doi:10.22100/ijhs.v7i2.845
Original Article

IJHS 2021;7(2):42-48
ijhs.shmu.ac.ir

IJHS
International Journal of Health Studies

Prevalence and Covariates of Metabolic Syndrome among Elderly People Living in Nursing Homes, Semnan, Iran

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Received: 7 February 2021
Accepted: 25 April 2021

Abstract

Background: *The study aimed to determine the prevalence and covariates of metabolic syndrome among the elderly residents in nursing homes in Semnan province, Iran.*
Methods: *This cross-sectional study was conducted among aged participants institutionalized in nursing home in 2018. The study participants' characteristics were assessed using a demographic assessment form. Moreover, the mini nutritional assessment (MNA) questionnaire, mentally assessing nutritional assessment (MANA), Katz's index of independence in activity of daily living, mini-mental state examination (MMSE) and well-being were applied to assess the participants' physical and mental status. In addition, para-clinical and biochemical tests for diagnosis of metabolic syndrome used based on the adult treatment panel (ATPIII).*
Results: *In this study, of 129 eligible participants, 27.7% were suffering from metabolic syndrome. The prevalence of MS in male and female subjects were 26.6% and 28%, respectively. The results of the study indicated a significant relationship between metabolic syndrome and nutritional statues (Pvalue=0.004), mental status (Pvalue=0.001) and ADL (Pvalue=0.003). Moreover, the results showed no significant relationship between well-being and metabolic syndrome. Of all variables of the study, significant relationship between smoking habit, lack of daily activity, abdominal obesity, high systolic and blood pressure, high density lipoprotein cholesterol (HDL-C) HDL-cholesterol, waist circumference (WC), systole blood pressure (SBP) were found to be statistically significant.*
Conclusions: *The findings of the study indicated the prevalence of metabolic syndrome among institutionalized elderlies is high. It is recommended to implement preventive and therapeutic measures in this vulnerable group of elderly people.*

Keywords: Metabolic syndrome; Elderly people; Nursing homes, Prevalence.
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Please cite this paper as: Bahar A, Delvarianzadeh M, Khosravi F, Aryaeian N, Dadgari A. Prevalence and covariates of metabolic syndrome among elderly people living in nursing homes, Semnan, Iran. Int J Health Stud 2021;7(2):42-48

Introduction

Most societies are a facing aging population and increased life expectancy due to different reasons such as health-promoting measures, lifestyle modification, and advancement of medical science.[1] Currently, the aging population will take on younger people for the first time in history.[2] It has been estimated that the worldwide prevalence of metabolic syndrome ranges from <10% to as much as 84%, depending on the region, urban or rural environment, sex, age, race, and ethnicity studied, as well as the definition used to classify patients.[3]

The Iranian center of statistics reported that more than six million (9.27 %) people are 60 years old and above.[4] Moreover, in Semnan province, the rate of aging exceeds 12%.[5] Metabolic syndromes, also called X syndrome, is a cluster of disorders that are commonly associated with abdominal obesity, hypertension, dyslipidemia, hyperglycemia, and possibly insulin resistance.[6] Nowadays, this syndrome is considered a threat to public health, due to its well-known role in an increased risk of cardiovascular disease, type II diabetes, and mortality.[7-9] Metabolic syndrome is associated with older age.[10,11] There is growing literature indicating that the prevalence of metabolic syndrome in Iran is sharply increasing. One study in Tabriz indicated it at 39.2%.[12] Overall, other domestic studies on the prevalence of metabolic syndrome have reported 10% to nearly 50% in different regions.[13] The prevalence of the syndrome varies based on population, nationality, geographic location, and applied diagnostic criteria.[14] Despite growing attention and literature on metabolic syndrome, few domestic studies have been conducted among the elderly residents of nursing homes. Therefore, this study aimed to assess the prevalence of metabolic syndrome and its related factors among aged institutionalized subjects in Semnan province, Iran.

Materials and Methods

In this cross-sectional multicenter study, elderly participants residing in Shahroud and Damghan elderly care centers were recruited. Subjects of the study were selected by convenience sampling and based on inclusion criteria including age 60 years old and above, being permanent residents in nursing homes, being on oral nutrition, not undergone gastrointestinal surgery, and lack of cognitive and mental disorder in the last 6 months, lack of physical and motor impairments disrupting activities of daily life. Moreover, the exclusion criteria were hospitalization for the last 3 months, history of extensive surgery, amputation, and newly diagnosed and/or undergone cancer treatment. This study was approved by the research ethics Committee of Iran university of medical

sciences with the reference no. of 5279463736. All participants of the study signed a consent form. They were allowed to participate or withdraw from the study for any reason at any stage of the study.

The method of data collection in this study was based on the demographic questionnaire focusing on anthropometric factors was applied. Moreover, the following Para clinical and biochemical results including a) mini nutritional assessment (MNA) questionnaires, b) Katz index of independence in activities of daily living (ADL), c) mental and cognitive state examination by mini-mental state examination (MMSE), and d) well-bing (welfare status assessment) were applied. All the assessment tools and questionnaires were validated and used in previous researches.

The mini nutritional assessment is a simple and highly sensitive tool for nutritional screening and assessment. The MNA exhibits good sensitivity and specificity compared to a variety of nutritional assessment parameters including biochemical values, anthropometric values, and dietary intakes. The MNA consists of 18 questions derived from four parameters of anthropometric, general, dietary, and subjective assessment. The full MNA has two components-six screening questions in part 1 and 12 assessment questions in part 2- and can be completed in about 15 minutes. When a quick screening is all that's needed, just the first six questions-also known as the MNA short form (MNA-SF)-can be completed in less than five minutes. This questionnaire determines energy-protein malnutrition in the subjects. According to the interpretation of MNA results, the subjects were divided into 3 groups with adequate nutritional status with MNA≥24, at risk of malnutrition with MNA between 17 and 23.5, and malnutrition with MNA<17. Weight was measured with a portable scale with an accuracy of 0.1kg with minimal clothing and no shoes. To measure height, mid-arm circumference and peripheral arm circumference and peripheral muscle circumference and circumference from the middle of the last iliac ribs and vertebrae were measured parallel to the horizon with a non-elastic band meter with an accuracy of 0.1cm. In the calculation of height, participants were in the standing position according to the standard procedure, and in specific cases where it was not possible to measure subjects' height, the heel to knee height was measured. Also, body mass index was calculated by dividing the weight in kilograms by the square of the height in meters. The Persian version of the instrument has been validated among the Iranian elderly population. The reliability coefficient of the MNA was estimated to be more than 0.7.[15]

The Katz index of independence in activities of daily living, commonly referred to as the Katz ADL, is the most appropriate instrument to assess functional status as a measurement of the client's ability to perform ADLs independently. This is a 6-item questionnaire that includes queries about the participants' independent activities of daily living (ADL) including bathing, wearing, bowel movement, transport, urinary and fecal control, and feeding are assessed. Each item gets one point for doing each activity independently. Subjects with scores of 5 or 6 are categorized as an independent. Subjects with scores of 4 or less are considered as dependent subjects.[16,17]

The mini-mental state examination (MMSE) was first published in 1975 by M. F. Folstein et al[18] A practical method for grading the cognitive state of patients for the clinician study. The MMSE was designed as a screening test to evaluate cognitive impairment in older adults. Nowadays, the mini-mental state exam (MMSE) is a widely used test of cognitive function it includes tests of orientation, attention, memory, language, and visual-spatial skills. The maximum MMSE score is 30 points. A score of 20 to 24 suggests mild, 13 to 20 suggests moderate, and less than 12 indicates severe cognitive impairment.[19]

The 5-item world health organization well-being index (WHO-5) is a short and generic global good construct validity as a unidimensional scale measuring well-being in these populations. The WHO-5 consists of five statements, which respondents rate according to the scale rating scale measuring subjective well-being. The WHO-5 has been found to have adequate validity in screening for depression and in measuring outcomes in clinical trials. Item response theory analyses in studies of younger persons and elderly persons indicate that the measure has below (about the past two weeks). The total raw score, ranging from 0 to 25, is multiplied by 4 to give the final score, with 0 representing the worst imaginable well-being and 100 representing the best imaginable well-being.[20]

The laboratory tests were fasting blood sugar (FBS), Low and high-density lipoprotein- C (LDL-C and HDL-C), Cholesterol and Triglycerides (TG), and blood pressure (BP) measurements. All blood specimens were collected between 7 to 8 AM with 12 hours fasting beforehand. The samples were immediately sent to the laboratory. For clinical diagnosis, the adult treatment panel 2001 ATP III was followed. According to diagnosis criteria, participants with at least three simultaneous cardiovascular risk factors were diagnosed with metabolic syndrome[9] including abdominal obesity (waist circumference greater than 102 cm in male and more than 88 cm in female, triglyceride value greater than 150^{mg}, HDL-C <40$^{mg/dl}$ in male and <50$^{mg/dl}$ in female, blood pressure ≥130/85^{mmHg}, fasting blood sugar≥110$^{mg/dl}$).[21]

All participants' BP was measured from their right arm using the same sphygmomanometer. To obtain the most accurate blood pressure, the instruction of the American heart association was followed.

All data were entered into SSPS software and analyzed. Chi-square test was used to assess the relationship between metabolic syndrome and nutritional status, the activity of daily living, well-being, and participants' mental status. A t-test was used to investigate the relationship between quantitative demographic factors and participants' metabolic syndrome.

Results

The findings of the study showed that 129 elderly people participated in this study with a mean age of 75.44±10.56 years old. Of all subjects of the study, 59 (45.7%) and 70 (54.3%) were living in nursing homes in Shahroud and Damghan, respectively. The overall prevalence of metabolic syndrome was estimated to be 27.7%. It was 26.6% in female and 28.6% in male subjects; however, this difference was not statistically significant. Moreover, the results of the study showed no significant relationship between

age and metabolic syndrome in terms of age groups (young-old, middle-old, and oldest-old). Other findings of the study revealed that 43 (33.3%) subjects were a smoker. A related finding of the study indicated that there was a significant statistical relationship between smoking and metabolic syndrome (Pvalue=0.001). There was a significant association between metabolic syndrome and leisure time activities such as regular walking and exercise and watching television (Pvalue=0.05). Among the previous household dimensions, the number of children, education, marital status, retirement, medication, and some age-related illnesses such as visual impairment, arthritis, osteoporosis, urinary incontinence, heart problems, as well as anemia, daily milk intake, and meal intake was not significantly associated with the metabolic syndrome. The results are summarized in table 1.

Nutritional and mental status, the activity of daily living, and wellbeing were assessed about metabolic syndrome. Among individuals with metabolic syndrome, 54.3% were nutritionally susceptible to malnutrition, 65.7% were mentally desirable, 52.7% were dependent on daily activity, and 54.3% were optimally wellbeing. Also, have a statistically significant relationship interval and nutritional weakness (Pvalue=0.004), mental status (Pvalue=0.001), daily physical activity (Pvalue=0.003) were observed with metabolic syndrome. However, there was no association between well-being status and metabolic syndrome (table 2). Moreover, we found a significant difference between women and men in DBP, HDL, and waist. (Table 3).

Table 1. Characteristics of some demographic factors and diseases associated with aging in metabolic syndrome

Variable	No. (%)	Metabolic syndrome		Pvalue
		Yes	No	
Sex				
−Female	79(61.2)	21(26.6)	58(73.4)	0.085
−Male	50(38.3)	14(28)	36(72)	
Education				
−Illiterate	84(65.1)	28(80)	56(59.6)	0.085
−Primary	37(29.7)	6(17.1)	31(33)	
−High School	2(1.6)	1(2.9)	1(1.1)	
−Bachelor	6(4.7)	0(0)	6(4.7)	
Occupation				
−Unemployed	30(23.30)	10(28.6)	20(21.3)	0.708
−Hand worker	9(7)	2(5.7)	7(7.4)	
−Farmer	23(17.8)	8(22.9)	15(16)	
−Employee	16(12.4)	4(11.4)	12(12.8)	
−Self-employed	9(7)	3(8.9)	6(6.4)	
−Homemaker	32(24.8)	5(14.3)	27(28.7)	
−Others	10(7.8)	3(8.6)	7(7.4)	
Marital Status				
−Single	18(14)	5(14.3)	13(3.8)	0.551
−Married	60(46.5)	14(40)	6(6.4)	
−Widow	7(5.4)	1(2.9)	6(6.4)	
−Divorced	44(34.1)	15(42.9)	29(30.9)	
Age Group				
−60-69	41(31.8)	13(31.7)	28(68.3)	0.682
−70-90	41(31.8)	11(26.8)	30(73.2)	
−>90	47(47)	11(23.4)	36(76.6)	
Pension status				
−Yes	44(34.1)	10(28.6)	25(71.4)	0.277
−No	85(65.9)	25(71.4)	60(63.4)	
Smoking				
−Yes	43(33.3)	33(94.3)	10(10.6)	
−No	86(89.4)	2(5.7)	84(89.4)	<0.001
Daily exercise				
−Yes	63(48.80)	8(22.9)	27(77.1)	
−No	66(129)	55(58.5)	39(41.5)	
Age related disease				
Arthritis				
−Yes	33(25.6)	8(22.9)	25(26.6)	0.744
−No	96(74.4)	25(26.6)	68(72.3)	
Osteoporosis				
−Yes	52(40.3)	16(45.7)	36(38.3)	
−No	77(59.7)	19(54.3)	58(61.7)	
Need for rehabilitation				
−Yes	63(48.8)	7(20)	56(59.6)	<0.001
−No	66(51)	28(80)	38(40.4)	
Watching TV				
−Yes	69(53.5)	6(17.1)	29(82.9)	<0.001
−No	60(46.5)	63(67)	31(33)	

Table 2. Relationship between nutritional status, mental state, daily activity, and well-being according to the metabolic syndrome of the nursing home, Semnan, 2018

Variable	No. (%)	Metabolic Syndrome		Pvalue
		Yes	No	
Nutritional status				
−Malnourished	29(22.5)	3(8.65)	26(27.7)	<0.001
−At risk of malnourished	74(57.4)	19(54.3)	55(58.5)	
−Well-nourished	26(20.2)	13(37.1)	13(13.8)	
Mental status				
−Severe Disorder	55(42.6)	6(17.1)	49(52.1)	
−Moderate Disorder	23(17.8)	6(17.1)	17(18.1)	<0.001
−Good condition	51(39.5)	23(65.7)	28(29.8)	
Activity of daily living				
−Dependent	52(40.3)	7(20)	28(80)	
−Independent	77(59.7)	28(52.7)	49(52.1)	
Well-being				
−Not desirable	67(51.9)	16(45.7)	51(54.3)	=0.253
−Desirable	62(48.1)	19(54.3)	437(45.7)	

Table 3. Subjects' Clinical and Laboratory results (Mean±SD)

	Male Mean±SD	Female Mean±SD	Total Mean±SD	Pvalue
Age (Year)	74.24±9.94	76.71±9.94	9.75±94.71	0.179
BMI	24.1±4.40	24.85±5.16	24.52±4.88	0.261
WC $^{(CM)*}$	97.30±9.98	86.84±13.58	90.89±13.29	0.015
FBS$^{(mg/dl)}$	102.24±19.8	104.45±19.9	103.59±19.8	0.665
SBP$^{(mmHg)}$	130.52±13.6	129.64±10.4	129.98±11.7	0.001
DBP$^{(mmHg)*}$	84.38±6.60	81.23±12.66	82.45±10.80	0.932
TC$^{(mg/dl)}$	198.86±18.87	198.05±21.1	198.36±20.2	0.722
HDL$^{(mg/dl)}$*	40.72±2.73	48.36±6.45	45.40±6.49	0.001
LDL$^{(mg/dl)}$	132.1±28.03	131.1±25.38	131.72±26.3	0.334
TG$^{(mg/dl)}$	198.05±28.1	167.41±38.1	173.79±48.9	0.488

BMI (body mass index), waist conferences (WC), FBS (fasting blood sugar), TC (total cholesterol), TG (Triglycerides). HDL – cholesterol (mg/dl) LDL – cholesterol (mg/dl), high density lipoprotein cholesterol (HDL-C), Systole blood pressure (SBP), diastole blood pressure (DBP)

Discussion

The results of this study showed that the prevalence of metabolic syndrome was higher than in some similar studies[22,23] and was lower than in some other studies.[24,25] These similarities and differences may be due to population, ethnicity, geographic location, and different diagnostic criteria applied for metabolic syndrome in different studies.[26] Similarly, regarding the gender difference, the results of the current study indicated that the prevalence of metabolic syndrome was higher in men, although this difference was not statistically significant, which is comparable to similar foreign and domestic studies.[14,26,27] For instance, it is consistent with the study conducted by Ho et al,[28] in Taiwan and Gause-Nilsson et al, on the Swedish aged population who reported a higher prevalence of the metabolic syndrome among male subjects[24] which is in harmony with the Indian study conducted by Kamble, et al.[29] However, Vidigal et al, reported that the prevalence of metabolic syndrome was the same in both sexes.[30]

The prevalence of abdominal obesity among the male subjects in our study may be an important finding and may be justified by a sedentary lifestyle and nutrition. Gender difference in metabolic syndrome is a matter of attention for most previous studies (reference). The results of the current study showed that there was no significant relationship between age and metabolic syndrome, which is similar to most previous studies.[31,32] Lifestyle, co-residency, and using the same facilities have caused this difference in age groups of the elderly.

Regarding cigarette smoking, there was a significant statistical relationship between smoking and metabolic syndrome, since smoking and alcohol consumption (in non-Islamic countries) have also been identified as other social behaviors. Most of the previous studies have reported a higher mortality rate among tobacco smokers and alcohol abusers among older adults aged 70 years old and above. Some researchers suggested that older adults are more likely to be exposed to tobacco and alcohol misuse.[33,34] Also, a meta-analysis of 13 prospective cohort studies showed that current smokers had a 26% increased risk of developing metabolic syndrome in comparison to non-smoker-aged subjects. Metabolic syndrome is high in comparison to non-smokers subjects.[35] Moreover, smoking is a known risk factor for

atherosclerosis and cardiovascular disease. Researchers showed that smokers have impaired lipoprotein metabolism and endothelial function.[36,37] Also, there is evidence to support that smokers are at greater risk for hyperinsulinemia.[38] As metabolic syndrome can be a link between cardiovascular disease,[39,40] it may increase the cost of treatment in the elderly and is one of the factors contributing to the increased burden of obesity.[41,42]

Another finding in the current study was a reverse significant relationship between watching television and metabolic syndrome, meaning that TV watchers were at less risk of metabolic syndrome. It may be due to watching public education programs related to health issues and may increase their awareness, whereas, in the study of Li C-L et al,[43] watching television program for a long time decreased subjects' physical activity and the prevalence of metabolic syndrome was reported to be higher in those individuals. A study on senior citizens 65 years old and above, found that participation in activities of daily life, even in free time and doing leisure activities, positively influenced subjects' mental and physical health.[44] Lack of physical activity, being overweight, and some dietary factors have been recognized as a modifiable risk factor for metabolic syndrome and its consequences.[45] These differences indicate that dietary habits and environmental and genetic factors may differ in different areas due to lifestyle differences. Also, nutritional status, mental status, dependency on daily activities, and exercise were assessed as risk factors for metabolic syndrome. In terms of nutritional status, an interesting finding of the current study was the association between nutritional status and metabolic syndrome. Most patients with metabolic syndrome were subjected to malnutrition. Perhaps the most likely reason that people in developing countries die because of heart problems at earlier ages. MNA is a valid and reliable tool to assess nutritional status in the elderly subjects;[46] however, abdominal obesity is an important criterion of the metabolic syndrome is not assessed by MNA. So, other accurate diagnostic tests should be applied to assess abdominal obesity in older adults. A controlled study has shown that in addition to exercise, a low-fat, high-fat diet, fruit, and vegetables with low glycemic index and high intake of dairy and low consumption of meat and exercise have a positive effect on metabolic syndrome criteria, which can reduce the risk of cardiovascular disease - diabetes and metabolic syndrome.[46] A study aiming to explore the relationship between nutritional status and metabolic syndrome found that malnourishment is significantly related to metabolic syndrome.[47] Similarly, other studies suggested that most of the subjects with malnourishment were are at higher risk of.[48-50]

There is growing literature suggesting that nutritional intervention on dietary regimen can decrease the risk of some components of metabolic syndrome.[51] Also, there is some evidence supporting that improved nutritional status is associated with higher socioeconomic status.[52] A study aiming to examine the nutritional status reported that 22.5% of the subjects were suffering from malnutrition, 57.4% had malnutrition risk and 20.2% of them had good nutritional status. Moreover, the results indicated a statistically significant relationship between the nutritional status and sex age, income, and body mas.[53] It seems that severe malnutrition, by itself, is not an exact criterion for metabolic syndrome. It may be necessary to consider other parameters affecting it.

In this study, there was a significant relationship between the activities of daily living which is supported by the findings of the majority of the previous works in this field metabolic syndrome.[54] Liaw et al. reported a relationship between functional activity with diagnostic criteria of metabolic syndrome, especially abdominal obesity and high triglyceride levels.[55] The present findings seem to be consistent with a 3-year longitudinal study that reported the association between ADL and disability.[56] In addition to exercise, a diet low in saturated fat and high in fruits and vegetables with a low glycemic index and high intake of dairy and low meat intake can reduce the risk of cardiovascular disease, diabetes, and metabolic syndrome.[46] Our results were supported by some studies which showed a link between physical activity,[57] exercise history, and physical and mental health and metabolic syndrome.[58]

Although, the results of the current study differed from some published studies. In contrast with our finding Murtagh et al found that daily activity in form of 20 minutes walking, 3 times a week for 12 weeks did not affect BMI, abdominal girth, blood pressure, and lipid blood profile in participants of their study.[59] The possible reason for this could be the low intensity of exercise applied in that study. Factors such as diet, age, the activity of daily life may also mediate the effect of exercise on anthropometric factors. Exercise is one of the effective factors in improving the quality of life. Most previous studies have suggested that metabolic syndrome significantly affects the quality of life among the subjects with metabolic syndrome.[60]

Long-term results of anthropometric studies on metabolic syndrome and mental status have been reported to increase the risk of cognitive decline among the elderly subjects.[61,62] The above-mentioned studies showed that in most cases, hyperglycemia was consistently associated with cognitive dysfunction in older adults, but the role of metabolic syndrome on cognitive decline and onset of dementia showed heterogeneous results. Metabolic disorders may increase cognitive decline and the risk of dementia. Cognitive decline has been assessed in some studies using the mental state examination (MMSE).[43,57,60] An increased risk of cognitive impairment has been reported in patients with diagnostic criteria of metabolic syndrome.[63]

A study on aged subjects 85 years old and above rejected any correlation between metabolic syndrome and mental status which was not observed in our results. The various reason has been suggested to justify this. For instance, in some studies on older adults, researchers suggested that insulin resistance may affect the relationship between cognitive impairment and one of the components of metabolic syndrome.[64] Moreover, another mechanism that may influence this correlation is increased inflammatory response, which may occur in old age and metabolic syndrome.[65] This study found no significant association between metabolic syndrome and well-being. A study of the elderly community dwellers showed that well-being was significantly lower among institutionalized subjects. Also, components of happiness, life satisfaction, mental health,

positive mood, and self-efficacy among elderly community dwellers were significantly higher than institutionalized counterparts. However, both groups did not differ significantly in self-esteem.[66]

The results of this study could establish a base for other studies, especially future analytical studies on the functional status of the elderly and their well-being and nutrition, and the factors affecting their aging populations, and should focus on them, especially in the areas of physical, mental and social health. Functional independence and day-to-day planning. However, there are some drawbacks to this study. In this study, the activity of the elderly was recorded through self-report which may be affected by the subject's memory. On the other hand, this study was carried out among the elderly residents in the nursing home with specific characteristics, so its results cannot be completely generalizable to other populations. It would also be possible to obtain more accurate results if this study was conducted in a larger population of subjects.

The study emphasized that older adults are prone to metabolic syndrome. It also showed that the metabolic syndrome among the aged subjects is associated with nutritional status, mental status, and activity of daily living. Therefore, prevention should be considered as a strategy in the early diagnosis of metabolic syndrome. Moreover, paying attention to nutrition status by nutritionists to individually plan nutrition for susceptible cases and to enhance mental activity and necessary training and provision of space in a nursing home to enhance the age-friendly environment for the elderly as a therapeutic aspect.

Acknowledgement

The present study was a result of a research project approved by the research deputy of Iran university of medical sciences. We would like to appreciate the participants of the study for their sincere cooperation and patience in answering the questions. Our special thanks go to the deputy of research for their kind contributions and support for running to the study.

Conflict of Interest

The authors declare that they have no conflict of interest.

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