Changes in Abdominal Obesity and Age-Related Macular Degeneration

The Atherosclerosis Risk in Communities Study

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Objective: To examine the association between changes in waist-hip ratio (WHR), a measure of abdominal obesity, and age-related macular degeneration (AMD).

Methods: A total of 12,515 persons from a population-based cohort study, aged 45 to 64 years in 1987 to 1989, were followed up over 6 years. The percentage change in WHR during follow-up was ranked into sex-specific deciles; an increase in WHR was defined as the top 10% of change and a decrease in WHR as the bottom 10%. The association of increased or decreased WHR and presence of AMD at follow-up was determined using logistic regression adjusting for potential confounders.

Results: The average change in WHR was an increase of 2%, ranging from a decrease of 44% to an increase of 102%. A decrease in WHR of 3% or more was associated with 29% lower odds of any AMD (odds ratio=0.71; 95% confidence interval, 0.52-0.97). This effect was most pronounced among obese participants at baseline, where a decrease in WHR was associated with 59% lower odds of AMD (odds ratio=0.41; 95% confidence interval, 0.20-0.82).

Conclusions: Middle-aged persons who had a 3% or greater reduction in WHR over time were less likely to have AMD, particularly among those who were initially obese.


AGE-RELATED MACULAR DEGENERATION (AMD) is the leading cause of visual impairment among elderly persons. Despite advances in research, few modifiable risk factors for AMD have been identified. Although clear associations have been shown with smoking, associations with hypertension, cardiovascular disease, dyslipidemia, and dietary fat intake have not been consistent.1-4

The relationship between obesity and AMD has been the subject of several studies (Table 1), including cross-sectional and case-control studies5-7,19 and more recently longitudinal studies8,9,11,12,14 Most of these have examined AMD associations with overweight and obesity defined by the body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared).3,11 Some studies investigating the relationship between BMI and incident AMD have found no association9,13,16 or have found associations solely within specific population subgroups such as women.10

The waist-hip ratio (WHR) is a measure of central or abdominal obesity. There is now increasing evidence that WHR is a better predictor of diabetes and cardiovascular diseases than BMI.17 However, only 2 studies have investigated relationships between WHR and AMD10,12 with one of them showing stronger relationships between WHR and AMD than between BMI and AMD.

To our knowledge, there has been no analysis of the association between changes in WHR, BMI, or weight with the presence of AMD to date. In the current study, we use longitudinal data from the Atherosclerosis Risk in Communities Study to examine the relationship between changes in WHR during a 6-year period and presence of AMD at the end of the 6-year period. Our hypothesis is that WHR, a measure of central obesity, and changes in WHR over time are associated with the prevalence of AMD.

STUDY POPULATION

The Atherosclerosis Risk in Communities Study is a population-based cohort study that included 15,792 women and men aged 45 to 64 years at baseline in 1987 to 1989.18 Population samples were selected from 4 US communities. Of those examined at baseline, 86% of the survivors returned for the third examination 6 years after the baseline examination (1993-1995).

Our study population comprised persons who returned to the third examination, when retinal photography was first performed.5,10,20 Of the 12,887 who returned for this examina-
tion, we excluded 271 with no retinal photographs or with ungradable photographs, 30 without measurements of weight, height, waist circumference, or hip circumference, and, owing to small numbers, 38 whose race was neither black nor white and 42 black residents in Minneapolis, Minnesota, and Maryland, leaving 12,506 who provided data for this study. Characteristics of participants with and without gradable retinal photographs have been previously reported.19

Institutional review boards at each study site and at the Fundus Photograph Reading Center, University of Wisconsin, Madison, approved the study. Informed consent was obtained from all of the participants, and the study was conducted in accordance with the Declaration of Helsinki.

### WHR, BMI, AND WAIST CIRCUMFERENCE

Waist and hip circumferences were determined by horizontal measurement of the maximum girth at the umbilicus and over the buttocks, respectively.

To analyze the relationship between change in WHR from baseline and the third examination and AMD at the third examination, we defined change in 2 ways: absolute and relative. Absolute change (in centimeters) was defined as the difference between WHR at baseline and WHR at the third examination. Relative change was defined as the percentage change in WHR between baseline and the third examination. For categorical comparisons, we wanted categories of decreased and increased WHR to contain a change of at least 3% based on current ideas of clinical significance.21 We divided change in WHR into sex-specific deciles; decreased WHR was defined for primary analyses as the bottom decile of percentage change (including change of −3% to −44%), increased WHR was defined as the top decile of percentage change (including change of 6% to 102%), and stable WHR was defined as the intermediate 8 deciles. Change in waist circumference was similarly defined.

Height and weight circumferences were measured with participants in scrub suits. For analysis by weight group, the population was divided into normal weight (BMI <18.5), overweight (BMI 18.5 to 24.9), and obese (BMI ≥ 25) groups.22 Owing to their small numbers (88 individuals), those with BMI less than 18.5 were not included in the analyses stratified by weight group. We defined changes in BMI in the same way as WHR.

### RETINAL PHOTOGRAPHY AND AGE-RELATED MACULAR DEGENERATION

The retinal photography procedure and the assessment of AMD have been previously reported.6,20,21 Briefly, a 45° nonmydriatic retinal photograph centered on the region of the optic disc and the macula of 1 randomly selected eye of each participant was taken following 5 minutes of dark adaptation. Graders masked to subject identity evaluated the photographs at the University of Wisconsin, Madison, using a modification of the Wisconsin AMD grading system.24 The presence of soft drusen, retinal pigment epithelial depigmentation, increased retinal pigment, pure geographic atrophy, and signs of exudative macular de-

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**Table 1. Summary of Studies on Body Mass Index, Waist-Hip Ratio, and Age-Related Macular Degeneration**

<table>
<thead>
<tr>
<th>Study Population</th>
<th>Type of Study</th>
<th>Participants, No. (Age, y)</th>
<th>Definition of BMI or WHR</th>
<th>AMD Definition</th>
<th>Main Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Mountains Eye Study, Australia4</td>
<td>Population based, cross-sectional</td>
<td>3654 (≥49)</td>
<td>Overweight: BMI ≥25 and &lt;30; obesity: BMI ≥30</td>
<td>Early and late AMD</td>
<td>OR = 1.78 for early AMD and obesity</td>
</tr>
<tr>
<td>Age-Related Eye Disease Study4</td>
<td>Clinic based, cross-sectional</td>
<td>4519</td>
<td>Increasing BMI</td>
<td>Neovascular AMD and central geographic atrophy</td>
<td>Increased BMI associated with increase in neovascular AMD</td>
</tr>
<tr>
<td>POLA study, ages 60-95 y7</td>
<td>Population based, cross-sectional</td>
<td>2584 (60-95)</td>
<td>Obesity: BMI ≥30</td>
<td>Soft drusen, late AMD, pigmentary abnormalities</td>
<td>OR = 2.29 for late AMD and obesity</td>
</tr>
<tr>
<td>Beaver Dam Eye Study, United States9-10</td>
<td>Population based, cross-sectional, and prospective cohort</td>
<td>3722 (43-86)</td>
<td>Continuous BMI and WHR</td>
<td>Early and late AMD</td>
<td>BMI and WHR associated with increased early AMD in women in cross-sectional study; no relation of BMI to incident early or late AMD</td>
</tr>
<tr>
<td>Physicians’ Health Study, United States11</td>
<td>Prospective cohort study of incidence</td>
<td>21 121</td>
<td>Overweight: BMI ≥25 and &lt;30; obesity: BMI ≥30</td>
<td>Dry or neovascular AMD</td>
<td>RR = 2.15 for dry AMD and obesity</td>
</tr>
<tr>
<td>Hospital-based retinal practice, United States12</td>
<td>Longitudinal study of progression</td>
<td>261 (≥60)</td>
<td>Overweight: BMI ≥25 and &lt;30; obesity: BMI ≥30</td>
<td>Geographic atrophy and neovascular disease (combined)</td>
<td>BMI: RR = 2.32 for overweight, RR = 2.35 for obesity; WHR: RR = 1.84 for highest tertile vs lowest tertile</td>
</tr>
<tr>
<td>Pooled data from 3 studies in Australia, United States, and Europe13</td>
<td>Prospective cohort</td>
<td>9523 (43-95)</td>
<td>Overweight: BMI ≥25 and &lt;30; obesity: BMI ≥30</td>
<td>Late AMD</td>
<td>No association</td>
</tr>
<tr>
<td>Clinical cohort with early or intermediate AMD, United States14</td>
<td>Longitudinal study of incidence</td>
<td>2506</td>
<td>Obesity: BMI ≥30</td>
<td>Neovascular AMD or central geographic atrophy</td>
<td>OR = 1.93 for obesity and central geographic atrophy</td>
</tr>
<tr>
<td>Lithuania15</td>
<td>Population based, case-control</td>
<td>1403 (35-64)</td>
<td>Overweight: BMI ≥25 and &lt;30; obesity: BMI ≥30</td>
<td>AMD</td>
<td>AMD was associated with increased BMI in men</td>
</tr>
<tr>
<td>Israel16</td>
<td>Population based, case-control</td>
<td>130 (56-77)</td>
<td>Overweight: BMI ≥25 and &lt;30; obesity: BMI ≥30</td>
<td>No association</td>
<td></td>
</tr>
</tbody>
</table>
generation were determined in the macular area circumscribed by the outermost circle of the grading grid.

Soft drusen were defined as those having a diameter larger than 63 µm. Retinal pigment epithelial depigmentation and increased retinal pigment associated with AMD (the presence of granules or clumps of gray or black pigment in or beneath the retina) were defined as present or absent/questionable. Early AMD was defined as the presence of soft drusen alone, retinal pigment epithelial depigmentation alone, or a combination of soft drusen with increased retinal pigment and/or retinal pigment epithelial depigmentation in the absence of late AMD. Late AMD was defined as the presence of signs of exudative AMD or pure geographic atrophy. Any AMD was defined as the presence of either early or late AMD.

Quality-control procedures were based on repeated assessment of photographs for 520 participants. In general, weighted k of signs of AMD ranged from 0.67 to 0.81 for intra-grader comparisons and 0.55 to 0.92 for inter-grader comparisons.

OTHER RISK FACTORS

Participants were evaluated for cardiovascular risk factors at each examination. Patients were defined as having pre-existing coronary heart disease if they had a history of acute myocardial infarction, silent infarction, or coronary revascularization procedures at baseline. Blood pressure was taken according to a standardized protocol with a random-zero sphygmomanometer, and the mean of the last 2 measurements was used. Blood was drawn after the patient had fasted overnight and processing was performed for total cholesterol, low-density lipoprotein cholesterol, triglycerides, glucose, and fibrinogen levels and white blood cell count as described elsewhere. Diabetes mellitus was defined as a fasting glucose level of 126 mg/dL or higher (to convert to millimoles per liter, multiply by 0.0555), a non-fasting glucose level of 200 mg/dL or higher, or a self-reported history of or treatment for diabetes. Education and cigarette smoking were ascertained from interview. Education was divided into basic (<12 years), intermediate (12-16 years), or advanced (17-21 years) levels. Participants were categorized as current, former, and never smokers, and years of smoking cigarettes were also recorded. Physical activity was characterized by sports and leisure activity indexes (scores within each index ranging from 0-5) described elsewhere.

STATISTICAL ANALYSES

The crude distribution of potential confounders across categories of change in WHR was determined by analysis of variance. To analyze the cross-sectional relationship between WHR and AMD, logistic regression was performed on AMD at examination 3 using standardized values of WHR measured at examination 3 and confounders measured at examination 3. All of the analyses were adjusted for sex, age (continuously), race, and study center. A second set of models was additionally adjusted for smoking status, blood glucose level, systolic blood pressure, serum total cholesterol level, the presence of coronary heart disease or diabetes, physical activity level, fibrinogen level, and white blood cell count measured at baseline.

To analyze the relationship between change in WHR, BMI, or waist circumference between baseline and the third examination and AMD at the third examination, we used sex-specific deciles of relative change as described earlier. The association between change in weight and AMD was analyzed using logistic regression with the stable weight group (deciles 2-9) as the reference group and presence or absence of AMD at the third examination as the outcome.

All of the analyses were adjusted for sex, age, race, and study center. A second set of models was additionally adjusted for baseline WHR, BMI, or waist circumference in the analyses of change in WHR, BMI, or waist circumference, respectively. A third set of models was also adjusted for baseline BMI or WHR, smoking status, years of cigarette smoking, change in smoking status during follow-up, serum glucose level, systolic blood pressure, serum total cholesterol level, the presence of coronary heart disease or diabetes, physical activity level, fibrinogen level, and white blood cell count, all measured at baseline. If one of the variables was used for stratification, it was no longer included in the model. Subgroup analyses were performed after stratifying by sex, age group, weight group, diabetes status, smoking status, and race. Interaction terms for each of the stratification variables with change in WHR were also tested in the logistic regression models. All of the analyses were performed using Stata/SE version 8.0 statistical software (Stata Corp, College Station, Texas).

RESULTS

Between baseline and the third examination, the average change in WHR was an increase of 1% for men and 3% for women, ranging from a decrease of 4% to an increase of just more than 100% (Figure). Those whose WHRs decreased, increased, or remained stable differed according to race, education, baseline WHR, obesity prevalence, baseline coronary heart disease, diabetes prevalence, and baseline cardiovascular disease risk factors (Table 2). In general, the group with decreasing WHR
had the highest baseline levels of cardiovascular risk factors, including BMI and WHR.

There was a positive cross-sectional relationship between WHR at examination 3 and presence of AMD at examination 3 (Table 3). After full multivariate adjustment, the increased odds of any AMD associated with a 1-SD increase in WHR was 14% (95% confidence interval [CI], 1.02-1.27). An association was seen with all forms of AMD analyzed. There was no association between BMI at examination 3 and presence of AMD (odds ratio [OR] = 1.02 per 1-SD increase; 95% CI, 0.92-1.12).

There was a slight increase in the prevalence of AMD across the WHR relative change categories, with 50 cases of AMD (4%) in the group with decreasing WHR, 495 cases (5%) in the group with stable WHR, and 63 cases (5%) in the group with increasing WHR. There was no significant association between continuous change in WHR (OR = 1.09 per 1-SD change; 95% CI, 0.90-1.19) and the presence of AMD after full multivariate adjustment.

Increasing a decrease in WHR was associated with 29% lower odds of any AMD in the total population (Table 4). Such a decrease was associated with lower odds of early AMD and soft drusen but not with retinal pigment epithelial pigmentary abnormalities. We were unable to analyze late AMD as there were no cases within the decreasing group. No factors for which the variables were adjusted appreciably altered the associations observed (Table 4).

Among persons who were obese at baseline, a decrease in WHR was associated with 59% lower odds of AMD (OR = 0.41; 95% CI, 0.20-0.82) (Table 5). There was no relationship between a decrease in WHR and a decreased risk of AMD in those who were overweight or normal weight at baseline. However, there was no significant interaction between WHR change category and baseline weight group (P = .23). No factors for which the variables were adjusted appreciably altered the associations observed (Table 5).

There was no large significant relationship between an increase in WHR over time and increased odds of AMD (Table 4). Stratification by weight category suggested that an increase in WHR was associated with increased odds of any AMD in individuals with normal weight (Table 5), although this was not statistically significant in the fully adjusted model (P = .09).

Analyses were also performed in subgroups defined by sex, diabetes, race, and smoking status. A decrease in WHR was significantly associated with lower odds of having AMD compared with those with stable WHR in women (OR = 0.63; 95% CI, 0.40-0.98) and nonsmokers (OR = 0.60; 95% CI, 0.46-0.93). However, no interaction terms between change in WHR, so defined, and sex, diabetes, race, or smoking status were found to be significant.

When categories were defined by absolute change in WHR, the same trends seen earlier were observed (data not shown). After adjustment for age, sex, race, and center, a decrease in WHR was associated with decreased odds of AMD in the total population (OR = 0.74; 95% CI, 0.55-1.00). In the obese subgroup, the fully adjusted OR for AMD was 0.59 (95% CI, 0.33-1.06).

Analysis of the relationship of percentage change in BMI with AMD demonstrated a relationship similar to that with WHR (data not shown), although the relationship with a large decrease in weight was generally weaker. There was no relationship between decreases in BMI and AMD in the total population (OR = 0.99; 95% CI, 0.74-1.32). In the obese subpopulation, there were decreased odds of 50% (95% CI, 0.27-0.89). A similar relationship with change in waist circumference, similarly defined, was also observed (data not shown), although the only significant association was that between a decrease in waist circumference and AMD in the obese subgroup (OR = 0.34; 95% CI, 0.16-0.71).

In this middle-aged population, a decrease in WHR over a 6-year period, defined as the bottom decile of percentage change in WHR, was associated with a reduced prevalence of AMD. This effect was particularly apparent among...
persons who were obese at baseline, with a 61% decrease in the odds of AMD associated with a reduction in WHR over time. While there was a trend to suggest that increases in WHR were also associated with an increased prevalence of AMD, this relationship was not statistically significant.

Our findings suggest a role of weight loss in preventing the development of AMD, adding to existing literature on the increased risk of AMD associated with higher BMI and WHR (Table 1). Prospective data from the Physicians’ Health Study, for example, demonstrated that the 15-year incidence for visually significant dry AMD was highest in obese men and lowest in men with normal BMI while controlling for age and smoking.11 The mechanisms linking higher body weight with AMD are still unclear. Prior studies have suggested that oxidative stress may be one such mechanism.29-31 Other risk factors for AMD, including physical inactivity, hypertension, and hyperlipidemia, are also associated with obesity, suggesting that these associations may reflect shared risk factors. However, associations between WHR and AMD were independent of these risk factors.

Our finding of a reduction in WHR related to decreased odds of prevalent AMD is consistent with studies showing that weight loss leads to improvements in cardiovascular risk factors, including diabetes and hypertension.33-36 Studies have further suggested that the beneficial effects of weight loss are most apparent among the overweight or obese,34,35 which supports the stronger association we found for AMD in persons who were obese. One

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### Table 3. Cross-sectional Association of Waist-Hip Ratio and Age-Related Macular Degeneration at the Third Examination

<table>
<thead>
<tr>
<th>AMD Subtype</th>
<th>Participants, No.</th>
<th>Participants at Risk, No.</th>
<th>OR (95% CI) of AMD, Per 1-SD Change in WHR at Third Examination Adjusted for Age, Sex, Race, and Center^b</th>
<th>Multivariate-Adjusted^d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any AMD</td>
<td>608</td>
<td>12,506</td>
<td>1.09 (1.00-1.20)</td>
<td>1.14 (1.02-1.27)</td>
</tr>
<tr>
<td>Early AMD</td>
<td>591</td>
<td>12,506</td>
<td>1.08 (0.99-1.19)</td>
<td>1.11 (1.00-1.24)</td>
</tr>
<tr>
<td>Late AMD</td>
<td>17</td>
<td>12,506</td>
<td>1.37 (1.00-1.90)</td>
<td>1.36 (1.02-1.83)</td>
</tr>
<tr>
<td>Soft drusen</td>
<td>504</td>
<td>12,506</td>
<td>1.07 (0.96-1.18)</td>
<td>1.09 (0.96-1.22)</td>
</tr>
<tr>
<td>RPE abnormalities</td>
<td>293</td>
<td>12,506</td>
<td>1.14 (1.01-1.30)</td>
<td>1.20 (1.04-1.39)</td>
</tr>
</tbody>
</table>

Abbreviations: AMD, age-related macular degeneration; CI, confidence interval; OR, odds ratio; RPE, retinal pigment epithelium; WHR, waist-hip ratio.

- ^a Adjusted in logistic regression models.
- ^b Adjusted additionally for baseline WHR.
- ^c Adjusted additionally for baseline smoking status, years of cigarette smoking, change in smoking status during follow-up, baseline body mass index (calculated as weight in kilograms divided by height in meters squared), systolic blood pressure, prior coronary heart disease, diabetes, total cholesterol level, triglycerides level, serum glucose level, plasma fibrinogen level, white blood cell count, and physical activity level.
- ^d Decrease and increase in WHR are defined as the bottom and top sex-specific deciles, respectively, of percentage change in WHR over the 6-year follow-up.

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### Table 4. Change in Waist-Hip Ratio Between Baseline and the Third Examination and Age-Related Macular Degeneration at the Third Examination

<table>
<thead>
<tr>
<th>WHR Change</th>
<th>Participants, No.</th>
<th>Participants at Risk, No.</th>
<th>Adjusted for Age, Sex, Race, and Center^b</th>
<th>Multivariate-Adjusted^b</th>
<th>Multivariate-Adjusted^c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any AMD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease^d</td>
<td>50</td>
<td>1250</td>
<td>0.74 (0.55-1.00)</td>
<td>0.71 (0.53-0.97)</td>
<td>0.71 (0.52-0.97)</td>
</tr>
<tr>
<td>Stable</td>
<td>495</td>
<td>10,004</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Increase^d</td>
<td>63</td>
<td>1252</td>
<td>1.09 (0.83-1.42)</td>
<td>1.16 (0.87-1.53)</td>
<td>1.11 (0.82-1.49)</td>
</tr>
<tr>
<td>Early AMD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease^d</td>
<td>50</td>
<td>1250</td>
<td>0.77 (0.57-1.04)</td>
<td>0.74 (0.55-1.00)</td>
<td>0.74 (0.54-1.01)</td>
</tr>
<tr>
<td>Stable</td>
<td>482</td>
<td>10,004</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Increase^d</td>
<td>59</td>
<td>1252</td>
<td>1.04 (0.79-1.38)</td>
<td>1.10 (0.83-1.47)</td>
<td>1.05 (0.77-1.42)</td>
</tr>
<tr>
<td>Soft drusen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease^d</td>
<td>44</td>
<td>1250</td>
<td>0.79 (0.58-1.09)</td>
<td>0.78 (0.56-1.07)</td>
<td>0.78 (0.56-1.08)</td>
</tr>
<tr>
<td>Stable</td>
<td>410</td>
<td>10,004</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Increase^d</td>
<td>50</td>
<td>1252</td>
<td>1.04 (0.77-1.40)</td>
<td>1.08 (0.79-1.47)</td>
<td>1.00 (0.72-1.39)</td>
</tr>
<tr>
<td>RPE abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease^d</td>
<td>30</td>
<td>1250</td>
<td>0.98 (0.67-1.45)</td>
<td>0.90 (0.60-1.33)</td>
<td>0.89 (0.59-1.34)</td>
</tr>
<tr>
<td>Stable</td>
<td>230</td>
<td>10,004</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Increase^d</td>
<td>33</td>
<td>1252</td>
<td>1.24 (0.85-1.79)</td>
<td>1.41 (0.96-2.07)</td>
<td>1.39 (0.93-2.07)</td>
</tr>
</tbody>
</table>

Abbreviations: AMD, age-related macular degeneration; CI, confidence interval; OR, odds ratio; RPE, retinal pigment epithelium; WHR, waist-hip ratio.

- ^a Adjusted in logistic regression models.
- ^b Adjusted additionally for baseline WHR.
- ^c Adjusted additionally for baseline smoking status, years of cigarette smoking, change in smoking status during follow-up, baseline body mass index (calculated as weight in kilograms divided by height in meters squared), systolic blood pressure, prior coronary heart disease, diabetes, total cholesterol level, triglycerides level, serum glucose level, plasma fibrinogen level, white blood cell count, and physical activity level.
- ^d Decrease and increase in WHR are defined as the bottom and top sex-specific deciles, respectively, of percentage change in WHR over the 6-year follow-up.
problem with analyzing observational weight loss data is that unintentional weight loss is often caused by illness, leading to an association between weight loss and ill health or mortality. Studies specifically analyzing intentional weight loss have generally found it to be beneficial for health. In our study, we did not have data to differentiate intentional weight loss, so it is possible that the true beneficial effects observed are underestimated. However, including only individuals free of coronary heart disease and diabetes at baseline had little effect on the results.

The finding that weight gain (both absolute and relative changes) was not significantly associated with an increased risk of AMD was somewhat unexpected. There was a suggestion of increased AMD risk among persons with normal weight at baseline. This was also seen in another study where substantial weight gain was significantly associated with increased cardiovascular risk only in middle-aged persons, particularly those who were initially obese, may be associated with a decrease in the likelihood of prevalent AMD. With increasing prevalence of obesity, these results should be confirmed in future studies as reduction in risk of AMD may be an additional benefit of reducing weight, especially in obese and overweight patients.

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**REFERENCES**


