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Prevalence and risk factors of lens opacities in the elderly in Cuenca, Spain

J.J. NAVARRO ESTEBAN[1], J.A. GUTIÉRREZ LEIVA[2], N. VALERO CARACENA[3], J. BUENDÍA BERMEJO[3], M.E. CALLE PURÓN[4], V.J. MARTÍNEZ VIZCAÍNO[5]

[1]Department of Ophthalmology, Hospital Virgen de la Luz, Cuenca
[2]Honrubia Health Centre, Cuenca
[3]Cuenca II Health Centre, Cuenca
[4]Department of Public Health, School of Medicine, Universidad Complutense de Madrid, Madrid
[5]Social and Health Research Centre, University of Castilla-La Mancha, Cuenca - Spain

PURPOSE. *To estimate the prevalence of lens opacities in a group of elderly people and evaluate their relation with diverse risk factors.*
METHODS. *Cross-sectional observational study of the cohort of all persons over the age of 64 years from an urban area and a rural nucleus of the province of Cuenca, Spain. Information on sociodemographic parameters and smoking was compiled using a structured questionnaire. A physical examination was made in which weight, height, and waist circumference were measured, and an ophthalmologic examination was made of visual acuity and lens opacities. Cataracts were classified using the method of the WHO cataract group.*
RESULTS. *The study included 1155 subjects out of 1435 elderly persons who were invited to participate (response rate 80.5%). The prevalence of cataract in men was 69.2% and in women, 65.5% ($p>0.05$). The percentage of persons with aphakia/pseudophakia was 17.8% in men and 17.5% in women ($p>0.05$). In a logistic regression model, age, obesity of more than 35 kg/m^2, and low educational level were associated with the presence of cataract or aphakia/pseudophakia.*
CONCLUSIONS. *The prevalence of cataract in people over 64 years is similar to that of other countries, but the prevalence of subjects with previous surgery for cataracts is the highest reported in the literature. Age, body mass index of more than 35 kg/m^2, and low educational level were associated with the probability of having cataracts or undergoing surgery for cataracts. (Eur J Ophthalmol 2007; 17: 29-37)*

KEY WORDS. *Body mass index, Cataract, Educational status, Pseudophakia, Risk factors*

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INTRODUCTION

Cataract is a condition responsible for approximately 50% of cases of blindness in the world (1). Since cataracts are directly related to loss of visual acuity, they are associated with a reduction in functional capacity and, in general, to diminished quality of life (2). In addition, the loss of sight increases the risk of falls (3) and clinical depression (4), and increases mortality (5).

Studies of the prevalence of cataract reveal geographic differences (6-13). In Spain, to our knowledge, the prevalence of cataract has not been studied in a representative sample of people over 64 years old, so we cannot compare the frequency of this condition in Spain to other re-

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gions of the world.

Diverse risk factors for the development of cataract have been identified, but there are still gaps in our knowledge of the respective importance of each factor. Among them, age is the factor most consistently associated with the presence of cataract (14). In addition, several studies have related smoking with the appearance of cataracts, but estimates of the strength of this association vary (15-19). A third risk factor that is interesting and extraordinarily controversial is the importance of obesity (14, 20-22). Finally, other factors that have been associated more or less consistently with the presence of cataract include arterial hypertension, exposure to ultraviolet radiation, low educational level, alcohol consumption, diabetes, and steroid use (17, 23, 24).

In 2003–2004, a population study was made in the province of Cuenca, Spain, to examine the prevalence of visual acuity disorders in people over 64 years old. The relation between these disorders and diverse risk factors was evaluated, and the impact of visual acuity disorders on quality of life in terms of health was assessed. This study reports on the prevalence of lens opacities and examines the relation between this condition and various risk factors.

METHODS

Design and study subjects

A cross-sectional observational study was made of all people over 64 years old from two rural community-based primary care centers (Honrubia and Cañete) and an urban community-based primary care center (Cuenca II) of the province of Cuenca (1155 subjects), which attends all the people of the area. This sample size is enough to estimate a 95% confidence interval of cataract prevalence, considering an expected cataract prevalence of 50%, and a precision of 3%. All subjects with physical and/or mental disorders, who could not cooperate sufficiently for an ophthalmologic examination, or who were unable to go to the health center for the examination were excluded from the study.

Measurement variables and instruments

A trained nurse administered a structured questionnaire which was used to obtain information on sociodemographic variables (age, sex, educational level, and occupation), current and life-long smoking habits, secondhand smoke inhalation, presence of chronic disease (arterial hypertension, diabetes, rheumatic disease), and current use of medications.

The same nurse measured the following anthropometric parameters:

• Weight: Subjects were weighed with a homologated, easily calibrated scale while they were barefoot and wearing light clothing. The reading was accurate to within 0.1 kg.

• Height: A stadiometer built into the scale was used and height was measured with the individual barefoot, erect, and with the midline aligned with the vertical axis of the stadiometer. The subject stood with his or her chin parallel to the ground and the measurement was accurate to the millimeter.

• Body mass index (BMI): Weight/height^2.

The eye examination was carried out by an ophthalmologist of the health center of each municipality. The examination included the following:

• Refraction: Participants were refracted using RM-8000 auto refractor (Topcon Optical Co). This refraction was used as the starting point for a full subjective refraction.

• Visual acuity: Distance acuity was tested under standardized illumination with 8 feet-LogMAR charts developed for the Early Treatment Diabetic Retinopathy Study (ETDRS) based on de LogMAR Visual Acuity Chart developed by Bailey and Lovie and Ferris et al (25, 26). Distance acuity was studied for the first time with the patient's optical correction (if he or she wore glasses) and then the best-corrected visual acuity determined after objective autorefraction and subjective refinement.

After this examination, sodium fluorescein and oxybuprocaine drops were instilled for preliminary determination of intraocular pressure. Next, drops of phenylephrine hydrochloride and tropicamide were instilled to achieve at least 6.5 mm mydriasis for correct examination of the lens and structures of the posterior pole.

Corneal examination

The presence of corneal injuries that might be responsible for the reduction or loss of visual acuity was examined first using the Topcon SL8Z (Topcon Optical Co.) photographic slit lamp equipped with a digital photographic system associated with an Imagenet 2000 imaging system (Topcon Optical Co.). Subjects with a corneal opacity

that impeded correct examination were excluded.

Examination of lens opacity

A slit lamp with a 10x magnification was used. Serial photographs were made with a slit lamp in all subjects under routine examination conditions (illumination at a 30º angle with a 1-mm slit lamp for nuclear sclerosis and back illumination for the classification of subcapsular cataract and subcortical cataract).

According to the WHO Cataract Grading System Group (27), lens opacities are classified by their location as nuclear, cortical, and posterior subcapsular cataracts. Using the same photographic system, four degrees of severity were differentiated: Grade 0 (no or minimal cataract), Grade 1 (clinically significant cataract), Grade 2 (stage of progression, intermediate situation), Grade 3 or more (severity sufficient to require surgical treatment), and Grade 9 (if cannot grade). Location and severity were classified by comparison with standard photographs of the WHO Cataract Grading System Group. The aphakia or pseudophakia presence were not included in the prevalence of cataract, catalogued in a different section, the same as the presence of capsular opacity.

Authorizations

The study project was approved by the Commission of Investigation of Primary Care Management of the Area of Cuenca. All study activities complied with the principles of the Declaration of Helsinki for investigations with human beings.

After approval of the financing and individual meetings with the council of health and primary care team of each municipality to inform them of the purpose of the study and request approval, a letter was sent to each subject selected for examination.

In this letter, the subject was invited to participate in the study, informed about its aims, and given contact telephones so that he or she could change appointments if he or she could not keep the scheduled appointment. If the patient did not keep the first appointment, the nurse of the health center called the patient to find out if he or she had decided not to participate in the study or had not received the notification.

When the subject came to the center, he or she was received by a nurse who again explained the reasons for the study, described the examinations to be performed and their risks (mainly allergic reactions), and asked for the patient's written consent to participate.

Statistical analysis

The Student *t*- test for independent samples was used to test hypotheses of differences between means and proportions. The association between the presence of cataracts and a history of smoking, diabetes, or hypertension was analyzed with the χ^2 test.

The association between presence of cataract and body mass index was analyzed using the Mantel-Haenszel χ^2 test for tendencies, classifying the patient's weight as normal (<25 kg/m^2), overweight (25–29.9 kg/m^2), obese (30–34.9 kg/m^2), or severely obese (35 kg/m^2).

To avoid the effect of potential variables of confusion when estimating the strength of association between the presence of cataract and the variables sex, age, weight status, educational level, diabetes, arterial hypertension, and history of smoking, an unconditional logistic regression model was used, with presence of cataract in at least one eye and/or presence of aphakia/pseudophakia as the dependent variable. Using this model, the presence of the following interactions was demonstrated: weight status and age, weight status and smoking habit, weight status and diabetes, and smoking habit and arterial hypertension. Variables were selected using the step-forward method of unconditional selection based on Wald statistics values. The fit was tested with the Hosmer and Lemeshow test.

Statistical analyses were made with the SPSS 12.0 package for Windows.

RESULTS

The study included 1155 people out of a total of 1435 who were invited to participate (response rate 80.5%). Of them, 520 (45.5%) were men and 624 (54.5%) were women; 11 subjects were lost due to defects in photographic quality or administrative errors. The age range of participants was 65 to 97 years, mean age 73.71 years (SD=6.05 years). The mean age of men was 73.8 years (SD=6.16 years) and of women, 73.63 years (SD=5.96 years); no statistically significant differences were observed in mean age by sex. Diabetes had been diagnosed in 15.6% of patients and arterial hypertension in 46%.

Of 932 subjects who had not undergone surgery for cataract, 626 (67.2%) had a cataract in at least one eye. The frequency of previous surgery for cataract was 65.5% in women and 69.2% in men; these differences were not statistically significant. Similarly, no statistically significant differences were apparent between the prevalence of cataract in rural (68.5%) and urban areas (65.3%).

The prevalence of cataract by age group and sex is summarized in Table I. Stratification by age groups disclosed no differences by sex in the prevalence of cataract. The frequency of cataract was greater in persons over 74 years old than in the 65- to 74-year-old group (p<0.001). Late cataract was observed in more than 50% of patients over 74 years old.

The frequency of previous surgery for cataract (aphakia or pseudophakia) was 17.8% in men and 17.5% in women (Tab. II). Previous surgery was more frequent in people over 74 years old than in the group between 64 and 74 years; these differences were statistically significant in men (p<0.0001) and women (p=0.007).

The prevalence of cataract and aphakia/ pseudoaphakia in relation to history of smoking, weight status,

TABLE I - PREVALENCE OF CATARACT BY AGE GROUP AND SEX AMONG PEOPLE OVER 64 YEARS OLD RESIDING IN CUENCA, SPAIN

		Stage of development (%)* (95% confidence interval)			
Age group, yr	**Sex**	**No cataract**	**Early cataract**	**Late cataract**	**p**
65–74	Men	39.0	37.6	23.4	0.155
	(n=290)	(33.2–44.7)	(31.8–43.3)	(18.4–28.5)	
	Women	45.7	30.9	23.4	
	(n=337)	(40.2–51.1)	(25.8–35.9)	(18.8–28.1)	
>74	Men	12.8	36.3	50.8	
	(n=79)	(7.7–18.0)	(30.0–43.6)	(43.2–58.4)	0.712
	Women	12.7	32.5	54.7	
	(n=212)	(8.0–17.5)	(26.0–39.1)	(47.8–61.6)	
Total		31.1	34.1	34.8	
	(n=1018)	(28.2–34.0)	(31.1–37.6)	(31.8–37.7)	

*Early cataract is stage 1 and late cataract is stage 2 or more of the WHO Cataract Grading System Group

TABLE II - ABSOLUTE FREQUENCY AND PROPORTION OF PERSONS WITH APHAKIA/PSEUDOPHAKIA IN AT LEAST ONE EYE BY AGE GROUP AND SEX

Age group, yr	**Men**		**Women**		
	No. (%)	**95% CI**	**No. (%)**	**95% CI**	**p**
65-74	32 (10.4)	6.8–14.0	35 (9.6)	6.5–12.8	0.737
>74	60 (28.6)	22.2–34.9	74 (28.4)	22.7–34.0	0.958
Total	92 (17.8)	14.4–21.2	109 (17.5)	14.4–20.5	0.885

95% CI = 95% confidence interval

educational level, and presence of diabetes or arterial hypertension is summarized in Table III. Cataracts were more frequent among persons with a history of smoking, severe obesity, low educational level, diabetes, and arterial hypertension, although only the associations between educational level, diabetes, and arterial hypertension and presence of cataract were statistically significant. No statistically significant association was observed between any of the previous variables and the presence of aphakia/ pseudophakia.

Table IV shows the results of logistic regression analysis taking as dependent variable the presence of cataract and/or aphakia/pseudophakia and as independent variables age, sex, educational level, obesity, smoking history, and the presence of diabetes or arterial hypertension. Age, sex, weight status, diabetes, and educational level were predictive of the appearance of cataract or of previous surgery for this condition. Cataracts were more frequent in men age 75 years or older and in people with BMI = 35 kg/m^2, diabetes, or a low educational level.

DISCUSSION

To our knowledge, our work is the first study in Spain of the prevalence of cataract in a representative sample of noninstitutionalized people over 64 years old. We report estimates of the strength of the association between age, sex, obesity, diabetes, and educational level and the presence of cataract and/or aphakia/pseudophakia. Our study shows the highest prevalence of aphakia/pseudophakia of any population study published in the world.

Estimates of the prevalence of cataracts in persons over 64 years old in the province of Cuenca occupy an intermediate position among reports published until now. The prevalence is higher than that of the Melbourne Visual Impairment Project (6) or Tanzania study (13), slightly lower than the prevalence reported in the Framingham Eye Study (8), and similar to the prevalence of the Beaver Dam Eye Study (7), Blue Mountains Eye Study (10), Finland (11), and Taiwan studies (12). Variability in estimates of the prevalence of cataract can be attributed to popula-

TABLE III - RELATION* BETWEEN THE PRESENCE OF CATARACT OR APHAKIA/PSEUDOPHAKIA AND HISTORY OF SMOKING, WEIGHT STATUS, EDUCATIONAL LEVEL, DIABETES, AND ARTERIAL HYPERTENSION IN ELDERLY PEOPLE OF THE PROVINCE OF CUENCA, SPAIN

		Cataract			Aphakia/pseudophakia		
		No. (%)	95% CI	p	No. (%)	95% CI	p
History of smoking	Yes	217 (70.9)	65.6–76.2	0.546	68 (19.5)	15.2–23.8	0.270
	No	466 (67.3)	63.8–70.9		129 (16.8)	14.0–19.4	
Weight status	Normal	103 (72.0)	64.3–79.7	0.230	26 (16.3)	10.2–22.3	0.155
	Overweight	304 (67.3)	62.8–71.7		85 (16.8)	13.4–20.1	
	Obese	215 (67.6)	60.3–72.9		61 (17.2)	13.1–21.2	
	Extremely obese	75 (77.3)	68.5–86.2		27 (24.1)	15.7–32.5	
Educational level	Illiterate	105 (78.4)	71.0–85.7	0.000	33 (21.3)	14.5–28.1	0.075
	Incomplete elementary school	514 (68.7)	65.3–72.1		145 (17.2)	14.6–19.8	
	Elementary school	46 (56.1)	44.7–67.4		9 (10.5)	3.4–17.5	
	High school or higher	18 (52.9)	34.7–71.2		10 (27.0)	11.3–42.7	
Diabetes	Yes	114 (77.6)	70.5–84.6	0.007	32 (18.7)	12.6–24.8	0.622
	No	550 (66.3)	63.0–69.6		158 (17.2)	14.6–19.6	
Arterial hypertension	Yes	329 (72.0)	67.7–76.2	0.013	81 (16.0)	12.7–19.3	0.272
	No	335 (64.5)	60.3–68.7		109 (18.6)	15.3–21.8	

*The hypothesis of an association between cataract or pseudophakia and history of diabetes, arterial hypertension, or smoking was compared using χ^2 of Pearson. The hypothesis of an association between cataract or pseudophakia with weight status and educational level was examined with the Mantel-Haenszel χ^2 test for tendencies.
95% CI = 95% confidence interval

TABLE IV - VARIABLES ASSOCIATED WITH PRESENCE OF CATARACT AND APHAKIA/PSEUDOPHAKIA IN AN UNCONDITIONAL LOGISTIC REGRESSION MODEL

Variable		B	p	OR	95% CI, OR
Sex		0.399	0.010	1.490	1.098–2.022
Age		0.193	0.000	1.213	1.174–1.253
Weight status			0.003		
	BMI 25–29.9	0.083	0.723	1.086	0.687–1.718
	BMI 30–34.9	0.334	0.176	1.396	0.861–2.263
	BMI=35	1.086	0.001	2.961	1.521–5.765
Educational level				0.018	
	Incomplete elementary school	–0.502	0.042	0.605	0.373–0.982
	Elementary school	–1.018	0.003	0.361	0.185–0.705
	High school or higher	–0.923	0.035	0.397	0.168–0.939
Diabetes		0.636	0.005	1.889	1.215–2.936

95% CI = 95% confidence interval; BMI = Body mass index

tion differences in characteristics like age, the prevalence of obesity or diabetes, or educational level, among others, that have been related to the appearance of cataracts. Nevertheless, it also is possible that, at least partly, these differences in estimates of the frequency of cataract can be attributed to differences in the diagnostic classification systems used. The system of cataract classification used in our study is the system proposed by a work group sponsored by the World Health Organization (27), which in time may become the standard for comparison in epidemiologic studies.

The prevalence in Cuenca of previously operated cataract in at least one eye is, to our knowledge, the highest reported to date. Compared to 28.6% of men and 28.4% of women over 74 years old with aphakia/pseudoaphakia found in our study, fewer than 15% of participants of this age in an Australian study had this problem (6) and fewer than 10% had it in various American studies (7, 8). Among the possible explanations for these differences is universal health care coverage, meaning that it is not uncommon to see a high proportion of octogenarian patients on waiting lists for cataract surgery in Spanish hospitals.

The cataract risk factors analyzed in our study have been examined in many published studies. In all of them, age showed a statistically significant association (11, 12, 14). In our study, although the frequency of early cataract was lower in people over 74 years old than in people 65 to 74 years old, the frequency of late cataract was almost twice as high and the overall frequency of cataract was significantly higher. Logistic regression analysis showed that age was associated significantly with the presence of both cataract and aphakia/pseudophakia.

Although some studies have reported no differences by sex in the frequency of cataract when the effect of age is controlled (11), others report a greater frequency of cataract in women (14). In our study, a statistically significant relation was seen between sex and the frequency of cataract, which was more common in men. Although no credible explanation for the relation between sex and the presence of cataract has been advanced by any study, in our case it seems logical to think that the men, generally farmers, had more solar exposure throughout their lives and that this exposure was responsible for this weak, but significant, association.

Among the biological mechanisms that might explain the direct relation between obesity and cataract, two main mechanisms have been proposed: in the first place, the deterioration in blood sugar control that occurs in obese people, with or without diabetes (14), and in the second place, inflammatory mechanisms related to high concentrations of reactive C protein and plasma fibrinogen, both associated with obesity (18). Nevertheless, despite the biological coherence of these hypotheses of the origin of cataract, there is still no firm epidemiologic evidence to support this relation. Although most studies have revealed a close relation between high BMI values and the risk of cataract, others have found an inverse relation (14). It

should be noted that the root of this controversy could be a lack of homogeneity in study design. Some cohort studies take the diagnosis of cataract as an outcome measure (23); others use surgery for cataract removal (18). In addition, while the only objective of some studies is to analyze the frequency of cataract and associated factors (14), others are cohort studies with a variety of objectives (18).

In our study, logistic regression analysis with presence of cataract and/or pseudophakia as the dependent variable revealed obesity as the predictive variable. The extremely obese (BMI = 35) had a frequency of cataract almost three times greater than nonobese people, while the obese (BMI 30 to 35 kg/m^2) had a frequency more than 39.6% greater, although this difference did not reach statistical significance. Consequently, our study only showed a strong association between obesity and cataract and/or history of cataract surgery in subjects with a BMI of 35 kg/m^2 or more.

Another important consideration is that in our study an ophthalmologist diagnosed cataract and a nurse measured weight and height; in most studies, weight and height are reported by the subject, thus enhancing the value of our conclusions on obesity.

The relation between smoking and cataract has been demonstrated by numerous longitudinal (14) and cross-sectional studies (11, 12). Some of these studies have shown a dose-response relation between the number of cigarettes smoked and the risk of developing nuclear cataract (14). Nevertheless, the role of smoking in the development of non-nuclear cataracts is not clear (19). In our study, no association was observed with a history of smoking and current smoking habit, although cataract or previous surgery for cataract were more frequent in people who had smoked sometime in life. The reason why history of smoking was not identified as a predictive factor by the logistic regression model was that only four women in our study had been lifelong smokers; female smokers were uncommon in Spain 20 or 30 years ago.

Most studies report a moderate association between diabetes and the risk of cataract, although this association depends on the type of cataract in almost every study. In Leske and colleagues (14, 28) in the Barbados Eye Study, one of the few studies in which subjects age 40 to 84 years old were followed up, the relative risk was 2.9 for subcapsular cataract, 1.6 for nuclear cataract, and 2.4 for cortical cataract (14, 28). Similar estimates were reported by Hirvelä et al (11) in Finland, Delcourt et al (29) in France (in the Delcourt study the strength of the diabetic association was somewhat greater because only diabetics with a history of more than 10 years were included), McCarty et al (30) in Australia, and Foster et al (31) in Singapore. In one case-control study (32), no association was observed between diabetes and cataract (probably because subjects with diabetic retinopathy were not included) and in another study, diabetes appeared to be a protective factor (33). Our study showed an 89% greater probability of cataract in people with diabetes than in nondiabetics, an estimate similar to that of Leske et al (14) for nuclear cataract.

The relation between arterial hypertension and cataract is debated, with some studies like the Barbados Eye Study showing a weak association between diastolic blood pressure and cataract in people under the age of 60 years (OR=1.49), whereas others, like the Framingham Study, show no statistically significant association with any type of senile cataract. Other authors suggest that the relation may be not so much with arterial hypertension as with the use of certain teratogenic medications like furosemide.

In our study, arterial hypertension showed a statistically significant association in bivariate analysis, but the association disappeared in logistic regression analysis when adjusted for variables associated with hypertension, like weight status or diabetes.

Among the main limitations of our study is that it was carried out in a noninstitutionalized population, meaning that the prevalence of cataract could nave been underestimated, since loss of visual acuity due to cataract is a reason for institutionalizing older people. However, the proportion of people institutionalized in the province of Cuenca is low (less than 1% of the population over 64 years old), so we assume that this factor would not affect the prevalence of cataract very much.

Another limitation of our study is that, even though logistic regression analysis has been used in many cross-sectional studies to analyze variables predictive of diverse conditions, only longitudinal studies provide reliable evidence of the relation between a given factor and a condition. Nevertheless, certain risk factors, like sex or educational level, are presumably free of temporal ambiguity, at least for most study subjects.

The final limitation is that our study included only people from the province of Cuenca, so its conclusions cannot be generalized to other Spanish communities. Nevertheless, if we consider that our study population included people from urban and rural areas, that access to health-

care services is universal in Spain, and that the latitude of Cuenca and, therefore, the number of hours of sunlight a day, is intermediate for the Spanish territory, there seem to be no arguments of consequence for thinking that the data obtained from our study will differ greatly from data obtained in other regions. Finally, given the low rate of nonresponse in this study, our results could provide a reasonable estimate of the frequency of cataract and aphakia/pseudophakia in Spain and of the association between these conditions and sex, age, obesity, and educational level.

In summary, our findings show that cataract is more prevalent among people over 64 years old, as other international studies have shown. Nevertheless, the percentage of people this age who had received surgical treatment for cataracts is the highest reported to date in the world. Finally, sex, age, obesity, and educational level were factors associated with the presence of cataract and/or previous surgery for the condition.

Our findings are relevant for purposes of prevention, as they show a high prevalence of cataract in people over the age of 64 years and they demonstrate that the control of obesity at all stages of life can reduce the risk of developing cataracts, in addition to having other benefits.

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Reprint requests to:
Prof. V. Martinez Vizcaíno
Centro de Estudios Socio Sanitarios
Edificio Melchor Cano Universidad de Castilla La Mancha
Camino de Pozuelo s/n. 16071 Cuenca, Spain
Vicente.Martinez@uclm.es

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