Weight Reduction and Increased Physical Activity to Prevent the Progression of Obstructive Sleep Apnea: A 4-Year Observational Postintervention Follow-up of a Randomized Clinical Trial

Obstructive sleep apnea (OSA) has become a major health burden in affluent populations. It is a chronic, progressive disease, and it is well documented that severe OSA is associated with increased cardiovascular morbidity and mortality.[1-3] Obesity is the most important risk factor for OSA; in fact, most patients with OSA are obese.[4] Weight reduction has been shown to improve OSA or even cure it.[5,6] However, whether beneficial changes related to weight loss are maintained after stopping the active lifestyle intervention, and, thus, the progression of OSA prevented, is not known. The aim of the study was to assess the long-term efficacy of a lifestyle intervention based on weight reduction, healthy diet, and physical activity during a 4-year postintervention follow-up in people with OSA who originally participated in a 1-year randomized, clinical lifestyle intervention trial.[5]

Methods. Altogether, 81 consecutive obese adults with mild OSA were randomized into either an intervention group or a control group (eFigure; http://www.jamainternalmed.com). Individuals in the intervention group received a 1-year lifestyle intervention[5] (based on healthy diet and physical activity counseling), including an initial intensive weight reduction program with 12 weeks on a very low calorie diet. The control group received 3 general dietary and exercise counseling sessions. The participants underwent nocturnal cardiorespiratory monitoring using the Embletta polysomnography device (Embla), in accordance with accepted guidelines for diagnosing OSA.[7] The design of the study and lifestyle counseling have been reported previously in detail.[5] During the subsequent 4 years, active counseling was no longer offered. The change in apnea-hypopnea index (AHI) was the main objective outcome variable. The study protocol was approved by the research ethics committee of the Hospital District of Northern Savo, Kuopio, Finland. The participants were given both oral and written information about the protocol, and they provided a signed informed consent. Differences in changes between the groups were assessed with analysis of covariance. Baseline differences in age, sex, body mass index, and the baseline level of respective variable were taken into account by including these variables as explanatory variables in the model. Kaplan-Meier survival curves were calculated to estimate the probability of the progression of mild OSA to moderate or severe OSA in the 2 groups. Participants who were lost during follow-up were treated as censored observations. All comparisons between the treatment groups were based on the intention-to-treat principle, and all analyses were based on the 57 participants who completed the 4-year follow-up. The study sample size was set in order to achieve 90% power at a 5% significance level to detect a 25% difference in the prevalence of mild OSA between the groups after 5 years.

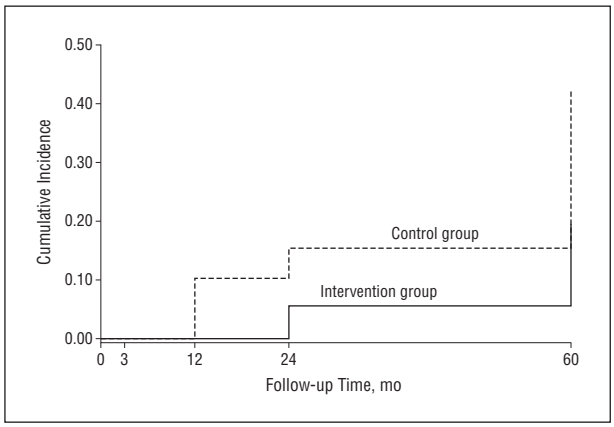

Figure. Progression of obstructive sleep apnea (OSA) by treatment group during the postintervention follow-up period. Kaplan-Meier estimate of probability of progression of OSA. The difference between the survival curves was tested with the log-rank test. The Cox proportional hazard model was used to estimate the hazard ratio for the progression of OSA. There were 14 events in the control group and 6 in the intervention group. The incidence rate for the control group was 0.7 (95% CI, 0.4-1.3), and for the intervention group, 0.3 (95% CI, 0.1-0.7). Log-rank test, $P = .04$. Hazard ratio, 0.39 (95% CI, 0.2-1.0) ($P = .049$).

Results. There were no differences in the characteristics at baseline (eTable 1) and the 12- or 24-month follow-up in individuals who participated in the entire 4-year follow-up compared with those who dropped out earlier. During the 5-year period, the mean change in weight was −5.5 kg (5.5% of the initial weight) in the intervention group and 0.6 kg (0.7% of the initial weight) in the control group ($P = .03$). The changes in AHI between the groups were also significant ($P = .04$) in the intervention group (AHI, −0.8; 95% CI, −3.3 to 1.8) compared with the control group (AHI, 5.0; 95% CI, 0.8 to 9.2) (eTable 2). Over the 4-year follow-up period, the degree of OSA deteriorated from mild to moderate in 6 individuals in the intervention group, all with unsuccessful weight reduction, and in 12 individuals in the control group. Furthermore, the disease deteriorated to severe OSA in 2 people in the control group. The intervention achieved a 61% reduction in the incidence of progression of the OSA compared with the control group (log-rank test $P = .04$) (**Figure**).

Discussion. To our knowledge, this is the first study to provide long-term evidence that a healthy lifestyle along with weight reduction can result in marked improvement of OSA that is sustained even 4 years after the active intervention. Based on current knowledge about the evolution of OSA, weight gain represents a high risk for further progression toward more severe disease, particularly in those patients who already have mild to moderate OSA.[3] This time point is crucial for active intervention since especially severe OSA is known to increase the risk for cardiovascular morbidity and mortality.[1,2] Our results highlight the importance of early detection of OSA and more active treat-

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ment of obesity in these patients. It has been estimated that up to 80% to 90% of patients with OSA are undiagnosed,[8] and weight reduction as a treatment of OSA is underrated by many clinicians. There are no national programs for screening OSA or preventing its progression. Thus, there is a definite need for larger, well-controlled trials on the effects of different lifestyle programs among patients with OSA to determine the overall efficacy and long-term success, before large-scale programs may be implemented in clinical settings, as have been done for prevention of type 2 diabetes mellitus, for example.

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Less Is More

Investigation Momentum: The Relentless Pursuit to Resolve Uncertainty

Debate regarding the prostate-specific antigen (PSA) screening test centers around test reliability and whether screening reduces mortality.[1-3] We consider yet another potential downside to the widespread use of unreliable screening tests: the downstream effect of receiving inconclusive or ambiguous

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results. When receiving information from screening tests, we usually want to know whether the result is a "yes" or a "no." Receiving an inconclusive result amounts to a "don't

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