SCIENTIA PLENA
www.scientiaplena.org.br
VOL. 22, NUM. 02 2026
doi: 10.14808/sci.plena.2026.026001

Prevalence of chondrocalcinosis on knee radiographs and associations with sociodemographic factors: The Brazilian Longitudinal Study of Adult Health - Musculoskeletal (ELSA-Brasil MSK)

Prevalência da condrocalcinose em radiografias de joelhos e associações com fatores sociodemográficos: Estudo Longitudinal de Saúde do Adulto - Musculoesquelético (ELSA-Brasil MSK)

V. S. Cunha[1,2*]; L. B. Nogueira[3,4]; R. A. Pinto[1,5]; L. Costa-Silva[6]; A. M. A. Oliveira[1,7]; A. B. Vargas-Santos[1,8]; S. M. Barreto[1,9]; R. W. Telles[1,10,11]

[1]*Estudo Longitudinal de Saúde do Adulto, HC UFMG/Ebserh, 30130-100, Belo Horizonte-MG, Brasil*
[2]*Programa de Pós Graduação em Ciências Aplicadas à Saúde do Adulto, Faculdade de Medicina, UFMG, 30130-100, Belo Horizonte- MG, Brasil*
[3]*Departamento de Anatomia e Imagem, Faculdade de Medicina, UFMG, 30130-100, Belo Horizonte-MG, Brasil*
[4]*Departamento de Engenharia Nuclear, Escola de Engenharia, UFMG, 31270-901, Belo Horizonte-MG, Brasil*
[5]*Programa de Pós Graduação em Saúde Pública, Faculdade de Medicina, UFMG, 30130-100, Belo Horizonte-MG, Brasil*
[6]*Instituto Hermes Pardini/Grupo Fleury, 30140-070, Belo Horizonte-MG, Brasil*
[7]*Tecnóloga em Radiologia, Faculdade de Medicina, UFMG, 30130-100, Belo Horizonte-MG, Brasil*
[8]*Serviço de Medicina Interna, Hospital Universitário Pedro Ernesto, UERJ, 20551-030, Rio de Janeiro-RJ, Brasil*
[9]*Departamento de Medicina Preventiva e Social, Faculdade de Medicina, UFMG, 30130-100, Belo Horizonte-MG, Brasil*
[10]*Departamento de Clínica Médica, Faculdade de Medicina, UFMG, 30130-100, Belo Horizonte-MG, Brasil*
[11]*Serviço de Reumatologia do Hospital das Clínicas da UFMG/Ebserh, 30130-100, Belo Horizonte-MG, Brasil*

**vitoriasantos.rad@gmail.com*
(Recebido em 15 de janeiro de 2025; aceito em 27 de outubro de 2025)

An increase in the burden of diseases among older adults is expected due to the aging of the Brazilian population. Understanding the prevalence of such diseases is essential for health service planning, including human resources, diagnostics and treatments. This article describes the prevalence of chondrocalcinosis in knees according to sociodemographic factors and chronic diseases. A cross-sectional study was conducted with 2,732 public servants from the ELSA-Brasil MSK baseline (2012-2014). Chondrocalcinosis was defined as a radiographic finding of calcium crystals deposition in the cartilage (punctate and linear calcifications) in any compartment of the left and/or right knees. Sociodemographic factors, anthropometric measures, and chronic diseases including diabetes, hypertension (HTN) and chronic kidney disease (CKD), were investigated. The prevalence of chondrocalcinosis was described considering the total population and the age group over 60 years (n=945). Pearson's chi-squared/Fisher's exact tests compared chondrocalcinosis distribution according to sociodemographic factors and chronic diseases. Multivariate logistic regression examined factors independently associated with chondrocalcinosis. The mean age of participants was 56.0 years (SD=8.7). Considering the entire population, prevalence of chondrocalcinosis was 1.4%, increasing with age ($p<0.001$) and lower education ($p<0.01$) and only age (OR=1.13, CI95% 1.09-1.18) remains in multivariate model. Among those aged ≥60 years (34.6%), prevalence was 3.3%, more frequent in males, Black and Brown race/skin color, those with lower education level, obese, diabetes, and non-HTN. Lower education (OR=2.62, CI95%1.10-6.23) and age (OR=1.15, CI95%1.07-1.23) were independently associated with chondrocalcinosis. This study reports preliminary findings from the ELSA-Brasil MSK baseline (2012–2014), serving as a foundation for future analyses.
Keywords: chondrocalcinosis, knee, radiographs.

Associado ao envelhecimento crescente da população brasileira, espera-se um aumento dos problemas de saúde em idosos. Compreender a prevalência dessas doenças é essencial para o planejamento dos serviços de saúde, incluindo recursos humanos, diagnósticos e terapêuticos. Este artigo descreve a prevalência de condrocalcinose de joelhos de acordo com fatores sociodemográficos e a presença de doenças crônicas. Foi realizado estudo transversal com 2.732 servidores públicos da linha de base (2012-2014) do ELSA-Brasil MSK. Condrocalcinose foi definida pelo achado radiográfico de deposição de cristais de pirofosfato de cálcio (calcificações puntiformes e lineares) em nos joelhos esquerdo e/ou direito. Fatores sociodemográficos, antropométricos e doenças crônicas que incluem diabetes, hipertensão (HAS) e doença renal crônica (DRC), foram investigados. A prevalência foi descrita na amostra total e no grupo ≥60 anos (n=945). Teste Qui-quadrado de Pearson e Exato de Fisher compararam a distribuição da condrocalcinose. Regressão logística multivariada avaliou fatores associados independentemente. A média (DP) da idade foi 56,0 (8,7) anos. A prevalência geral foi 1,4%, aumentando com a idade ($p<0,001$) e menor escolaridade ($p=0,002$). Análise multivariada mostrou associação significativa com a idade (OR=1,13; CI95% 1,09-1,18). Em indivíduos ≥60 anos, a prevalência foi 3,3%, mais frequente em homens (3,5%), pretos (3,9%), pardos (3,5%), com ensino fundamental ou menos (6,9%), obesos (4,4%), diabéticos (3,5%) e não-hipertensos (3,6%). Menor escolaridade (OR=2,62; $p=0,029$) e idade (OR=1,15; CI95%1,07-1,23) foram associadas independentemente à condrocalcinose. Este estudo relata resultados preliminares da linha de base do ELSA-Brasil MSK (2012–2014), servindo como base para análises futuras.
Palavras-chave: condrocalcinose, joelhos, radiografias.

1. INTRODUCTION

Brazilian demographic structure is undergoing a remarkable shift, characterized by a widening at the top and narrowing at the base of the age pyramid, indicating an aging population. Associated with this demographic transition is the epidemiological transition, which leads to changes in the living patterns of this specific population including social, economic, and health changes, suggesting an imminent increase in the prevalence of health conditions affecting the older population [1, 2]. Understanding diseases prevalence in this scenario is crucial for assessing health needs and devising strategies for the allocation of human, diagnostic, and therapeutic resources to effectively meet public health demands [3, 4].

Calcium pyrophosphate dihydrate deposition disease (CPPD) is an arthropathy in the group of microcrystalline arthritis, first reported by McCarty in 1962 [5], with the term chondrocalcinosis introduced by Zitnan and Sitaj in 1963 [6] to describe the radiographic alteration found. Chondrocalcinosis arises because of the pathological presence of microcrystals within the joints, hyaline cartilage, or fibrocartilaginous structures [7]. Previous studies have shown that the joints most affected by chondrocalcinosis are the knees, accounting for over 90% of cases, followed by wrists and shoulders. The most commonly used method for diagnosing knee chondrocalcinosis is the knee radiography [8-11].

The etiology of CPPD is still not fully understood and may result from dysfunction in phosphate metabolism in the body. For example, some metabolic syndromes are associated with CPPD, such as hyperparathyroidism, hemochromatosis, hypomagnesemia, and hypophosphatasia [9-11]. It has been noted that magnesium increases the solubility of the crystals and acts in the degradation of pyrophosphate. Thus, hypomagnesemia may favor the accumulation of these phosphates in the cartilaginous matrix and the formation of crystal deposits. Excess iron resulting from hemochromatosis may have an inhibitory action on pyrophosphatases. Regarding thyroid problems, it is known that there is a change in calcium metabolism, elevation of uric acid, and consequently the accumulation of calcium crystals [5, 11].

The clinical manifestations of CPPD can vary greatly and often coexist, both with acute and chronic symptoms such as pain, discomfort, and stiffness, presenting as chronic inflammatory arthritis, acute arthritis, and osteoarthritis (OA) with CPPD. Also, CPPD often presents as an isolated radiographic finding without associated clinical manifestations [9-11]. International research reports varying prevalence rates of chondrocalcinosis, with variation attributable to differences in study design, population characteristics, and radiographic methods used.

In the United States, studies involving hospitalized and clinical patients have reported a prevalence rate of approximately 10%, with significantly higher rates observed in older age groups, specifically, for those over 65 years old, the prevalence is 14.6% [12]. In Europe, similar findings are noted. Spain studies, which also used hospitalized and clinical patients, observed a prevalence of 10%, with a rate of 7% in individuals aged 60-65 years [13]. In Italy, an epidemiological study found a 7.8% prevalence among those aged 65-74 years and older adults [14]. Sweden studies, which also involved hospitalized and clinical patients, reported a prevalence of 2.84% [15]. Further cohort studies from South Korea found a prevalence of 2.7% and showed that advancing age is a risk factor for CPPD [9]. China's cohort study identified a prevalence of 0.34% [16], and Iran's cross-sectional study reported 1.5% [17]. Despite the variability in prevalence rates across different regions and study designs, all studies consistently show a higher occurrence of chondrocalcinosis in the older population. This pattern underscores the strong association between CPPD and aging.

Recent studies have considerably expanded the understanding of CPPD and chondrocalcinosis. Wu et al. (2025) [18], analyzing two large prospective cohorts, the Rotterdam Study (RS) and the Multicenter Osteoarthritis Study (MOST) cohort, reported that baseline knee chondrocalcinosis was present in approximately 5% of participants without osteoarthritis and was associated with a 1.75-fold higher risk of incident knee osteoarthritis over 20 years of follow-up. In addition, these authors developed a chondrocalcinosis severity score for radiograph assessment to quantify the severity of knee chondrocalcinosis. Sirotti et al. (2025) [19] highlighted the ongoing challenges in CPPD terminology and classification, emphasizing the urgent need for standardized diagnostic definitions to enhance comparability across studies and clinical

recognition. In this context, the 2023 EULAR recommendations introduced an updated framework for CPPD classification, distinguishing phenotypes based on clinical presentation, imaging findings, and crystal identification [20]. Together, these findings underscore the increasing international attention to CPPD and the relevance of non-clinical and population-based research to clarify its prevalence, determinants, and clinical implications, particularly in underrepresented regions such as Latin America.

There is a notable gap in the literature regarding the prevalence of knee chondrocalcinosis in Brazil, a middle-income country with sociodemographic characteristics distinct from those of high-income countries. The Brazilian Longitudinal Study of Adult Health (ELSA-Brasil) - Musculoskeletal (ELSA-Brasil MSK) includes, in its assessment, knee radiographs, allowing the investigation of chondrocalcinosis in a non-clinical, non-institutionalized population, with the potential to enhance the understanding of this problem in the Brazilian context [21, 22].

The objective of the present study is to describe the prevalence of chondrocalcinosis in this cohort and to investigate the association of chondrocalcinosis with sociodemographic and clinical characteristics.

2. MATERIALS AND METHODS

A cross-sectional analysis was performed using data from the baseline (2012-2014) of the ELSA-Brasil MSK. Digital knee radiographs, including non-fluoroscopic posteroanterior (fixed-flexion) and lateral views of both knees, were acquired.

From the initial cohort of 2,901 participants, who agreed and signed the Informed Consent Form, 2,824 had knee radiographs and complete data on chondrocalcinosis. Participants who self-identified as Asian (N=63) and Indigenous (N=15), as well as those with a Body Mass Index (BMI) below 18.5 kg/m² (N=14), were excluded from the final analysis due to the limited number, which precluded reliable prevalence estimates. Consequently, the final analysis was based on 2,732 individuals, as detailed in the flowchart presented in Figure 1.

The response variable was chondrocalcinosis, defined as the presence of typical punctate and linear calcifications in articular cartilage (fibrocartilage and/or hyaline cartilage) on left and/or right knee radiography, characteristic of calcium pyrophosphate dihydrate crystals deposition in any compartment (medial tibiofemoral, lateral tibiofemoral, and/or patellofemoral) of the knees. The analysis investigated the prevalence of chondrocalcinosis across the entire population and a subanalysis was conducted considering the specific age group of 60 years and older, which included 945 participants.

Sociodemographic characteristics and chronic conditions were investigated as possible associated factors. Sociodemographic characteristics included age group, sex, race/skin color (white, brown, black) and education level (primary, secondary, and higher education). Anthropometric and chronic conditions included BMI (normal weight, overweight, obesity), diabetes, hypertension (HTN) and chronic kidney disease (CKD).

Statistical analysis was conducted using Fisher's exact tests and Pearson's chi-squared test to compare the distribution of chondrocalcinosis based on the sociodemographic variables and anthropometric/chronic diseases in a univariate analysis. A multivariate logistic regression analysis was conducted, including the variables age and education level, with the outcome being chondrocalcinosis in all of the analytical sample and in those with 60 years or older. The Z-test was used in the logistic regression model.

All statistical analyses were performed with Stata 14.00 software (Stata Corporation, College Station, USA), with a significance level set at 5%. This comprehensive approach allowed for an in-depth examination of the prevalence and associated factors of chondrocalcinosis in the study population.

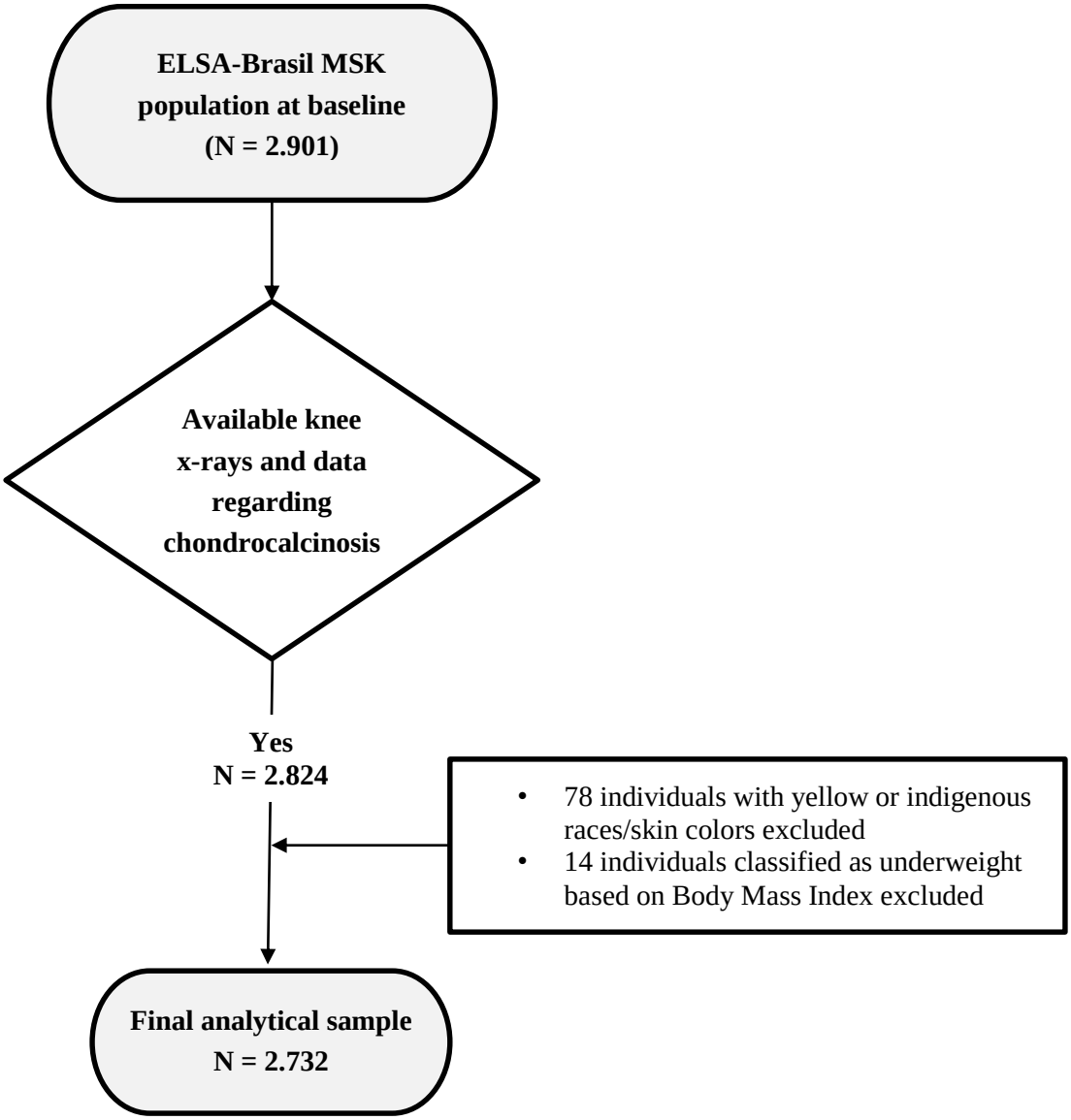

Figure 1: Flowchart of the ELSA-Brasil MSK study population.

3. RESULTS AND DISCUSSION

Most of the participants included in the study were female (52.8%), with a mean age (SD) of 56.0 (8.7) years, ranging from 38 to 79 years. The population was also characterized by the following distribution of race/skin color: White (50.8%), Brown (35.9%), and Black (13.3%, Table 1). Regarding education level, 8.2% had completed primary school or less, 25.1% had secondary education, and 66.7% had higher education. In terms of BMI, 36.4% of participants were classified as eutrophic (18.5 kg/m² < BMI < 25 kg/m²), 40.8% were overweight (25 kg/m² ≤ BMI < 30 kg/m²), and 22.8% were obese (BMI ≥ 30 kg/m², Table 1). Additionally, 40.8% of the participants had HTN, diabetes was present in 7.5% of the population, and CKD was reported in 21.5% of participants (Table 1).

Table 1: Distribution characteristics and prevalence of chondrocalcinosis according to investigated covariates among all the participants – the Brazilian Longitudinal Study of Adult Health Musculoskeletal (ELSA-Brazil MSK), 2012-2014 (N=2,732).

Variable	Total sample N=2,732 N (%)	CHONDROCALCINOSIS - PREVALENCE		p-value
		Yes N = 38 (1.4%) N(%)	No N = 2,694 (98.6%) N(%)	
Sociodemographic variables				
Age Group				
38 – 44 years	268 (9.8)	1 (0.4)	267 (99.6)	
45 – 54 years	980 (35.9)	3 (0.3)	977 (99.7)	
55 – 64 years	977 (35.8)	12 (1.2)	965 (98.8)	<0.001[a]
65 – 74 years	425 (15.5)	13 (3.1)	412 (96.9)	
74 years or more	82 (3.0)	9 (11.0)	73 (89.0)	
Sex				
Female	1,441 (52.8)	17 (1.2)	1,424 (98.8)	0.319[b]
Male	1,291 (47.2)	21 (1.6)	1,270 (98.4)	
*Race/Skin color**				
White	1,369 (50.8)	18 (1.3)	1,351 (98.7)	
Brown	968 (35.9)	14 (1.5)	954 (98.5)	0.869[b]
Black	358 (13.3)	6 (1.7)	352 (98.3)	
*Education Level **				
Primary school or less	225 (8.2)	9 (4.0)	216 (96.0)	
Secondary school	684 (25.1)	7 (1.0)	677 (99.0)	0,002[b]
Superior Education	1,821 (66.7)	22 (1.2)	1,799 (98.8)	
Anthropometric variables				
*Body Mass Index**				
Eutrophy (18.5<BMI<25)	994 (36.4)	13 (1.3)	981 (98.7)	
Overweight (25≤BMI<30)	1,114 (40.8)	14 (1.3)	1,100 (98.7)	0.659[b]
Obesity (BMI≥30)	623 (22.8)	11 (1.8)	612 (98.2)	
Chronic diseases and conditions				
*Hypertension**				
Presence	1,114 (40.8)	21 (1.9)	1,093 (98.1)	0.068[b]
Absence	1,617 (59.2)	17 (1.1)	1,600 (98.9)	
*Diabetes**				
Presence	204 (7.5)	5 (2.5)	199 (97.5)	0.179[b]
Absence	2,527 (92.5)	33 (1.3)	2,494 (98.7)	
*Renal Disease**				
Presence	587 (21.5)	9 (1.5)	578 (98.5)	0,743[b]
Absence	2,142 (78.5)	29 (1.4)	2,113 (98.6)	

*Race/skin color has 37 missing data points; education and renal disease have 2 missing data points; body mass index and hypertension have 1 missing data point; renal disease has 3 missing data points.
[a]p-value calculated using Fisher's exact test
[b]p-value calculated using Pearson's chi-squared test

The prevalence of chondrocalcinosis among the entire population and its distribution according to the investigated covariates is presented in Table 1. Chondrocalcinosis was identified in 38 individuals (1.4%) (Table 1). Additionally, the prevalence of chondrocalcinosis was notably low in younger age groups, with only 0.4% of the cases in the age group of 38 to 44 years and 0.3% in the age group of 45 to 54 years (Table 1). In contrast, the prevalence increased with age,

with 1.2% in the 55 to 64 years age group and 3.1% in the 65 to 74 years age group (Table 1). The highest prevalence was observed in individuals older than 74 years, with 11.0% diagnosed with chondrocalcinosis (Table 1). It is noteworthy that the ELSA-Brasil MSK study includes a higher number of participants in the younger age groups.

When considering the entire population, chondrocalcinosis was found mostly in males (1.6%), black race/skin color (1.7%), people with primary school or less (4.0%), with obesity (1.8%), HTN (1.9%), diabetes (2.5%) and CKD (1.5%). However, only age and education level were statistically significant (Table 1). This data highlights a significant association between chondrocalcinosis and advanced age, indicating a marked increase in prevalence in older age groups. In accordance with literature, this finding suggests that age is a critical factor in the occurrence of chondrocalcinosis and emphasizes the need for targeted screening and management strategies in older populations.

Table 2 presents the results of the multivariate logistic regression analysis between the variables age and education level, with chondrocalcinosis as the outcome variable, which were previously statistically significant in the univariate analysis of the entire sample (N=2,732). The results showed that, across the entire sample, continuous age remained associated with chondrocalcinosis (OR=1.13; 95%CI=1.09-1.18; p<0.001), meaning that with each additional year of age, the individual's odds of having chondrocalcinosis increased by 13%.

As for the association between education level and chondrocalcinosis, it appears that age compensated for this relationship when considering all individuals. When education was analysed alongside age in the logistic regression, higher education and secondary education may have acted as protective factors (in terms of having or not having chondrocalcinosis) compared to lower education levels. However, these results were not statistically significant (Table 2). The results were borderline.

Table 2: Chondrocalcinosis as an outcome in a multivariate logistic regression analysis involving age and education level, among all the population - the Brazilian Longitudinal Study of Adult Health Musculoskeletal (ELSA-Brazil MSK), 2012-2014 (N=2,732).

Variable	Odds Ratio ajusted (CI)	p-value
Age	1.13 (1.09-1.18)	<0.001
Education Level		
Superior Education	Ref.	
Secondary school	0.95 (0.40-2.27)	0.916
Primary school or less	2.02 (0.90-4.53)	0.090

p-value calculated using Z-test

Table 3 presents a subanalysis considering the individuals aged 60 and over. The prevalence of chondrocalcinosis in this age group was 3.3%, with 31 individuals affected out of 945 (Table 3). The results highlight that chondrocalcinosis was notably more prevalent in individuals over 74 years of age, with a prevalence rate of 11.0%, compared to 2.1% in those aged 60-64 years and 1.7% in those aged 65-69 years. This age-related increase in prevalence was statistically significant (p<0.001).

In terms of sex, the prevalence of chondrocalcinosis was similar between males (3.5%) and females (3.1%), with no significant difference observed (p=0.686). Race/skin color also did not show a significant association with chondrocalcinosis prevalence (p=0.863). However, education level demonstrated a significant association with chondrocalcinosis. Participants with primary education or less had a higher prevalence of chondrocalcinosis (6.9%) compared to those with secondary (3.2%) or higher education (2.5%) (p=0.038).

Regarding anthropometric variables, no significant association of BMI categories with chondrocalcinosis prevalence was found (p=0.403), indicating that eutrophic, overweight, and obese individuals did not differ significantly in their chondrocalcinosis prevalence in our population. Similarly, the prevalence of chondrocalcinosis did not show a significant association with the presence of chronic diseases, including HTN (p=0.577), diabetes (p=0.782), or CKD

(p=0.445). These findings emphasize that age is the most significant factor influencing chondrocalcinosis prevalence in this cohort, followed by level of education.

Table 3: Distribution of chondrocalcinosis according to investigated covariates among participants aged 60+ years – the Brazilian Longitudinal Study of Adult Health Musculoskeletal (ELSA-Brazil MSK), 2012-2014 (N= 945).

VARIABLE	Participants 60+ years N=945 N(%)	CHONDROCALCINOSIS - PREVALENCE Yes N = 31 (3.3%) N(%)	No N = 914 (96.7%) N(%)	p-value
Sociodemographic variables				
Age Group				
60 - 64 years	438 (46.3)	9 (2.1)	429 (97.9)	
65 - 69 years	291 (30.8)	5 (1.7)	286 (98.3)	<0.001[a]
70 - 74 years	134 (14.2)	8 (6.0)	126 (94.0)	
>74 years	82 (8.7)	9 (11.0)	73 (89.0)	
Sex				
Female	491 (52.0)	15 (3.1)	476 (97.0)	0.686[a]
Male	454 (48.0)	16 (3.5)	438 (96.5)	
*Race/Skin color**				
White	545 (58.5)	17 (3.1)	528 (96.9)	
Brown	284 (30.5)	10 (3.5)	274 (96.5)	0.863[b]
Black	103 (11.0)	4 (3.9)	99 (96.1)	
*Education Level **				
Primary school or less	130 (13.8)	9 (6.9)	121 (93.1)	
Secondary school	216 (22.9)	7 (3.2)	209 (96.8)	0,038[a]
Superior Education	598 (63.3)	15 (2.5)	583 (97.5)	
Anthropometric variables				
Body Mass Index				
Eutrophy (18.5<BMI<25)	331 (35.0)	12 (3.6)	319 (96.4)	
Overweight (25≤BMI<30)	409 (43.3)	10 (2.4)	399 (97.6)	0.403[a]
Obesity (BMI≥30)	205 (21.7)	9 (4.4)	196 (95.6)	
Chronic diseases and conditions				
Hypertension				
Presence	533 (56.4)	19 (3.6)	514 (96.4)	0.577[a]
Absence	412 (43.6)	12 (2.9)	400 (97.1)	
Diabetes				
Presence	114 (12.1)	4 (3.5)	110 (96.5)	0.782[b]
Absence	831 (87.9)	27 (3.2)	804 (96.8)	
*Renal Disease **				
Presence	238 (25.2)	6 (2.5)	232 (97.5)	0.445[a]
Absence	706 (74.8)	25 (3.5)	681 (96.5)	

*Race/skin color has 13 missing data points; education and renal disease have 1 missing data point.
[a]p-value calculated using Pearson's chi-squared test
[b]p-value calculated using Fisher's exact test

Table 4 shows the results of the multivariate logistic regression analysis between the variables age and education level, with chondrocalcinosis as the outcome, limited to individuals aged 60 years or older (N=945). The results indicated that age remained associated (OR=1.15; 95%CI=1.07-1.23; p<0.001), meaning that with each additional year of age, the odds of having chondrocalcinosis increased by 15%.

As for the association between chondrocalcinosis and education level in individuals aged 60 years or older, there was a strong statistically significant association, independent of age, for those with lower education levels: primary education or less (OR=2.62; 95%CI=1.10-6.23; p=0.029). That means that individuals with primary education or less had 1.62 more chances of chondrocalcinosis compared to those with higher education levels. This suggests that a lower educational level is a risk factor for chondrocalcinosis in individuals aged 60 or older when compared to those with higher education. Secondary education did not show statistical significance (OR=1.56; 95%CI=0.62-3.93; p=0.346).

Table 4: Chondrocalcinosis as an outcome in a multivariate logistic regression analysis involving age and education level, among participants aged ≥60 years - the Brazilian Longitudinal Study of Adult Health Musculoskeletal (ELSA-Brazil MSK), 2012-2014 (N= 945).

Variable	**Odds Ratio ajusted (CI)**	**p-value**
Age ≥ 60 years	1.15 (1.07-1.23)	<0.001
Education Level		
Superior Education	Ref.	
Secondary school	1.56 (0.62-3.93)	0.346
Primary school or less	2.62 (1.10-6.23)	0.029

p-value calculated using Z-test

Studies have investigated chondrocalcinosis prevalence in clinical or hospitalized populations, such as those conducted in the United States [12] and in Spain [13], and have reported high prevalence rates, ranging from 9.6% to 10.4%. These studies described higher frequencies among institutionalized or hospital-based older populations. The elevated prevalence observed in these clinical settings is likely influenced by selection bias, since individuals seeking medical care tend to have poorer overall health status and a higher burden of comorbidities. In contrast, studies involving non-clinical populations, like the ELSA-Brasil MSK population, have reported much lower prevalence rates, ranging from 1.5% to 2.7% [15-17]. This trend is also supported by more recent population-based investigations, such as Wu et al. (2025) [18] which found lower rates in community-dwelling cohorts compared to hospital samples. These findings align closely with the prevalence identified in the present analysis, which underscores the variability in chondrocalcinosis rates depending on the population studied and the methodological differences across studies.

This analysis revealed a clear association between chondrocalcinosis and advanced age, with a significantly higher prevalence observed in older age groups, particularly among individuals aged 60 years and older. This finding is consistent with existing literature, which similarly identifies aging as a key factor influencing the prevalence of chondrocalcinosis [9, 12-17]. In contrast, we did not find a statistically significant association between chondrocalcinosis and sex, suggesting that the observed differences in prevalence between sexes might be due to random variation. Specifically, among participants aged over 60 years with chondrocalcinosis (N=31), the prevalence was slightly higher in men (3.5%) compared to women (3.1%). This small difference corroborates findings from Karimsadeh et al. (2017) [17] that described minimal sex differences in individuals aged over 50 years (men: 4.1%; women: 3.6%; p=0.77), reinforcing that sex may play a limited role once age is accounted. The results presented here contrast with the results of Zhang et al. (2006) [16], who reported a higher frequency of chondrocalcinosis in women compared to men in both the Beijing and Framingham cohorts.

Furthermore, the study revealed a significant association between lower education level and higher prevalence of chondrocalcinosis. This correlation was observed both in the univariate analysis across the entire population and in the multivariate analysis within the subpopulation aged 60 and over. However, although the association did not reach statistical significance in the multivariate analysis for the entire population, it was considered borderline and may have

occurred due to statistical power, given the small number of cases of chondrocalcinosis among individuals under 60 years old in the ELSA-Brasil population. This observation suggests that socioeconomic determinants, reflected here by educational level, may influence disease occurrence, an aspect seldom explored in prior epidemiologic studies. Future analyses including larger and longitudinal samples may help clarify these associations.

This finding provides a unique contribution to the literature, as it explores an aspect of chondrocalcinosis that has not been extensively addressed previously. The association highlights the potential influence of socioeconomic factors, expressed through educational level in this population, on the prevalence of chondrocalcinosis, suggesting that these factors may play a role in the distribution of this condition.

These analyses represent preliminary results from the ELSA-Brasil MSK study, derived from baseline data collected in 2012–2014. The recent advances in CPPD research, including the 2025 classification criteria and new prospective data, highlight the importance of future analysis under updated diagnostic and conceptual frameworks [19, 20]. Even as preliminary, these data provide the first evidence of knee chondrocalcinosis prevalence for community-dwelling adults in Latin America and establish a foundation for future longitudinal analyses, in line with recent advances in chondrocalcinosis research highlighted by Wu et al. (2025) [18]. Our results can also be compared with estimates obtained according to new diagnostic criteria in the future, contributing to the understanding of how different diagnostic criteria may impact on the prevalence of chondrocalcinosis in populations.

4. CONCLUSION

The prevalence pattern of chondrocalcinosis in this study, when compared to others, reinforces its association with aging and extends this finding to show an association with low education level in the group with 60 years or older, but not with other sociodemographic factors. This result is consistent with recent evidence indicating that advanced age remains the primary determinant of calcium pyrophosphate dihydrate deposition, while socioeconomic conditions may modulate disease expression in older adults [14, 16, 22]. Results point to the most vulnerable groups for the disease and support the need to develop health service strategies to promote health for the older people. The study suggests further investigations on the topic, particularly in Brazil. Importantly, these results should be interpreted as preliminary findings from the ELSA-Brasil MSK baseline (2012–2014), providing the first estimate of knee chondrocalcinosis in Latin America for community-dwelling individuals. Future longitudinal analyses within the ELSA-Brasil MSK cohort, in line with the methodological updates proposed by Wu & Boer et al. (2025) regarding classification of chondrocalcinosis severity and the EULAR 2023 CPPD classification, distinguishing phenotypes based on clinical presentation, imaging findings, and crystal identification, will enable deeper investigation of disease progression, severity and social exposures in this population [18, 20]. These findings highlight the importance of continued epidemiological surveillance and the inclusion of musculoskeletal health indicators in public health for aging populations.

5. ACKNOWLEDGMENT

The authors would like to thank the staff and participants of the ELSA-Brasil Project, the Universidade Federal de Minas Gerais, and the Hospital das Clínicas da UFMG/Ebserh.

ELSA-Brasil is funded by the Ministry of Health, Ministry of Science, Technology and Innovation and the Federal Government (FINEP and CNPq-BR). ELSA-Brasil MSK is funded by FAPEMIG (APQ-00549-22) and CNPq (404728/2021-9).

6. BIBLIOGRAPHIC REFERENCES

1. Leal Cortez AC, Silva CRL, Silva RCL, Dantas EHM. Aspectos gerais sobre a transição demográfica e epidemiológica da população brasileira. Enferm Bras. 2019 out;18(5):700-9. doi: 10.33233/eb.v18i5.2785
2. Lima-Costa MF. Envelhecimento e saúde coletiva: Estudo longitudinal da saúde dos idosos brasileiros (ELSI-Brasil). Rev Saude Publica. 2018 set;52(2):1-3. doi: 10.11606/s1518-8787.201805200supl2ap
3. Instituto Brasileiro de Geografia e Estatística (IBGE). Síntese de indicadores sociais: uma análise das condições de vida da população brasileira: 2020. Rio de Janeiro (RJ): IBGE; 2020 [cited 2024 Jun 03]. Available from: https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=2101760.
4. Instituto Brasileiro de Geografia e Estatística (IBGE). Pesquisa Nacional de Saúde - Ciclos de vida: 2019. Rio de Janeiro (RJ): IBGE; 2019. Available from: https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=2101846.
5. McCarty DJ. Arthritis associated with crystals containing calcium. Med Clin North Am. 1986 Mar;70(2):437-54. doi: 10.1016/S0025-7125(16)30962-2
6. Zitnan D, Sitaj S. Chondrocalcinosis articularis Section L Clinical and radiological study. Ann Rheum Dis. 1963 May;22(3):142-52. doi:10.1136/ard.22.3.142
7. Rosenthal AK, Ryan LM. Calcium pyrophosphate crystal deposition disease. N Engl J Med. 2016 Jun;374(26):2575-84. doi: 10.1056/NEJMra1511117
8. Abhishek A, Dohertyet M. Update on calcium pyrophosphate deposition. Clin Exp Rheumatol. 2016 Jul-Aug;34(4 Suppl 98):32-8.
9. Cho NH, Song Y, Lee S, Sung YK, Jun JB. Incidence of knee chondrocalcinosis and its risk factors in a community-based cohort. Int J Rheum Dis. 2018 Jul;21(7):1391-7. doi: 10.1111/1756-185X.13317
10. Pascart T, Latourte A, Tedeschi SK, Dalbeth N, Neogi T, Adinolfi A, et al. Features associated with different inflammatory phenotypes of calcium pyrophosphate deposition (CPPD) disease: study using data from the international ACR/EULAR CPPD classification criteria cohort. A&R (ACR). 2024;76(12):1780-8. doi: 10.1002/art.42962
11. Telles RW, Lage RC, Pinheiro GRC. Artrites por deposição de cristais. In: Sampaio-Barros PD, Samara AM, Leme LEG, et al, editors. Reumatologia: Princípios e prática. 5. ed. São Paulo (SP): Editora Atheneu; 2018. p. 54-66.
12. Ellman MH, Brown NL, Levin B. Prevalence of knee chondrocalcinosis in hospital and clinic patients aged 50 or older. J Am Geriatr Soc. 1981 Apr;29(4):189-92. doi: 10.1111/j.1532-5415.1981.tb01764.x
13. Sanmartí R, Pafiella D, Brancos MA, Canela J, Collado A, Brugues J. Prevalence of articular chondrocalcinosis in elderly subjects in a rural area of Catalonia. Ann Rheum Dis. 1993 Jun;52(6):418-22. doi: 10.1136/ard.52.6.418
14. Ramonda R, Musacchio E, Perissinotto E, Sartori L, Punzi L, Corti MC, et al. Prevalence of chondrocalcinosis in Italian subjects from northeastern Italy. The Pro.V.A. (PROgetto Veneto Anziani) study. Clin Exp Rheumatol. 2009 Nov-Dec;27(6):981-4.
15. Hameed M, Turkiewicz A, Englund M, Jacobsson L, Kapetanovic MC. Prevalence and incidence of non-gout crystal arthropathy in southern Sweden. Arthritis Res Ther. 2019 Dec;21(1):291. doi: 10.1186/s13075-019-2077-6
16. Zhang Y, Terkeltaub R, Nevitt M, Xu L, Neogi T, Aliabadi P, Niu J, Felson DT, et al. Lower prevalence of chondrocalcinosis in Chinese subjects in Beijing than in white subjects in the United States: the Beijing Osteoarthritis Study. Arthritis Rheum. 2006 Nov;54(11):3508-12. doi: 10.1002/art.22189
17. Karimzadeh H, Sirous M, Sadati SN, Bashshash M, Mottaghi P, Ommani B, et al. Prevalence of chondrocalcinosis in patients above 50 years and the relationship with osteoarthritis. Adv Biomed Res. 2017 Jul;6:98. doi: 10.4103/2277-9175.211835
18. Wu Y, Liew JW, Boer JD, Westerland M, LaValley M, Voortman T, Bierma-Zeinstra S, et al. Chondrocalcinosis and incident knee osteoarthritis: findings from 2 large prospective cohorts with 20 years of follow-up. Ann Rheum Dis. 2025 Oct;84(10):1743-51. doi: 10.1016/j.ard.2025.07.009
19. Sirotti S, Jauffret C, Adinolfi A, Cipolletta E, Cirillo D, Ingrao L, et al. Pseudogout, chondrocalcinosis, CPPD et al: crystal clear… or clear as mud? The time has come to reconsider the nomenclature of calcium pyrophosphate deposition. Ann Rheum Dis. 2025 Aug;84(8):1287-92. doi: 10.1016/j.ard.2025.04.004
20. Abhishek A, Tedeschi SK, Pascart T, Latourte A, Dalbeth N, Neogi T, et al. The 2023 ACR/EULAR classification criteria for calcium pyrophosphate deposition disease. Arthritis Rheumatol Hoboken NJ. 2023;75:1703-13. doi: 10.1002/art.42619

21. Schmidt MI, Duncan BB, Mill JG, Lotufo PA, Chor D, Barreto SM, et al. Cohort profile: Longitudinal study of adult health (ELSA-Brasil). Int J Epidemiol. 2015 Feb;44(1):68-75. doi: 10.1093/ije/dyu027
22. Telles RW, Machado LAC, Costa-Silva L, Barreto SM. Cohort profile update: The brazilian longitudinal study of adult health musculoskeletal (ELSA-Brasil MSK) cohort. Int J Epidemiol. 2022 Dec;51(6):e391-e400. doi: 10.1093/ije/dyac084