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Prevalence of malnutrition and its association with activities of daily living in older adults attending primary health care centers: a multistage cross-sectional study

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Summary. Objective: Nutritional status plays a vital role in the quality of health of older adults. Thus, we aim to assess nutritional status and its association with functional status in older adults. **Methods:** A cross-sectional descriptive study with a multistage stratified sampling strategy was carried out in primary health care centers (PHCCs). Community-dwelling older adults ≥ 60 years of age (n=2045) participated in the study. Nutritional status was assessed using the mini-nutritional assessment tool, and BMI was measured. Functional status was measured by Katz index of independence in activities of daily living (ADL) and its relationship to nutritional status was examined and assessed using chi-square test and binary logistic regression. **Results:** Obesity prevalence was high (43.2%) while 20.9% were classified as at risk of malnutrition or were malnourished. There was a significant association between nutritional status and ADL. **Conclusions:** Assessing nutritional status of older adults identified a high prevalence of both undernutrition and obesity. Such assessments should be routine practice in PHCCs.

Keywords: Nutritional status, body mass index, older adults, primary health care centers, activities of daily living

Introduction

Aging of the population is emerging as a major demographic trend worldwide. In the Kingdom of Saudi Arabia (KSA), older adults (i.e., aged 60 years and over) made up about 5.6% of the total population in 2017, and this percentage is expected to reach 22.9% by the year 2050 (1). The age-related demographic transition is associated with a concomitant increase in the rates of chronic diseases. Globally, behavioral risk factors (e.g., unhealthy diet, physical inactivity, tobacco use) are responsible for about 80% of diagnosed coronary heart disease and cerebrovascular disease (2). Amongst these risk factors, aging may result in reduced physical activity and in a poor diet.

In older adults, malnutrition has been associated with increases in the risk of falls, loss of mobility, and poor wound healing (3), increased healthcare costs (4), and impaired quality of life (5). Nutritional status assessment is necessary because it can identify malnutrition, which is a potential cause of morbidity and mortality (6). Older adults who are malnourished when admitted to hospital tend to have a longer hospital stay and have more complications than well-nourished patients having the same disease (7). Thus, prevention of malnutrition in older subjects is likely to have benefits both while they are in the community and also if they need to be hospitalized. On the other hand, two national sur-

veys conducted in the KSA showed that overweight and obesity exceeds 60% of the adult population (8,9).

Previous research showed that declined functional ability is associated with malnutrition (10,11). Functional ability can be assessed using the Katz index of independence in activities of daily living (ADL) (12), which measures independence in six domains: feeding, transferring, bathing, continence, dressing, and using the toilet.

In KSA, there is limited data available on nutritional status, body mass index (BMI) and ADL in community-dwelling older subjects. Thus, the study was designed with the aim to have an overview of the nutritional status and its association with inability to perform ADL in Saudi-older adults attending PHHCs in Riyadh city, the capital of KSA.

Materials and Methods

Participants and design

The present study was conducted as a part of a research project evaluating the internal environment of primary health care centers (PHCCs) and assessing the health status of older people attending these centers in Riyadh city, KSA. The study was approved by the Ethical Committee at the Ministry of Health, KSA. It was designed as a cross-sectional descriptive study with a multistage stratified sampling strategy carried out in PHCCs in Riyadh city between January 2015 and April 2017. The inclusion criterion was older adults (≥ 60 years of age) attending the selected PHCCs for routine primary care services.

In the KSA, PHCCs provide preventive and curative primary care services, and these services are offered free of charge to Saudi Citizens. The PHCCs were randomly selected, according to geographical location (north, south, central, east and west) to represent the geographic sectors of the city of Riyadh. Three PHCCs were selected from each sector using the simple random sampling method (total: 15 PHCCs were chosen from the five sectors). Within each sector, the size of the older adults' sample was determined proportional to the population attending the three selected PHCCs, and the samples from each center were stratified according to the sex. The older adults from each PHCC were selected consecutively.

Older adults or their caregivers signed a written consent form before participating in the study.

Physicians (one man and one woman) selected from each PHCC received training sessions in order to conduct the data collection, including the completion of the mini-nutritional assessment (MNA®) and ADL forms. The MNA and ADL forms were answered directly by older persons. In some cases, caregivers helped to complete the forms.

Nutritional status

The nutritional status of older adults was assessed using the MNA® tool. The answers can give a maximum of 30 points {well-nourished (24-30 points), at risk of malnutrition (17-23.5) points, and undernourished (< 17 points)}(13). About 15% of older adults were excluded due to inability to complete the MNA form, mainly due to being unable to provide necessary information or a communication problem.

Functional status

Functional status was measured by the Katz ADL scale (12). A score of 6 indicates fully functional, 3-5 moderate functional impairment, and 0-2 severe functional impairment.

Body mass Index

Body mass index (BMI) [weight in kg/(height in m)^2] was used to classify participants as underweight (< 18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2) and obese (≥30 kg/m^2), based on the WHO international standard (14). Based on older adults-BMI classification (15,16), a BMI between 22-27 kg/m^2 is considered normal range for older adults aged ≥ 65 years. Therefore, the following cutoff points were also been used (< 22 kg/m^2 underweight, and > 27 kg/m^2 for overweight).

Statistical analysis

Data were analyzed using Statistical Package for Social Science (SPSS) software, version 22 (IBM Company, USA). Categorical data are expressed as frequency (number and percentage). Mann-Whitney U test was used for non-normally distributed variables and chi-square test was used for categorical variables. Binary logistic regression analysis was performed to

assess the impact of difficulties to perform ADL (the independent variable) on the nutritional status (dependent variable). Odds-ratios with 95% confidence intervals were calculated. Kolmogorov - Smirnov test was used to assess the normality of the data. Results were considered to be statistically significant at $p<0.05$.

Results

Table 1 shows the characteristics of the subjects. The total number of older adults (aged ≥ 60 years) who participated in the study was 2045. There were 55.6% men and 44.4% women. The data showed that 36.5%

Table 1. Characteristics of older adults attending primary health care centers in Riyadh city, KSA

Characteristics	Males (1138)		Females (907)		Total (2045)		P value
	N	%	N	%	N	%	
Sex	1138	55.6	907	44.4	2045	100	
Age (Mean, SD)	67.0	6.8	65.1	6.5	66.1	6.8	<0.001
60 – 69 y	767	67.4	708	78.1	1475	72.1	<0.001
70 – 79 y	298	26.2	158	17.4	456	22.3	
80 y and above	73	6.4	41	4.5	114	5.6	
Marital status							
Married	1084	95.2	540	59.5	1624	79.4	<0.001
Single	6	0.5	9	1.0	15	0.7	
Widow	45	4.0	304	33.5	349	17.1	
Divorced	3	0.3	54	6.0	57	2.8	
Education levels							
Illiterate	224	19.7	522	57.6	746	36.5	<0.001
Primary	337	29.6	214	23.6	551	26.9	
Intermediate & Secondary	416	36.6	137	15.1	553	27.0	
University or above	161	14.1	34	3.7	195	9.5	
Occupation							
Employed	259	22.8	74	8.2	333	16.3	<0.001
Not Employed	879	77.2	833	91.8	1712	83.7	
living conditions							
Alone	73	6.4	32	3.5	105	5.1	<0.003
With your children / spouse / other	1065	93.6	875	96.5	1940	94.9	
Weight (Mean, SD)	78.0	15.1	74.7	14.9	76.5	15.1	<0.001
Height (Mean, SD)	165.4	6.8	155.2	6.6	160.9	8.4	<0.001
BMI (Mean, SD)	28.5	5.3	30.9	5.7	29.6	5.6	<0.001
BMI (WHO)[+]							
Underweight	18	1.6	7	0.8	25	1.3	<0.001
Normal	251	22.8	102	12.0	353	18.1	
Overweight	450	40.9	280	32.8	730	37.4	
Obese	380	34.6	464	54.4	844	43.2	
BMI[++]							
Underweight	94	8.6	29	3.4	123	6.3	<0.001
Normal	376	34.2	187	21.9	563	28.8	
Overweight	629	57.2	637	74.7	1266	64.9	
Activities of daily living (ADL) (Mean, SD)	5.8	0.7	5.7	0.8	5.7	0.8	0.077

Values are presented as number (N) and percentage (%) or mean and standard deviation (SD). Chi-square test for categorical variables. Mann-Whitney U test to compare men and women mean values. *P* values are significant at $p< 0.05$.
[+]BMI (WHO): World health organization classification. [++]BMI**:** Older adults-BMI classification (15, 16).

of the included older adults were illiterate, 83.7% were not employed, and only 5.1% lived alone.

Older women had significantly higher BMI (30.9 kg/m^2) than older men (28.5 kg/m^2). However, based on the WHO-BMI classification, overweight prevalence was higher in the older men (40.9%), while obesity prevalence was higher in the older women (54.4%). Based on older adults-BMI classification, the prevalence of underweight was 8.6% and 3.4% for older men and older women, respectively, while the prevalence of overweight reached 57.2 % in older men and 74.7% in older women.

There was no significant difference in the ADL-mean score between older men and older women (p=0.077).

Table 2 presents the nutritional status of older adults by socio-demographic characteristics, functional status and BMI. The prevalence of malnutrition or at risk of malnutrition was higher in older women (24.9%) than in older men (17.7%). However, there were very few older adults classified as malnourished (1.4%) while 19.5% were at risk of malnutrition. In the age group ≥ 80 years, the % classified as at risk of malnutrition or malnourished increased to 47.1%.

The percent of older adults classified as at risk of malnutrition was higher in those who were single (33.3%) or widowed (34.8%) compared to those with another marital status. Those who were illiterate had a higher percent classified as at risk of malnutrition (27.3%) or malnourished (2.5%) compared to other educational levels.

There was a significant association between nutritional status and ADL. Among those who were classified as fully functional, only 15.2% were classified as at risk of malnutrition or malnourished. Among those classified as moderately functional impairment or severe functional impairment, 55.3% and 73.9% were classified as at risk of malnutrition or malnourished, respectively.

About 38% and 47.6% (total 85.7%) of older adults classified as underweight, based on the WHO-BMI classification, were at risk of malnutrition and malnourished, respectively. Based on BMI older-adults' classification, 53.4% and 13.6% (total 67%) of those classified as underweight were at risk of malnutrition and malnourished, respectively.

Binary logistic regression analysis was performed to assess the impact of difficulties to perform ADL (the independent variable) on the nutritional status (dependent variable), dichotomized as at risk of malnutrition or malnourished vs normal nutritional status (table 3). There was a significant influence of functional status using ADL index on the nutritional status of older adults. In the crude model (model 1), the results indicated that the reduction in one unit of ADL index, significantly increased the OR of being at risk of malnutrition or malnourished (OR: 2.64, CI: 2.19 – 3.17; p<0.001). After adjusting for sex and age in model 2, the relationship remained significant (OR: 2.09, CI: 1.73 – 2.53; p<0.001). It is worth mentioning that most older adults in the at risk of malnutrition or malnourished group, were categorized as at risk of malnutrition.

Discussion

The current study identified a high prevalence of both obesity (43.2%), and risk of malnutrition or malnutrition (20.9%) among older subjects attending PHCCs in Riyadh city. Individuals who were unemployed, illiterate, single and widowed were at a higher risk of malnutrition. Finally, there was a significant association between nutritional status and ADL. This study provides valuable new information of relevance to public health policy in KSA.

In the present study, there were more men classified as overweight compared to women, while there were more women classified as obese compared to men. The current study demonstrates that the picture of high prevalence of overweight and obesity in older adults and the sex differences in pattern, is not different when compared to studies conducted in adults in the KSA (8,9,17).

The current study identified that 17.7% of older men and 24.9% of older women were categorized as either at risk of malnutrition or as malnourished. However, most of these older adults were classified as at risk of malnutrition. These findings are in accordance with several studies in the literature from different countries. Winter et al. reported that 17% of older subjects attending a general practice clinic in Victoria, Austral-

Table 2. Nutritional status of older subjects attending primary health care centers by socio-demographic characteristics, functional status, and body mass index (row-wise)

	MNA								
Characteristics	**Normal nutritional status**		**At risk of malnutrition**		**p-value***	**Malnourished**		**p-value****	**p-value*****
Sex	**N**	**%**	**N**	**%**		**N**	**%**		
Male	791	82.4	157	16.4	< 0.001	12	1.3		
Female	586	75.0	183	23.4		12	1.5	0.465	< 0.001
Total	1377	79.1	340	19.5		24	1.4		
Age groups									
60 - 69 y	1095	84.8	186	14.4	< 0.001	11	0.9		
70 – 79 y	236	65.2	118	32.6		8	2.2	< 0.001	< 0.001
≥ 80 y	46	52.9	36	41.4		5	5.7		
Marital status									
Married	1145	82.9	224	16.2	< 0.001	12	0.9		
Single	8	66.7	4	33.3		0	0.0	< 0.001	< 0.001
Widow	184	61.5	104	34.8		11	3.7		
Divorced	40	81.6	8	16.3		1	2.0		
Occupation									
Employed	261	90.6	27	9.4	< 0.001	0	0.0	< 0.007	< 0.001
Not employed	1116	76.81	313	21.5		24	1.7		
Education levels									
Illiterate	444	70.1	173	27.3	< 0.001	16	2.5		
Primary	389	83.5	70	15.0		7	1.5	< 0.001	< 0.001
Intermediate & Secondary	407	85.0	71	14.8		1	0.21		
University or above	137	84.0	26	16.0		0	0.00		
Living conditions									
Alone	73	77.7	20	21.3	0.670	1	1.1	0.635	0.881
With your children/Spouse/Other	1304	79.2	320	19.4		23	1.4		
Activities of daily living (ADL)									
Fully functional	1275	84.8	217	14.4	<0.001	12	0.8		
Moderate functional impairment	92	44.7	103	50.0		11	5.3	<0.001	<0.001
Severe functional impairment	6	26.1	16	69.6		1	4.3		
BMI (WHO)⁺									
Underweight	3	14.3	8	38.1	<0.001	10	47.6		
Normal	172	58.3	116	39.3		7	2.4	<0.001	<0.001
Overweight	526	84.2	96	15.4		3	0.5		
Obese	638	87.4	91	12.5		1	0.1		
BMI⁺⁺									
Underweight	34	33.0	55	53.4	<0.001	14	13.6		
Normal	358	73.8	123	25.4		4	0.8	<0.001	<0.001
Overweight	947	87.4	133	12.3		3	0.3		

Nutrition status was assessed using the Mini-nutritional assessment (The MNA®) tool. Analysis by Chi-square test. P-value < 0.05 is considered statistically significant. * P-value between normal nutritional status & at risk of malnutrition; ** P-value between normal nutritional status & malnourished; *** p-value among all the groups. ⁺BMI (WHO): World health organization classification. ⁺⁺BMI: Older adults-BMI classification (15, 16).

Table 3. Binary logistic regression: The impact of reduction in the activities of daily living (ADL) on the odds ratio of being malnourished or at risk of malnutrition in comparison to normal nutritional status

	OR for nutritional status*	
	OR (*C.I.* 95%)	*P value*
Model 1		
ADL	2.64 (2.19-3.17)	<0.001
Model 2		
ADL	2.09 (1.73-2.53)	<0.001

*The reference category of the outcome is well nourished group (At risk of malnutrition group and malnourished group were merged). Model 1: crude. Model 2: adjusted for age & gender. OR=Odds ratio; C.I.=confidence interval. *P*-value < 0.05 is considered statistically significant.

ia were at risk of malnutrition or malnourished, using the MNA Short Form (18). A cross-sectional study conducted on community-dwelling older adults living in Lebanon, in which nutritional status was assessed by MNA®, and its association with socio-demographic characteristics, showed that the proportion classified as at risk of malnutrition or malnourished was significantly higher in older subjects aged >85 years, in women, and in widowed and illiterate individuals (19). This is consistent with the current study, in which the percentage classified as at risk of malnutrition was higher in women than in men, and the frequency of subjects classified as at risk of malnutrition or malnourished was higher in the group aged ≥ 80 years, in widowed and in illiterate individuals compared to other corresponding categories. Furthermore, Rosa and her colleagues have shown that the frequency of malnutrition and risk of malnutrition determined using the MNA® was 18.6% in non-hospitalized older adults (20).

A study conducted on a community-dwelling older Americans (aged 60 years and older) to determine the prevalence of malnutrition (21) showed that 14.2% of those who were categorized as malnourished were more likely to have more than two difficulties in performing ADL compared to only 1.6% of those categorized as well-nourished. The results of the above study are consistent with the present study, in which the percentage of older people classified as at risk of malnutrition or malnourished was higher among those with moderate functional impairment or severe functional impairment compared with those classified as fully functional. This is also supported by the binary logistic regression, which indicates that the reduction in the ADL significantly increased the OR of being at risk of malnutrition or malnourished.

In a cross-sectional study of elderly Japanese patients, Kuzuya and colleagues (22) found a significant positive correlation between MNA score and BMI. A population based-study conducted in a very old adults (>85 years) to investigate the association between nutritional status, assessed using MNA and BMI, and five years mortality (23) showed that the prevalence of at risk of malnutrition and malnourished was 40.3% and 13%, respectively. Sixty-five percent of those classified as malnourished and 28% of those classified as at risk of malnutrition had a BMI < 22.2 kg/m^2. In addition, they found that a BMI <22.2 kg/m^2 and a MNA score <17 were associated with lower survival. In our study, 66.6% (14/21) of those classified as malnourished and 17.7% (55/311) of those classified as at risk of malnutrition had a BMI <22 kg/m^2. When the nutritional status, using MNA and nutritional risk screening 2002, and other nutritional biochemical parameters of inpatient older adults aged ≥ 70 years was assessed within 24 hours of admission (24), those who were undernourished (malnourished and at risk of malnutrition group) had a lower BMI, hemoglobin, albumin and prealbumin and longer length of stay. Furthermore, the study showed that the nutritional and biochemical parameters were positively correlated with the MNA score. Thus, detecting malnourished older persons in PHCCs using an appropriate screening protocol followed by an appropriate nutrition intervention may reduce the risk of malnourished older people requiring hospital admission and may reduce the length of hospital stay.

The main limitations of the study were being a cross-sectional study and that it is not nationally representative, as it involved older adults from the capital of KSA, who may not represent older adults from other geographical regions of KSA.

Conclusions

To conclude, the current study provides health-policy makers in the KSA with the necessary data on

the current nutritional status of older adults in order to take appropriate measures to improve the existing health care services provided for older adults. Furthermore, there is an association between poorer nutritional status and low ADL in the older population of the KSA.

Conflict of interest
The authors have no conflicts of interest to declare.

Ethical approval
The study was approved by the Ethical Committee at the Ministry of Health, KSA.

Contribution of the authors
Study design, concept & acquisition of data: Adel Alhamdan, Saad Bindawas, Sulaiman Alshammari, Sadaa Al-Orf, May Al-Muammar, and Maysoon Al-Amoud; drafting of the manuscript: Adel Alhamdan; Analysis and interpretation of data: Adel Alhamdan, Saad Bindawas, Sulaiman Alshammari; Revising of the manuscript: Philip Calder, Saad Bindawas, Sulaiman Alshammari, Sadaa Al-Orf, May Al-Muammar, and Maysoon Al-Amoud; Study supervision, and Critically review and edit the manuscript: Philip Calder.

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References

1. United Nations. Department of Economics and Social Affairs. Population division, ed. World Population Ageing 2017. New York: United nations; 2017 Available at: http://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Highlights.pdf. Accessed February 2, 2018
2. World Health Organization (WHO). In: Global status report on noncommunicable diseases 2010: Burden: mortality, morbidity and risk factors. Geneva: WHO; 2010. p. 9-31. Available at: http://www.who.int/nmh/publications/ncd_report2010/en/. Accessed February 2, 2018.
3. Kenkmann A, Price GM, Bolton J. Health, wellbeing and nutritional status of older people living in UK care homes: An exploratory evaluation of changes in food and drink provision. BMC Geriatr 2010;10:28. doi: 10.1186/1471-2318-10-28
4. Freijer K, Tan, SS, Koopmanschap, MA, Meijers JM, Halfens RJ, Nuijten MJ. The economic costs of disease related malnutrition. Clin Nutr 2013;32:136–141.
5. Amarantos E, Martinez A, Dwyer J. Nutrition and quality of life in older adults. J Gerontol A Biol Sci Med Sci 2001;56:54–64.
6. Naseer M, Forssell H, Fagerstrom C. Malnutrition, functional ability and mortality among older people aged 60 years: a 7-year longitudinal study. Eur J Clin Nutr 2016;70:399-404.
7. Tucker HN, Miguel SG. Cost containment through nutrition intervention. Nutr Rev 1996;54:111-121.
8. Al-Nozha MM, Al-Mazrou YY, Al-Maatouq MA, Arafah MR, Khalil MZ, Khan NB, et al. Obesity in Saudi Arabia. Saudi Med J 2005;26:824-829.
9. Memish ZA, El Bcheraoui C, Tuffaha M, Robinson M, Daoud F, Jaber S, et al. Obesity and associated factors-Kingdom of Saudi Arabia, 2013. Prev Chronic Dis 2014;11:E174. doi: 10.5888/pcd11.140236.
10. Fávaro-Moreira NC, Krausch-Hofmann S, Matthys C, Vereecken C, Vanhauwaert E, Declercq A, et al. Risk Factors for Malnutrition in Older Adults: A Systematic Review of the Literature Based on Longitudinal Data. Adv Nutr. 2016;7:507-22.doi: 10.3945/an.5.011254.
11. Yildiz D, Büyükkoyuncu PN, Kiliç AK, Tolgay EN, Tufan F. Malnutrition is associated with dementia severity and geriatric syndromes in patients with Alzheimer disease. Turk J Med Sci 2015;45:1078-81.
12. Katz S, Downs TD, Cash HR, Grotz RC. Progress in development of the index of ADL. Gerontologist 1970;10:20-30.
13. Vellas B, Guigoz Y, Garry PJ, Nourhashemi F, Bennahum D, Lauque S, et al. The Mini Nutritional Assessment (MNA) and its use in grading the nutritional state of elderly patients. Nutrition 1999;15:116-122.
14. World Health Organization: Physical Status. The use and interpretation of anthropometry. Report of the WHO Expert Committee. Technical Report Series No. 854.Geneva: WHO: 1995;1–452.
15. Nutrition Screening Initiative. Nutrition interventions manual for professionals caring for older Americans. Washington DC: Nutrition Screening Initiative; 1992.
16. Lipschitz DA. Screening for nutritional status in the elderly. Prim Care 1994; 21:55-67.
17. Al Dokhi L, Habib SS. Assessment of gender differences in body composition and physical fitness scoring in Saudi adults by bioelectrical impedance analysis. Acta Clin Croat 2013;52:189-194.
18. Winter J, Flanagan D, McNaughton SA, Nowson C. Nutrition screening of older people in a community general practice, using the MNA-SF. J Nutr Health Aging 2013;17:322-325. doi: 10.1007/s12603-013-0020-0.
19. Boulos C, Salameh P, Barberger-Gateau P. Factors associated with poor nutritional status among community dwelling Lebanese elderly subjects living in rural areas: results of the AMEL study. J Nutr Health Aging 2014;18:487-494. doi: 10.1007/s12603-013-0436-6.
20. Rosa CB, Garces SBB, Hansen D, Brunelli AV, Bianchi PDA, Coser J, et al. Malnutrition risk and hospitalization in

elderly assisted in Primary Care. Ciencia & Saude Coletiva 2017;22:575-582.
21. DiMaria-Ghalili RA, Michael YL, Rosso AL. Malnutrition in a sample of community-dwelling older Pennsylvanians. J Aging Res Clin Pract 2013;2:39-45.
22. Kuzuya M, Kanda S, Koike T, Suzuki Y, Satake S, Iguchi A. Evaluation of Mini-Nutritional Assessment for Japanese frail elderly. Nutrition 2005;21:498–503.
23. Burman, M, Säätelä, S, Carlsson, M, Olofsson B, Gustafson Y, Hörnsten C. Body mass index, mini nutritional assessment, and their association with five-year mortality in very old people. J Nutr Health Aging 2015; 19:461-467.
24. Miao J, Quan X, Zhang C, Zhu H, Ye M, Shen LY, et al. Comparison of two malnutrition risk screening tools with nutritional biochemical parameters, BMI and length of stay in Chinese geriatric inpatients: a multicenter, cross-sectional study. BMJ Open 2019;9:e022993.

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