

# Sociodemographic Status and Self-Reported BMI-related Morbidity in Koreans

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**Purpose:** This study examined whether the relationship between body mass index (BMI) and the morbidity of chronic diseases differs by marital status, education, and income level. **Materials and Methods:** From a nationally representative sample of 5,526 adults from the third Korean National Health and Nutrition Examination Survey (2005), data regarding measured height and weight to classify BMI category ( $< 23$ ,  $23-24.9$ ,  $\geq 25$ ), self-reported sociodemographics (marital status, education, income, age, sex, and residence area), health behaviors (smoking, alcohol use, exercise, sleep, stress perception, and depression), and morbidity from at least one chronic disease were collected. **Results:** Education, income, and marital status were significantly associated with morbidity regardless of adjustment for BMI and health behaviors. After adjusting for BMI, other sociodemographic factors, and health behaviors, the odds ratio (95% confidence interval) of morbidity was 2.9 (2.4-3.7) for those in the married group and 2.9 (2.1-4.0) for those in the separated/divorced/widowed group, 2.0 (1.6-2.5) for those in the lowest education group, and 1.3 (1.2-1.6) for those in the lowest income group. When the BMI category and sociodemographic factors were combined, the odds ratios were elevated for those in the combination group with higher BMI and lower sociodemographic position. **Conclusion:** Korean subjects who were married, in the lowest education group, or in the lowest income level had a higher risk of morbidity in relation to BMI.

**Key Words:** Education, income, marital status, BMI, morbidity

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## INTRODUCTION

A large number of studies have already shown the association between adiposity and morbidity of many chronic diseases, such as type 2 diabetes, hypertension, coronary heart disease, hyperlipidemia, arthritis, cataracts, and urinary incontinence.<sup>1</sup> However, psychosocial, physiological, and social factors may interact to produce different levels of risk for adiposity-related debilitating complications. Therefore, it is important to find indicators of high risk for such complications in order to take action in prevention and early intervention. Sociodemographic factors including marital status, education, and income have been consistently suggested as determinants for differences in both morbidity and mortality. Overall, those in the lower education group, low income group, and maladaptive marital function are more likely to have higher mortality or morbidity.<sup>2,9</sup> Likewise, it is documented that those in a low socioeconomic position are more likely to have excess adiposity, particularly women in affluent societies.<sup>10</sup> Therefore, it can be hypothesized that a higher proportion of obesity among those in a lower sociodemographic position may explain the higher morbidity of chronic diseases. Otherwise, sociodemographic differences in morbidity would remain constant even after adjusting for adiposity. However, the effects of sociodemographic factors other than the effect of adiposity on the morbidity of chronic diseases have rarely been

investigated. The aim of this study is to examine whether the relationship between adiposity estimated using body mass index (BMI) and the morbidity of chronic disease differs by marital status, educational attainment, and income level in a nationally representative sample of Koreans.

## MATERIALS AND METHODS

### Subjects

The data analyzed for this study was obtained from the third Korean National Health and Nutrition Examination Survey (KNHANES). The KNHANES was a community-based cross-sectional survey conducted in 2005 by the Korean Ministry of Health and Welfare that used a stratified multistage area sample of non-institutionalized persons 19 years of age or older from South Korea.<sup>11</sup> Face-to-face interviews were conducted with 7,802 individuals, representing 93% of all sampled households. The present study included 5,526 individuals with complete data. The data for chronic diseases was self-reported. Morbidity was defined as the status of having at least one chronic disease including osteoarthritis, herniated disc, diabetes, hypertension, hyperlipidemia, stroke, coronary heart disease, hemorrhoid, bronchial asthma, cataract and glaucoma, or urinary incontinence.

### Sociodemographic variables

Three variables were considered for sociodemographic classification: marital status, educational attainment, and income level. Marital status was sorted into three statuses: unmarried, married and with a spouse, or divorced/separated/widowed. Education was grouped into three classes according to the highest school completed: middle school or lower, high school, or higher than high school. Income was assessed as the combined income from all sources of the subjects and his or her family in the preceding year and also was classified into three categories; < USD1,500/month; USD1,500-3,000/month; and > USD3,000/month. Other demographic variables analyzed were sex (male vs. female), age, and residential area (town vs. rural). Age was grouped into three categories: 19-39 years (young adulthood), 40-59 years (middle adulthood), or 60 years or older (older adulthood).

### Variables for health behaviors

Subjects had their weight and height measured according to standard procedures. Height was measured to the nearest 0.1 cm and weight to the nearest 0.1 kg. BMI was calculated as kg/m<sup>2</sup> and subjects were categorized as less than 23 (normal weight), between 23 and 25 (overweight), and more than 25 kg/m<sup>2</sup> (obesity).<sup>12</sup> Six health behaviors

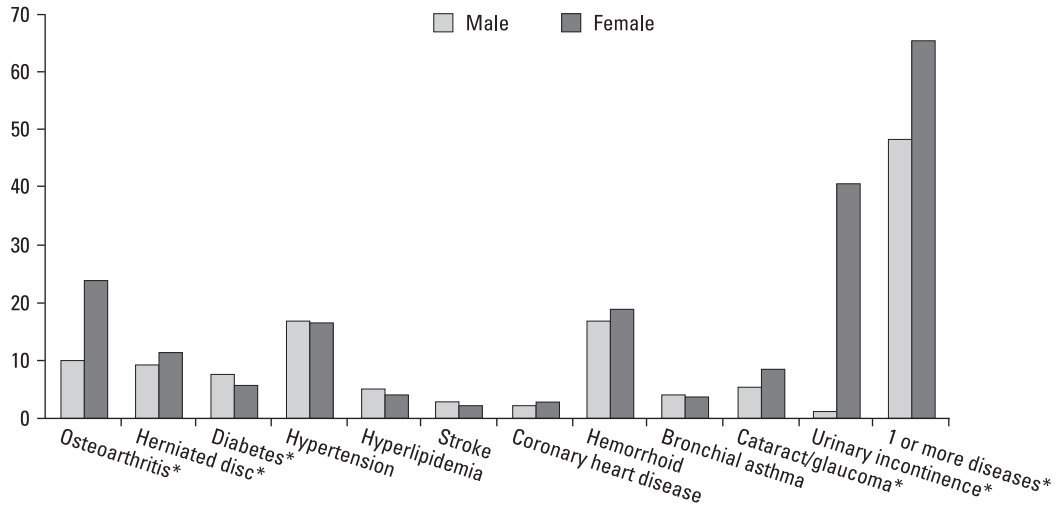
were assessed through self-reported questionnaires: smoking, alcohol use, exercise, sleep, stress, and depression. Smoking status was categorized into five groups: non-smokers, ex-smokers, and current smokers of 1-9 cigarettes per day, 10-19 cigarettes per day, or  $\geq 20$  cigarettes per day. Alcohol intake was categorized into five groups according to the average number of drinks consumed per week: non-drinker, 1-14 drinks, 15-28 drinks, 29-49 drinks,  $\geq 50$  drinks. One drink was assumed to contain nine grams of alcohol. The frequency of regular exercise per week during free time was divided into three groups:  $\leq$  once, 2-4 times, and  $\geq 5$  times. Satisfaction of sleep (satisfaction vs. dissatisfaction), perception of stress (low, middle, and high), and depression that were persistent for over two weeks in the past year (yes vs. no) were evaluated.

### Statistical analysis

A  $\chi^2$  test was used to compare morbidity by gender and to find a trend in the relationships between BMI category and the three sociodemographic variables (marital status, education, and income). Hierarchical logistic regression analyses were constructed. The baseline model estimated the odds ratio of morbidity in terms of BMI, age, and sex. In the second model, all sociodemographic variables (age, sex, residence, marital status, education, and income) were added to the baseline predictors to assess the separate effect of those factors. In the final model, six health behaviors (smoking, alcohol, exercise, sleep, stress, and depression) were additionally included with the second model to estimate the effects of those behaviors on a model including all other variables. A  $\chi^2$  test was conducted to assess the distinctive effect of added predictors as a whole in models 2 and 3 on morbidity. The effect of marital status, educational level, or income level on the association between BMI and morbidity was assessed by an odds ratio after adjusting for all other variables using logistic regression analysis. Those analyses were conducted for each BMI category and without dividing by the BMI category. A  $p$  value < 0.05 was considered to indicate statistical significance. All statistical analyses were performed using SPSS 14.0KO for Windows [Release 14.0.2 (21 Apr 2006); SPSS Inc., Chicago, IL, USA].

## RESULTS

In all, 32% of the study sample had a BMI of  $\geq 25$  kg/m<sup>2</sup> and 58% had at least one chronic disease (48% of males vs. 65% of females,  $p < 0.05$ ) (Fig. 1). Also, women were more likely to report having osteoarthritis, cataract/glaucoma, and urinary incontinence compared to men



**Fig. 1.** Distribution of chronic diseases by gender from the 3rd KHANES (n = 5526). KHANES, Korean National Health and Nutrition Examination Survey. \*Significant difference ( $p < 0.05$ ) by gender using  $\chi^2$  test.

**Table 1.** Hierarchical Logistic Regression Models Showing Relationship of Risk Factors to Morbidity\* in Korean Adults from the 3rd KHANES

Risk factors		Odds ratio and 95% confidence interval		
		Model 1	Model 2 <sup>†</sup>	Model 3 <sup>†</sup>
BMI (kg/m <sup>2</sup> )	23 - 24.9	1.3 (1.1 - 1.5)	1.2 (1.02 - 1.4)	1.2 (1.03 - 1.4)
(Reference: < 23)	≥ 25	1.7 (1.4 - 1.9)	1.5 (1.3 - 1.8)	1.5 (1.3 - 1.8)
Age (yrs)	40 - 59	3.2 (2.8 - 3.7)	1.8 (1.6 - 2.2)	1.8 (1.6 - 2.2)
(Reference: 19 - 39)	≥ 60	13.9 (11.5 - 16.9)	5.5 (4.3 - 7.0)	5.7 (4.4 - 7.4)
Sex (Reference: Male)	Female	2.6 (2.3 - 2.9)	2.2 (1.9 - 2.5)	2.2 (1.8 - 2.7)
Residence	City vs. Rural		1.2 (1.004 - 1.4)	1.2 (1.0 - 1.4)
Marital status	Married and with spouse		3.0 (2.4 - 3.7)	2.9 (2.4 - 3.7)
(Reference: Unmarried)	Divorced / Widowed / Separated		3.1 (2.3 - 4.2)	2.9 (2.1 - 4.0)
Highest education level	High school		1.2 (1.004 - 1.4)	1.2 (1.01 - 1.4)
(Reference: > High school)	≤ Middle school		2.0 (1.6 - 2.4)	2.0 (1.6 - 2.5)
Income (USD / month)	1,500 - 3,000		1.0 (0.8 - 1.1)	1.0 (0.8 - 1.1)
(Reference: > 3,000)	< 1,500		1.4 (1.2 - 1.7)	1.3 (1.2 - 1.6)
Exercise (frequency / wk)	2 - 4			0.9 (0.7 - 1.03)
(Reference: ≥ 5)	≤ 1			0.9 (0.7 - 1.05)
Smoking status	Ex-smoker			1.2 (0.95 - 1.5)
(Reference: non-smoker)	Smoker (1 - 9 cigarettes/day)			1.3 (0.97 - 1.8)
	Smoker (10 - 19 cigarettes/day)			1.0 (0.7 - 1.3)
	Smoker (≥ 20 cigarettes/day)			0.8 (0.6 - 1.1)
Alcohol use (drinks / wk)	1 - 14			0.8 (0.7 - 1.0)
(Reference: non-drinker)	15 - 28			0.8 (0.6 - 1.05)
	29 - 49			0.9 (0.8 - 1.1)
	≥ 50			1.0 (0.8 - 1.2)
Perception of stress	Middle			1.2 (1.002 - 1.5)
(Reference: Low)	High			1.7 (1.4 - 2.1)
Depression in the past year	No vs. Yes			1.2 (1.01 - 1.5)
Satisfaction of sleep	Satisfaction vs. Dissatisfaction			1.2 (1.1 - 1.4)

KHANES, Korean National Health and Nutrition Examination Survey.

\*Osteoarthritis, herniated disc, diabetes, hypertension, hyperlipidemia, stroke, coronary heart disease, hemorrhoid, bronchial asthma, cataract and glaucoma, or urinary incontinence.

<sup>†</sup> Statistical significance of predictors between model 1 and model 2 and between model 2 and model 3 was assessed by  $\chi^2$  test ( $p < 0.001$ ).

(Fig. 1). A total of 77% of the respondents lived in a city, 72% were married, 36% completed middle school, and 32% reported monthly incomes of less than USD1,500. 60% of the subjects reported the lowest level of exercise, 22% were current smokers, 40% were heavy drinkers (more than 15 drinks per week), 34% perceived a higher level of stress, 15% reported depression that persisted for at least two weeks in the past year, and 36% reported unsatisfying sleep.

Marital status, education level, and income level were associated with the BMI category. Those in the highest BMI group were more likely to have a spouse or be in divorced/widowed/separated status, lower education level, and lower income level ( $p < 0.05$ ). These trends were more remarkable in females than in males.

Table 1 presents the separate effect of sociodemographic factors on model 1 including BMI, sex, and age as predictors and morbidity as an outcome (model 2) and the separate effect of six health behaviors on model 2 (model 3) using hierarchical logistic regression analyses. Morbidity was associated with all of the sociodemographic factors regardless of adjustment for health behaviors. In model 3, morbidity was more likely to be elevated in females, those living in rural areas, those with spouse or divorced/widowed/separated, those with a lower education level, and those in the lower income level. As for health behaviors, subjects who reported higher stress perception, depression in the past year, and unsatisfying sleep were more likely to have at least one chronic disease.

The effects of marital status, education, and income on morbidity in relation to BMI are shown for each BMI

group (Table 2) and across BMI groups of each sex (Fig. 2). In each BMI group and across BMI groups, the odds ratio of morbidity increased for those with married/divorced/widowed/separated status and those in the lowest education group. In the analysis conducted for each BMI category, the association between sociodemographic factors and morbidity tended to be more prominent in the lowest BMI group. When BMI category and sociodemographic factors were combined, the odds ratios were greater for those in the combination group of higher BMI and lower sociodemographic position. Also, the magnitude of these odds ratios tended to be higher in females than in males. For example, obese men and women with a married/divorced/widowed/separated status were 2.5-2.8 times and 4.2-6.4 times, respectively, more likely to have chronic diseases compared to unmarried men and women of normal weight. Likewise, obese men and women in the lowest education level were 2.2-2.5 times and 3.1-3.9 times, respectively, more likely to have chronic diseases compared to men and women in the combination group subjects of normal weight and highest education level.

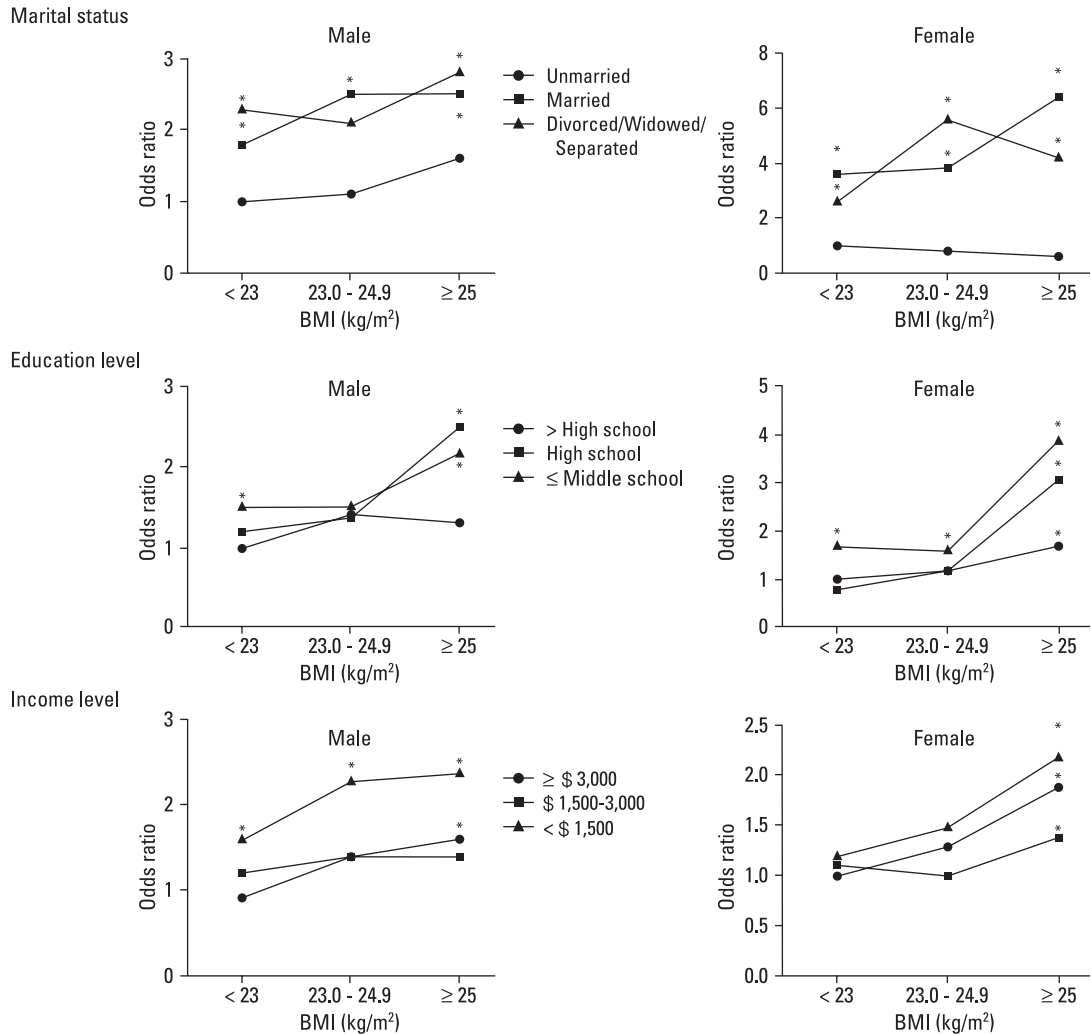
## DISCUSSION

The current study conducted with a sample representative of Korean adults provides support for the effects of sociodemographic status in the morbidity of chronic diseases in relation to BMI. The risk was highest for those in the combination group of highest BMI category and the lowest sociodemographic position. However, the risk was not

**Table 2.** Odds ratios for morbidity by sociodemographics in each BMI group of Korean adults from the 3rd KHANES

	BMI (kg/m <sup>2</sup> ), OR (95% CI)		
	< 23 (n = 2,368)	23 - 24.9 (n = 1,359)	≥ 25 (n = 1,782)
<b>Marital status*</b>			
Unmarried	1.0	1.0	1.0
Married	3.2 (2.4 - 4.3)	2.5 (1.5 - 4.1)	3.0 (1.8 - 4.9)
Divorced / Widowed / Separated	3.3 (2.1 - 5.1)	3.1 (1.6 - 6.1)	2.5 (1.3 - 4.7)
<b>Highest education level<sup>†</sup></b>			
> High school	1.0	1.0	1.0
High school	1.2 (1.0 - 1.6)	1.4 (1.02 - 2.0)	1.0 (0.7 - 1.3)
≤ Middle school	1.7 (1.2 - 2.3)	3.0 (2.0 - 4.6)	1.8 (1.2 - 2.6)
<b>Income (USD / month)<sup>‡</sup></b>			
> 3,000	1.0	1.0	1.0
1,500 - 3,000	1.2 (0.9 - 1.5)	0.9 (0.6 - 1.2)	0.8 (0.6 - 1.1)
< 1,500	1.5 (1.1 - 2.0)	1.2 (0.8 - 1.7)	1.3 (0.9 - 1.8)

KHANES, Korean National Health and Nutrition Examination Survey; OR, odds ratio; CI, confidence interval. Commonly adjusting for age, sex, residence area, health behaviors (smoking, alcohol use, exercise, sleep, stress perception, and depression) plus \*education and income (for marital status); or plus <sup>†</sup>marital status and income (for education); or plus <sup>‡</sup>marital status and education (for income).



**Fig. 2.** Odds ratios for morbidity of chronic diseases in relation to BMI according to sociodemographics in Korean adults from the 3rd KHANES. KHANES, Korean National Health and Nutrition Examination Survey; BMI, body mass index. Commonly adjusting for age, sex, residence, health behaviors (smoking, alcohol use, exercise, sleep, stress perception, and depression) plus education and income (for marital status) or plus marital status and income (for education) or plus marital status and education (for income). \* $p < 0.05$ . The reference group was comprised of those with unmarried status and with BMI < 23 for marital status, those in the highest education group and with BMI < 23 for education, and those in the highest income group and with BMI < 23 for income.

apparent for those with the highest educational attainment, the highest income level, or unmarried status even if they were in the highest BMI group. In numerous studies, socioeconomic status frequently assessed using education and income has been considered to be a determinant of health inequality and the current results are consistent with previous findings. Although marital status has not been frequently investigated to be a risk factor for morbidity, marital function has been suggested to be a significant factor in mental and physical health.<sup>8,9</sup>

Sociodemographic inequality in the risk of mortality and morbidity cannot be explained simply and several possible mechanisms may be suggested. One possible mechanism may be an uneven distribution of the group with excess adiposity across the sociodemographic status. Similar to

previous studies,<sup>10</sup> subjects with the highest BMI were more likely to be among those in the lower education group, lower income group, or with a married status. However, the effects of sociodemographic factors on morbidity remained after controlling for BMI. Therefore, sociodemographic differences in morbidity do not seem to be explained by unequal distribution of BMI.

Another possible explanation is that sociodemographic differences in the susceptibility of chronic diseases may contribute to the sociodemographic disparity in morbidity. In other words, unmeasured factors associated with the susceptibility of these diseases may also be associated with sociodemographic position.<sup>7,13</sup> These factors may include unhealthy environmental condition, weak social networks and social support, other psychosocial variables such as



disease-susceptible personality dispositions and depression, and chronic and acute stress.<sup>14</sup> Among those factors, this study was able to show the positive associations of morbidity with perception of stress, depression, and satisfactory sleep. There is evidence of psychosocial stress being an important contributing factor for a variety of diseases, cardiovascular disease in particular.<sup>15</sup> Also, depression has been positively related with both obesity and morbidity of chronic diseases.<sup>16,17</sup> Sleep dissatisfaction may be indirectly related with morbidity through life dissatisfaction.<sup>18</sup> However, in the current analysis, sociodemographic inequality in morbidity was still persistent when depression and sleep dissatisfaction were controlled. Other unmeasured factors that can be predictive for susceptibility may explain the differences in sociodemographic status. For example, in cases of marital status, undesirable marital function may play a role in augmenting susceptibility through depression, detrimental health habits, and physiological pathways using cardiovascular, endocrine, immune, and neurosensory systems.<sup>8,9</sup>

Finally, differences in access to health care services across sociodemographic levels may account for the disparity. If those in the lower social position and married status had a higher perception of their medical problems, perhaps they would use health care services more frequently and be more likely to have the possibility to have their illnesses diagnosed. Therefore, a multitude of factors including occupation, environmental exposure, health-related lifestyle, and individual psychosocial attitudes towards health may be interconnected in the relationship between sociodemographic factors and morbidity.

In addition to the marital status, educational attainment, and income level, there was a gender difference in morbidity: women were two times more likely to have chronic diseases compared to men after adjusting for other variables being studied. Therefore, the effects of education, income, and marital status on morbidity were stronger in females than in males. These gender-specific differences may be mediated in part by genetic factors, different fat distribution, different fat metabolism, or differential susceptibility.<sup>18</sup>

Several limitations of this study should be considered. First of all, morbidity, sociodemographic position, and health behaviors were based on self-report and the validity of this information was not assessed. A review study on the accuracy of self-reported health behaviors and risk factors relating to cancer and cardiovascular disease found that self-reported data consistently underestimated the proportion in the high risk group.<sup>19</sup> Therefore, the observed associations may be underestimated. A second limitation of this study is that these observations did not make inferences about causality. Since the study design was cross-

sectional, temporal relationship among morbidity, health behaviors, and sociodemographic factors such as income and marital status would not be clear. Also, uncontrolled potential confounders may influence true relationships.

Taken together and despite these limitations, the findings of this study performed with a representative sample of Koreans has reaffirmed the health inequalities reported by numerous studies that were conducted in differential social environments, health care systems, races, and cultures. While the current study did not reveal reasons for social disparities in the morbidity of chronic diseases, individuals at risk were similar to groups indicated in previous studies. Such subjects were obese individuals with a lower education, lower income, or with married status regardless of currently having spouse. Future research should explore solutions to reduce these disparities.

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