

# Trends of the Incidence and Prevalence of Metabolic Syndrome Among Participants of the Specific Health Check and Guidance System in Japan

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# Abstract

A specific nationwide health check-up and guidance system (Tokutei-Kenshin) was initiated in April 2008 to detect metabolic syndrome (MetS) and if confirmed, to provide individual instruction to modify lifestyle and the necessary treatment. However, trends of the incidence and prevalence of MetS are not yet available. Data of the Tokutei-Kenshin from 2008 to 2014 were used in this study. The total number of participants was 3,809,853. Among them, we identified 933,490 individuals who have screened at least twice during the study period. The mean number of visits was 3.4 times per person. Incidence of MetS was defined as those who were MetS (-) at the first screening and developed MetS next year. Persistent prevalence of MetS was defined as those who were MetS (+) at both the first and next year screening. We obtained five 1-year incidence and persistent prevalence of MetS during the study period. The average 1-year incidence of MetS was 5.7% (6.6%, 2.7%) and the average prevalence of MetS was 10.1% (16.1%, 6.2%) in the total (men, women) participants, respectively. The average persistent prevalence of MetS was 47.3% (49.6%, 43.3%) in the total (men, women) participants, respectively. Both incidence and prevalence of MetS were higher in men than that in women. Compared to those of age less than 65 years old, elderly participants had a higher incidence and prevalence of MetS. During the study period of 2008 to 2014, there were no apparent changes in the incidence, prevalence, and persistent prevalence of MetS.

## Introduction

A specific nationwide health check-up and guidance system, called Tokutei-Kenshin, was initiated in April 2008 in Japan<sup>1</sup>. This project aims to detect metabolic syndrome (MetS) and if confirmed, to provide individual instruction to modify lifestyle and the necessary treatment. The target population comprises Japanese citizens between the ages of 40–74 years. We have been focused mostly on chronic kidney disease (CKD)<sup>2-4</sup>, diabetes mellitus (DM)<sup>5,6</sup>, and mortality<sup>7-10</sup>. Lifestyle is a significant modifier of CKD<sup>11</sup>, cardiovascular disease (CVD)<sup>12</sup>, and mortality<sup>12-13</sup>. We recently confirmed that MetS was a significant risk factor of mortality<sup>14</sup>.

Intervention through this screening program was shown to be very effective for the reversal of MetS<sup>15</sup>. However, the proportion of people attending the intervention program is as low as 11%. The trends in the incidence and persistent prevalence of MetS have not been well studied. Such information would be helpful for the future modification of the protocol of screening among the Japanese population. Lifestyle modification if convinced by the screened participants would prevent the incidence of MetS and reduce the persistent prevalence of MetS.

In the present study, we calculated the incidence, prevalence, and persistent prevalence of MetS using the subjects who were screened at two consecutive years (1year) between 2008 and 2014. Also, we examined the total screened subjects as many of them were screened more than twice.

## Results

The **baseline prevalence** of MetS was summarized in **Table 1**. As a whole, they were 10.9% (total), 17.0% (men), and 6.8% (women), respectively. Men had more than twice the higher prevalence of MetS than that of women. **Figure 1** showed the prevalence of MetS in each year of screening. The **incidence** of MetS was summarized in **Table 2**. As a whole, they were 5.7% (total), 9.6% (men), and 3.5% (women), respectively. Men had more than twice the higher incidence of MetS than women. **Figure 2** showed the 1-year incidence of MetS from the baseline year of screening. The **persistent prevalence** of MetS was 47.3% (total), 49.6% (men), and 43.3% (women), respectively (**Table 3, Figure 3**).

We examined the risk of incidence and **prevalence of MetS** by gender and age group by using multivariate Cox hazard analysis. (**Table 4**) The multivariate-adjusted hazard ratio (HR) of the incidence of MetS was significantly higher in men; HR was 2.38 (95% confidence interval 2.29-2.47), and elderly (age $\geq$ 65 years); HR was 1.35 (95% confidence interval 1.31-1.39), respectively. The incidence of MetS was 5.7% (age $<$  65 years) and 6.6% (age $\geq$ 65 years). The multivariate-adjusted hazard ratio (HR) of the persistent prevalence of MetS was significantly higher in men; HR was 1.43 (95% confidence interval 1.37-1.51), and elderly (age $\geq$ 65 years); HR was 1.10 (95% confidence interval 1.05-1.14), respectively. **Persistent prevalence** of MetS was 45.5% (age $<$  65 years) and 47.5% (age $\geq$ 65 years).

Baseline characteristics of subjects who remained without MetS and developed MetS were summarized in (**Supplementary Table 1**). Those who developed MetS were a significantly higher proportion of men and older age. Other variables except renal failure/ dialysis were also significantly different as the number of subjects was large.

Baseline characteristics of subjects who remained MetS and disappeared MetS were summarized in (**Supplementary Table 2**). Those who remained MetS were a significantly higher proportion of men and older age. Other variables except for current smokers and history were also significantly different.

Baseline characteristics by gender were shown in **Supplementary Table 3**. In men, the prevalence of smokers, DM, and history of CVD and stroke were more than twice as high compared to women. However, the current smoker was less in the elder-age group ( $\geq$ 65 years) than in men (**Supplementary Table 4**). In women, the current smoker was also higher among the younger age group ( $<$ 65 years) (**Supplementary Table 5**).

## Discussion

This study examined the **1-year** incidence and **persistent prevalence** of MetS among the nationwide screening program during the fiscal year of 2008 to 2014 (6 years). As a whole, the 1-year incidence was 9.6% in men and 3.5% in women, and the persistent prevalence of MetS was 49.6% in men and 43.3% in women, respectively. Significant differences in sex and age group were evident in both the 1-year incidence and **persistent prevalence** of MetS. Men and the elderly group (age $\geq$ 65) population were at risk of higher 1-year incidence and **persistent prevalence** of MetS. According to the abridged life table from the Ministry of Health, Labour and Welfare, the life expectancy was 78.4 years in men and 85.3 years in

women in 2002, and it increases to 81.4 in men and 87.5 years in 2019, respectively. The gender discrepancy of life expectancy remains high at 6 years, yet the reasons are not clear.

Subjects with MetS have a significant impact on the incidence of CKD<sup>2,3,4</sup>, diabetes mellitus (DM)<sup>5,6</sup>, and mortality<sup>7-10</sup>. Accordingly, when diagnosed MetS, they are entitled to further examination and lifestyle intervention. Lifestyle per se is a significant modifier of CKD<sup>11</sup>, CVD<sup>12</sup>, and mortality<sup>12-13</sup>. Recently, we confirmed that MetS was a significant risk factor of mortality<sup>14</sup>. Therefore, early intervention in overweight/obese adults, namely MetS subjects is necessary to prevent the progression of CKD<sup>16,17</sup> and death.

The dipstick proteinuria test for CKD detection was shown to be cost-effective<sup>18,19</sup>, however not yet shown for the diagnosis of MetS at the general screening. The key strategy for the prevention of MetS is to keep body weight within the normal range by nutritional management and adequate exercise. in particular aged populations. Intervention through this screening program was shown to be very effective for the reversal of MetS<sup>15</sup>. However, the proportion of people attending the program as low as 11%. The trends in the **1-year** incidence and **persistent prevalence** of MetS have not been well studied. Such information would be helpful for the future modification of the protocol of screening among the Japanese population.

Lifestyle modification if convinced by the screened participants would prevent the overall incidence of MetS and reduce the prevalence of MetS. Other than the weight reduction in overweight and obese subjects, excess alcohol intake, in particular, men, is frequently observed with MetS. Alkerwi A et al recommended restricting alcohol consumption of less than 20 g/day among women, and of less than 40 g/day among men<sup>20</sup>. Other lifestyles such as depression<sup>21</sup> and self-reported sleep duration<sup>22</sup> are reported to be associated with MetS. These observations need to be confirmed among the Japanese but are suggesting the importance of further questionnaires among apparently healthy people.

MetS were defined as waist circumference (men $\geq$ 85cm, women $\geq$ 90cm) plus two or three abnormal values in blood sugar metabolism, lipid, and blood pressure<sup>14</sup>. Waist circumference is a surrogate of central obesity but is often variable by body size, gender, and race. We reported the significance of “a body shape index (ABSI)” on all-cause mortality among screened subjects<sup>10</sup>. ABSI seemed to be a better predictor of death than that of the body mass index (BMI). However, the presence of CKD affected differently on mortality between men and women.

## Strengths and limitations

The strength of the present study is that we have followed a large number of participants of the nationwide screening program. We believe that this cohort represents the currently available database for the analysis of the changes in MetS status in Japan.

There are several limitations in the present study. **First**, participants in this analysis were those who had an interest in lifestyle and their health condition. The participation rate was 38.9% (2008) and 51.4% (2016) of the target population. (Ministry of Health, Labour and Welfare) Therefore, it would not be representative of the whole Japanese population. We have no data on whether the MetS (+) individuals had attended the intervention program or not. A previous study showed that men and relatively younger (age<65 years) had a lower participation rate compared to their counterparts<sup>19</sup>. **Second**, other socio-economic factors related to the incidence and prevalence of MetS are unknown in this screening program. The number of family members, the presence of a spouse, and the location of residence might influence the lifestyle. **Third**, factors other than the differences in lifestyles and history of CVD, stroke, and renal failure at baseline may explain the results of the present study. Long-term lifestyle would be difficult to change by single intervention, in a particular elderly population. **Fourth**, we have no data of those aged 75 and over. The medical care system for the elderly in the later stage of life has also started in 2009 in Japan. Further studies on transition to this program may be warranted. **Finally**, other limitations on the diagnosis of MetS have been discussed in the previous paper<sup>14</sup>.

## Conclusions

This study showed the prevalence, **1-year** incidence, and the persistent prevalence of MetS and found that they remained high level. More provocative strategies are needed for subjects of aged ( $\geq 65$ ) men.

## Methods

Details of the dataset of the nationwide screening program of the Specific Health Check-up and Guidance System (Tokutei-Kensin) in Japan have been previously published<sup>2-14</sup>. From 2008 to 2014, we collected individual records of 3,809,853 participants from 192 municipalities of 27 prefectures. The process for the database construction is summarized in Figure 4. From the total number of subjects who participated (about 3.8 million), we selected those who visited at least twice during the study visit. Finally, we used the dataset of 933,490 participants for the analysis. During the study period, the mean number of visits was 3.4 times per subject. MetS was defined as waist circumference (men $\geq 85$ cm, women $\geq 90$ cm) plus two or three abnormal values in blood sugar metabolism (fasting blood glucose $\geq 100$ mg/dL or HbA1c $\geq 5.2\%$  by 2012 (JDS), HbA1c $\geq 5.6\%$  by NGSP since 2013), lipid (triglyceride $\geq 150$ mg/dL, or HDL cholesterol $< 40$ mg/dL), and blood pressure (systolic $\geq 130$ mmHg, or diastolic $\geq 85$ mmHg)<sup>14</sup>. From 2008 to 2013, the number of participants who had enough information for the diagnosis of MetS was 894,628 (more than twice), 752,809 (more than thrice), and 682,548 (1-year later), respectively. The original database was solely used and managed by Okinawa Heart and Renal Association (OHRA). Furthermore, the preliminary dataset was verified and confirmed independently by Dr. Tsuneo Konta. Afterward, further analyses were done by using a standard analysis file (SAF) without any personal identifier.

The prevalence of MetS was calculated as the denominator was the number of people at the year of screening and the numerator was the number of MetS among them. The 1-year incidence of MetS was

calculated as the denominator was the number of people with MetS (-) at the first checkup and the numerator was the number of developed MetS among them at the next year's screening. For the calculation of the 1-year persistent rate of MetS, we used the denominator was the number of people who are MetS (+) at the first checkup and the numerator was the number of people who remained MetS (+) at the next year screening.

### Statistical analysis

Data were analyzed with SAS/STAT software (version 6.03, SAS Institute, Tokyo, Japan). The student's t-test and the Chi-squared test were performed to compare the significance of discrete variables.

Multivariate Cox regression analysis was performed to evaluate the risks for the changes in the trend of the 1-year incidence and persistent prevalence of MetS. Factors used for the adjustment were body mass index, systolic and diastolic blood pressure, fasting blood glucose, HbA1c, triglyceride, HDL cholesterol, LDL cholesterol, eGFR, proteinuria, alcohol intake, smoking, history of stroke, acute myocardial infarction renal failure, dialysis, and drug use for hypertension, diabetes mellitus, and hyperlipidemia and were based on self-reported information in the medical questionnaire. Hazard ratio and 95% confidence interval were obtained. A *P* value of less than 0.05 was considered statistically significant in all analyses.

## Declarations

**The authors state they have no Conflict of Interest (COI).**

### Financial Support

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**Human Rights** Ethical approval: All procedures performed in studies involving human participants were performed following the ethical standards of the institutional and/or national research committee at which the studies were conducted (Fukushima Medical University; IRB approval number #1485, #2771) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** This study was performed according to Ethical Guidelines for Medical and Health Research Involving Human Subjects enacted by MHLW of Japan [<http://www.mhlw.go.jp/file/06->

Seisakujouhou-10600000-Daijinkanboukouseikagakuka/0000069410.pdf and <http://www.mhlw.go.jp/file/06-Seisakujouhou-10600000-Daijinkanboukouseikagakuka/0000080278.pdf>]. In the context of the guideline, the investigators shall not necessarily be required to obtain informed consent, but we made public information concerning this study on the web [[http://www.fmu.ac.jp/univ/sangaku/data/koukai\\_2/2771.pdf](http://www.fmu.ac.jp/univ/sangaku/data/koukai_2/2771.pdf)] and ensured the opportunities for the research subjects to refuse to utilize their personal information.

## References

1. Kohro T, Furui Y, Mitsutake N, Fujii R, Morita H, Oku S, Ohe K, Nagai R. The Japanese National Health Screening and Intervention Program Aimed at Preventing Worsening of the Metabolic Syndrome. *Int Heart J* 2008; 49:193-203.
2. Iseki K, Asahi K, Moriyama T, Yamagata K, Tsuruya K, Yoshida H, Fujimoto S, Konta T, Ohashi Y, and Watanabe T. Risk factor profiles based on eGFR and dipstick proteinuria: Analysis of the participants of the Specific Health Check and Guidance System in Japan 2008. *Clin Exp Nephrol* 2012; 16:244-249.
3. Konta T, Ikeda A, Ichikawa K, Fujimoto S, Iseki K, Moriyama T, Yamagata K, Tsuruya K, Yoshida H, Asahi K, Kurahashi I, Ohashi Y, Watanabe T. Blood pressure control in a Japanese population with chronic kidney disease: A baseline survey of a nationwide cohort. *Am J Hypertens* 2012; 25:342-347.
4. Tsuruya K, Yoshida H, Nagata M, Kitazono T, Iseki K, Iseki C, Fujimoto S, Konta T, Moriyama T, Yamagata K, Narita I, Kimura K, Kondo M, Asahi K, Kurahashi I, Ohashi Y, Watanabe T. Impact of the triglycerides to high-density lipoprotein cholesterol ratio on the incidence and progression of chronic kidney disease: a longitudinal study in a large Japanese population. *Am J Kidney Dis* 2015; 66:972-983.
5. Kudo A, Asahi K, Satoh H, Iseki K, Moriyama T, Yamagata K, Tsuruya K, Fujimoto S, Narita I, Konta T, Kondo M, Shibagaki Y, Kasahara M, Watanabe T, and Shimabukuro M. Fast eating is a sole predisposing factor for new-onset diabetes: a report from a Japanese nation-wide cohort. Fast eating is a strong risk factor for new-onset diabetes among the Japanese general population. *Sci Rep*. 2019;9(1):8210.
6. Iwasaki M, Kudo A, Asahi K, Machii N, Iseki K, Satoh H, Moriyama T, Yamagata K, Tsuruya K, Fujimoto S, Narita I, Konta T, Kondo M, Shibagaki Y, Kasahara M, Watanabe T, Shimabukuro M. Fast walking is a preventive factor against new-onset diabetes mellitus in a large cohort from a Japanese general population. *Sci Rep*. 2021;11(1):716 9.
7. Iseki K, Konta T, Asahi K, Yamagata K, Fujimoto S, Tsuruya K, Narita I, Kasahara M, Shibagaki Y, Yoshida H, Moriyama T, Kondo M, Iseki C, Watanabe T for the “Design of the comprehensive health care system for chronic kidney disease (CKD) based on the individual risk assessment by Specific Health Check.” Association of dipstick hematuria with all-cause mortality in the general population: Results from the Specific Health Check and Guidance Program in Japan. *Nephrol Dial Transplant* 2018;33(5):825-832.



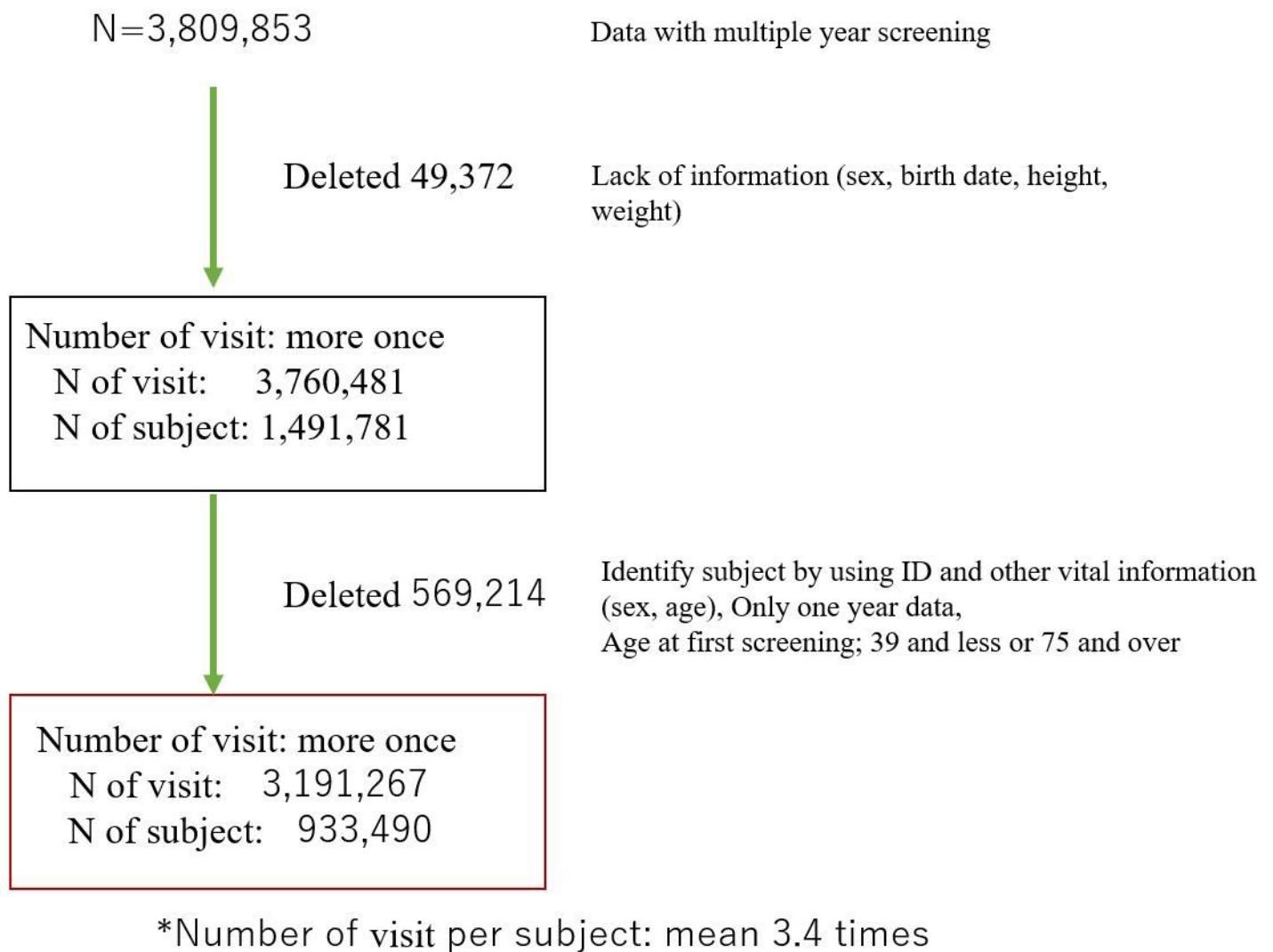
8. Iseki K, Konta T, Asahi K, Yamagata K, Fujimoto S, Tsuruya K, Narita I, Kasahara M, Shibagaki U, Yoshida H, Moriyama T, Kondo M, Iseki C, Watanabe T for the “Design of the comprehensive health care system for chronic kidney disease (CKD) based on the individual risk assessment by Specific Health Check.” Dipstick proteinuria and all-cause mortality among the general population. *Clin Exp Nephrol* 2018;22(6):1331-1340.
9. Iseki K, Asahi K, Yamagata K, Fujimoto S, Tsuruya K, Narita I, Konta T, Kasahara M, Shibagaki Y, Yoshida H, Moriyama T, Kondo M, Iseki C, Watanabe T for the “Design of the comprehensive health care system for chronic kidney disease (CKD) based on the individual risk assessment by Specific Health Check. Mortality risk among screened subjects of the specific health check and guidance program in Japan 2008-2012. *Clin Exp Nephrol* 2017; 21:978-985.
10. Sato Y, Fujimoto S, Konta T, Iseki K, Moriyama T, Yamagata K, Tsuruya K, Narita I, Kondo M, Kasahara M, Shibagaki Y, Asahi K, and Watanabe T. Body Shape Index: Sex-Specific Differences in Predictive Power for All-Cause Mortality in the Japanese Population. *PLoS One* 2017;12(5): e0177779.
11. Wakasugi M, Kazama JJ, Narita I, Iseki K, Fujimoto S, Moriyama T, Yamagata K, Konta T, Tsuruya K, Asahi K, Kondo M, Kurahashi I, Ohashi Y, Kimura K, Watanabe T. Association between overall lifestyle changes and incidence of proteinuria: a population-based, cohort study. *Intern Med* 2017;56(12):1475-1484.
12. Nishimoto M, Tagawa M, Matsui M, et al. A Prediction Model with Lifestyle in Addition to Previously Known Risk Factors Improves Its Predictive Ability for Cardiovascular Death. *Sci Rep* 2019;9(1):12953.
13. Wakasugi M, Narita I, Iseki K, Asahi K, Yamagata K, Fujimoto S, Moriyama T, Konta T, Tsuruya K, Kasahara M, Shibagaki Y, Masahide K, Watanabe T. The effect of CKD on associations between lifestyle factors and all-cause, cancer, and cardiovascular mortality: a population-based cohort study in Japan. *Int Med* (in press)
14. Iseki K, Konta T, Asahi K, Yamagata K, Fujimoto S, Tsuruya K, Narita I, Kasahara M, Shibagaki Y, Moriyama T, Kondo M, Iseki C, Watanabe T for the “Design of the comprehensive health care system for chronic kidney disease (CKD) based on the individual risk assessment by Specific Health Check. et al. Impact of Metabolic Syndrome on Mortality Rate among Participants in Specific Health Check and Guidance Program in Japan. *Int Med* 2020;59(21):2671-2678.
15. Nakao YM, Miyamoto Y, Ueshima K, Nakao K, Nakai M, Nishimura K, Yasuno S, Hosoda K, Ogawa Y, Itoh H, Ogawa H, Kangawa K, Nakao K. Effectiveness of nationwide screening and lifestyle intervention for abdominal obesity and cardiometabolic risks in Japan: The metabolic syndrome and comprehensive lifestyle intervention study on nationwide database in Japan (MetS ACTION-J study). *PLoS One* 2018;13(1): e0190862.
16. Andrés Díaz-López, Nerea Becerra-Tomás, Verónica Ruiz, Estefania Toledo, Nancy Babio, Dolores Corella, Montse Fitó, Dora Romaguera, Jesús Vioque, Ángel M Alonso-Gómez, Julia Wärnberg, J Alfredo Martínez, Luís Serra-Majem, Ramon Estruch, Francisco J Tinahones, José Lapetra, Xavier Pintó, Josep A Tur, José López-Miranda, Naomi Cano Ibañez, Miguel Delgado-Rodríguez, Pilar Matía-Martín, Lidia Daimiel, Jose Antonio de Paz, Josep Vidal, Clotilde Vázquez, Miguel Ruiz-Canela,

- Mònica Bulló, José V Sorlí, Albert Goday, Miquel Fiol, Manoli García-de-la-Hera, Lucas Tojal Sierra, Napoleón Pérez-Farinós, Maria Ángeles Zulet, Almudena Sánchez-Villegas, Emilio Sacanella, José Carlos Fernández-García, José Manuel Santos-Lozano, Miquel Gimenez-Gracia, Maria Del Mar Bibiloni, Javier Díez-Espino, Carolina Ortega-Azorin, Olga Castañer, Marga Morey, Laura Torres-Collado, Carolina Sorto Sanchez, Miguel Ángel Muñoz, Emilio Ros, Miguel A Martínez-Gonzalez, Jordi Salas-Salvadó, PREDIMED-Plus Investigators. Effect of an Intensive Weight-Loss Lifestyle Intervention on Kidney Function: A Randomized Controlled Trial. *Am J Nephrol*. 2021;52(1): 45-58.
17. Yamagata K, Makino H, Iseki K, Ito S, Kimura K, Kusano E, Shibata T, Tomita K, Narita I, Nishino T, Fujigaki Y, Mitarai T, Watanabe T, Wada T, Nakamura T, Matsuo S; Study Group for Frontier of Renal Outcome Modifications in Japan (FROM-J). Effect of Behavior Modification on Outcome in Early- to Moderate-Stage Chronic Kidney Disease: A Cluster-Randomized Trial. *PLoS One*. 2016;11(3): e0151422.
  18. Kondo M, Yamagata K, Hoshi SL, Saito C, Asahi K, Moriyama T, Tsuruya K, Yoshida H, Iseki K, Watanabe T, and on behalf of the Japanese Society of Nephrology Task Force for the Validation of Urine Examination as a Universal Screening. Cost-effectiveness of chronic kidney disease mass screening test in Japan. *Clin Exp Nephrol* 2012; 16:279-291.
  19. Kondo M, Yamagata K, Hoshi SL, Saito C, Asahi K, Moriyama T, Tsuruya K, Konta T, Fujimoto S, Narita I, Kimura K, Iseki K, Watanabe T. Budget impact analysis of chronic kidney disease mass screening test in Japan. *Clin Exp Nephrol* 2014;18(6): 885-891.
  20. Alkerwi A, Boutsen M, Vaillant M, Barre J, Lair ML, Albert A, Guillaume M, Dramaix M. Alcohol consumption and the prevalence of metabolic syndrome: a meta-analysis of observational studies. *Atherosclerosis* 2009;204(2):624-635.
  21. Pimenta AM, Lahortiga-Ramos F, Sayon-Orea C, Martínez-González MA, Sánchez-Villegas A. Depression and metabolic syndrome in participants of the "Seguimiento Universidad de Navarra" (SUN) cohort study. *J Affect Disord* 2021; 284:183-189.
  22. Xie J, Li Y, Zhang Y, Vgontzas AN, Basta M, Chen B, Xu C, Tang X. Sleep duration and metabolic syndrome: An updated systematic review and meta-analysis. *Review Sleep Med Rev* 2021; 59:101451.

## Tables

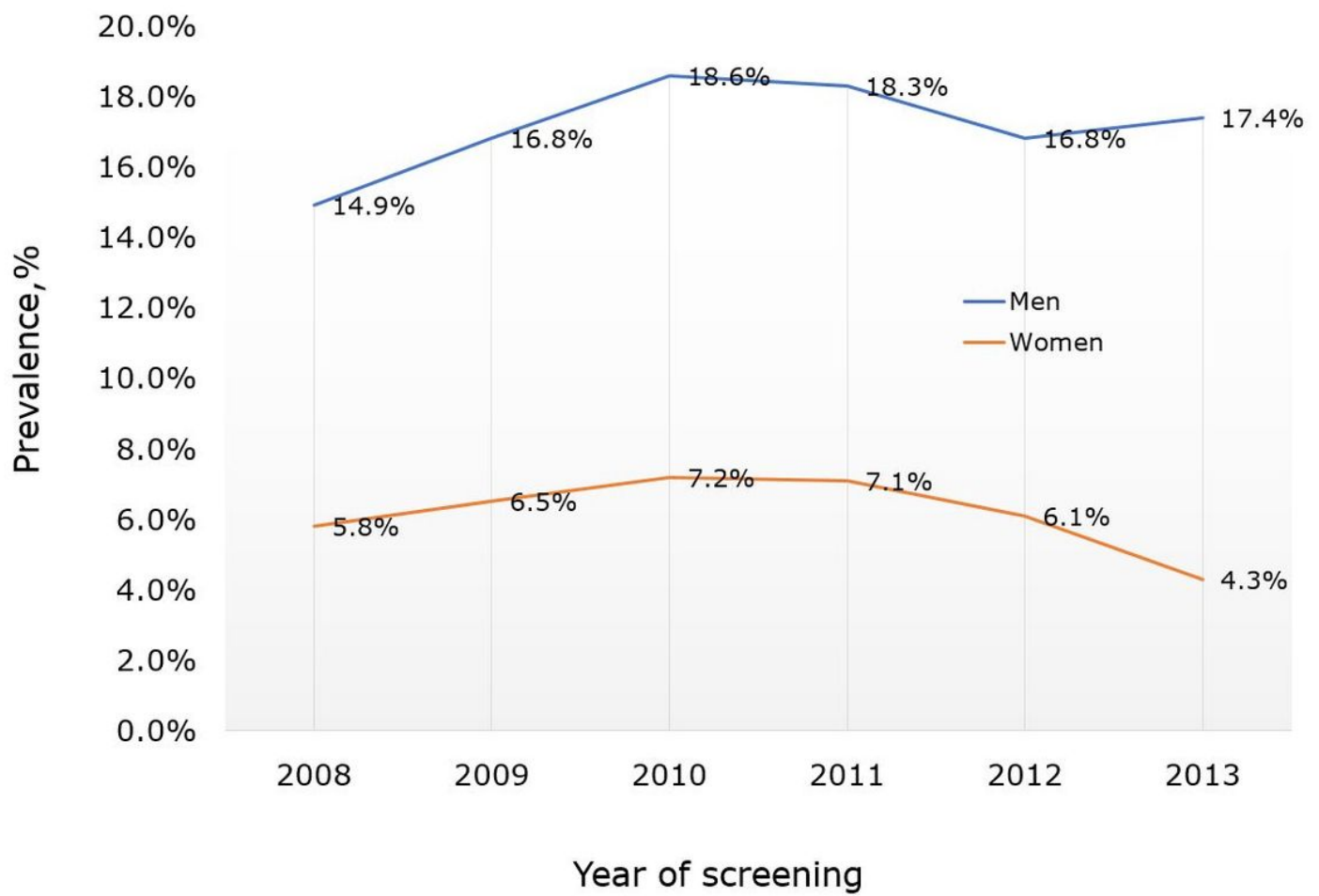
Due to technical limitations, table 1, 2, 3 and 4 is only available as a download in the Supplemental Files section.

## Figures



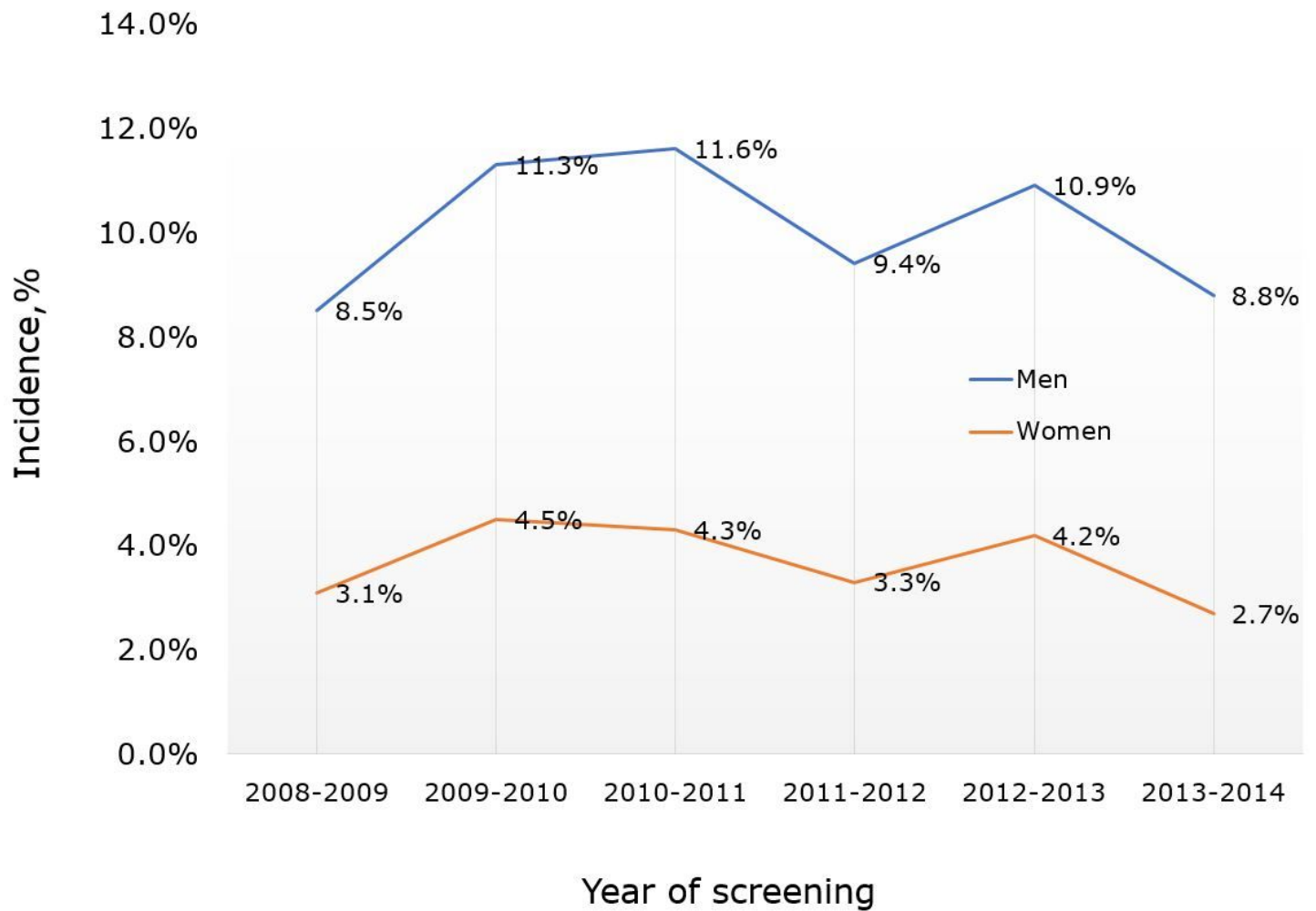
**Figure 1**

Flow chart of data creation



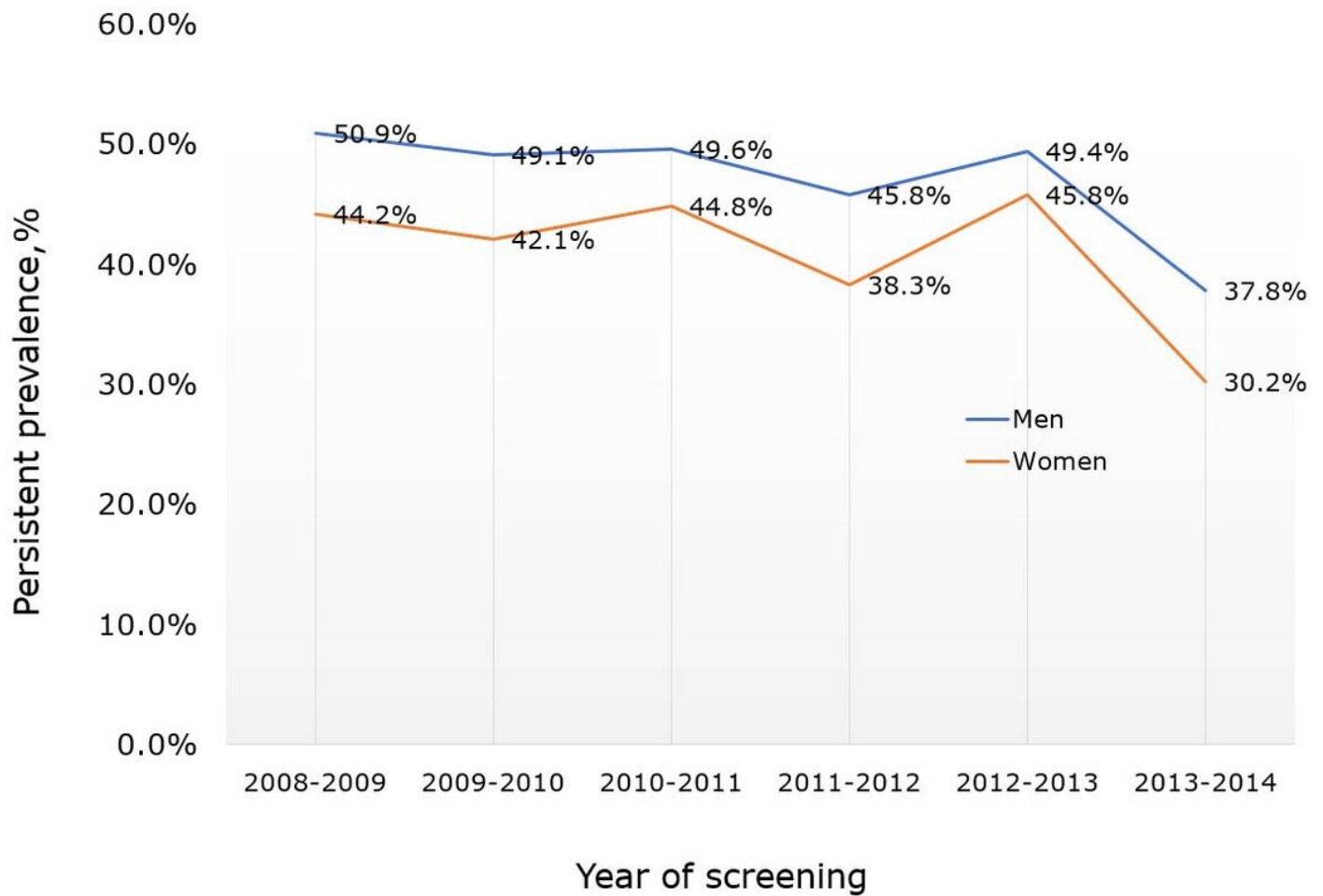
**Figure 2**

Prevalence of metabolic syndrome by year of screening.



**Figure 3**

1-year incidence of metabolic syndrome among those who were free of metabolic syndrome at the first screening.



**Figure 4**

1-year persistent prevalence of metabolic syndrome among subjects who were diagnosed with metabolic syndrome at the first screening.

## Supplementary Files

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