICAL CHARGES
between those who received health guidance and those who did not among those categorized into
" aggressive " or " motivational " intervention in health checks in FY2008 (age<65, both sexes, N=415)

One of the results of policy goals relating to the HC&G program targeting metabolic syndrome was obtained by analyzing HIC data. HIC data provide valuable information not only on medical charges but also on the incidence of targeted diseases, both of which serve as outcomes to evaluate the HC&G program. To facilitate the use of HIC data, computerization of HIC was promoted [8]. Computerization of HIC was almost achieved by fiscal 2011 and now health insurers have ready access to HIC data.

In fisal 2013, all health insurers are expected to evaluate the outcomes of HC&G provided during the five years from fiscal 2008 to 2012. By linking HC&G data with HIC data, new evidence not known so far will be illuminated. The weak or even opposite relationships between lifestyle factors and incidence and outpatient medical charges demonstrated by this study and by Suzuki-Saito are new evidence to be confirmed by follow-up studies. However, HIC data are complicated and its format is not designed for data analysis [9]. It requires special skills to draw meaningful information from them.

We demonstrated an example of evaluating the HC&G program by linking with HIC data with a relatively long observation period of 53 months. Not only did we compare the total medical charges for all diseases, we compared disease-specific charges by singling out metabolic-related diseases through objective methods. We found that (1) health risks detected in health check ups are reasonably accurate in predicting the future incidence and medical charges of targeted diseases, (2) lifestyles obtained from questionnaire are less accurate in predicting future incidence and medical charges for metabolic related diseases and (3) those who received health guidance showed lower incidence and medical charges than those who did not. As for lifestyles factors, we came up with somewhat negative conclusions: smoker and drinkers showed lower incidence and medical charges for both all diseases and metabolic-related diseases. Modification of lifestyles, such as eating habits, is not likely to lead to savings in health care expenditure at least in a short period of 53 months.

We have to acknowledge limitations from our findings in drawing any cause-effect relationship. Our findings are essentially observational ones with no control groups or matching. No cause-effect relationship may be drawn without some sophisticated methods such as propensity score matching. At least the methodology presented in this study will provide an example to all health insurers in evaluating the outcome of the HC&G program.

Acknowledgement

An excerpt of this article was presented at the 71st annual meeting of Japanese Society of Public Health held at Yamaguchi on October 25, 2012.

Reference

[1] Yajima T. New countermeasures for lifestyle related diseases considering metabolic syndrome. J of National Institute of Public Health. 2006;55(4):294-9 (in Japanese).

[2] Okamoto E, et al. Development of an IT infrastructure under Japan's health care reform 2008: A potential for regional health information networks. Japan J of Medical Informatics. 2008;28(2):93-8.

[3] Kohro T, et al. The Japanese national health screening and intervention program aimed at preventing worsening of the matabolic syndrome. International Health J. 2008;49(2):193-203.

[4] Okamoto E. Cost-benefit of health promotion. In: Muto T, Nam EW, Nakahara T, editors. Asian Perspectives and Evidence on Health Promotion and Education. New York: Springer; 2010. p.123-32.

[5] Okamoto E, Hata E. Estimation of disease-specific costs in health insurance claims: A comparison of three methods. Japanese J of Public Health. 2004;51:926-37.

[6] Okamoto E. Do individualized health promotional programs reduce health care expenditure?---A systematic review of controlled trials in the "Health-Up" model projects of the National Health Insurance. Japanese J of Public Health. 2008;55:822-9.

[7] Suzuki-Saito T, et al. Medical care costs and the characteristics of higher medical costs among BMI groups in the early-stage elderly: an analysis of data obtained from a large-scale study of 29,490 elderly. Japanese J of Public Health. 2012;9(7):466-73 (in Japanese).

[8] Okamoto E. Online submission of health insurance claims mandate: An analysis of the top-down decision-making process by the prime minister following the 2001 central bureaucratic reforms. Health Science & Health Care. 2007;7(2):66-77 (in Japanese).

[9] Nishiyama T, et al. A new data format of health insurance claims suitable for data processing. Japan J of Medical Informatcis. 2013;33(1). in press (in Japanese).

Etsuji OKAMOTO, Yoshimune HIRATSUKA, Koichi OTSUBO, Toshiro KUMAKAWA

レセプト突合による特定健康診査・保健指導の評価

抄録

[目的] 静岡県三島市国民健康保険の特定健康診査・保健指導データとレセプト情報とを突合し，健診から把握される健康リスク，質問票から把握される生活習慣ならびに特定保健指導受診の有無と，健診後のメタボ関連疾患発症率ならびに医科外来医療費を累積額で比較することによって同市の特定健康診査・保健指導事業の評価を試みた．

[方法] 2008年度三島市が実施した特定健康診査・保健指導データを2008年６月～2012年10月分の医科外来レセプトデータと個人単位で突合し，(1) 健診から把握される健康リスク，(2) 質問票から把握される生活習慣ならびに (3) メタボ症候群の有リスク者を対象とする特定保健指導受診の有無，の３要因を評価した．評価指標は，レセプトから把握されるメタボ関連疾患の発症率ならびに医科外来医療費（総医療費とメタボ関連医療費）の53か月の累積額である．

[結果] 健診から把握される健康リスクと特定保健指導受診の有無は，その後のメタボ発症率と医科外来医療費に明確な差異がみられた．しかしながら,食習慣や運動といった生活習慣との関連は弱く，喫煙や飲酒では不健康な生活習慣の者の方が発症率や医科外来医療費が低いという予想とは逆の結果となった．

[考察] 特定健康診査・保健指導データとレセプトデータを個人単位で突合することによって，特定健康診査・保健指導データ内のみの分析ではわからない結果が得られ,その中には予想外のものもあった．特定健康診査・保健指導の評価はレセプトデータとの突合も合わせて行う必要性が示唆された．

キーワード：メタボリック症候群，特定健康診査・保健指導，レセプト，生活習慣，比例配分法

岡本悦司，平塚義宗，大坪浩一，熊川寿郎
国立保健医療科学院医療・福祉サービス研究部