


ORIGINAL ARTICLE

# The Portuguese Albuminuria Study: national insights into prevalence and risk factors

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## ABSTRACT

**Background.** Chronic kidney disease (CKD) is a global health concern associated with increased cardiovascular risks. In Portugal, the high burden of CKD highlights the urgent need for early detection strategies. The primary aim of this study was to assess the presence of albuminuria in the Portuguese general population while raising awareness of CKD.

**Methods.** An epidemiological, cross-sectional study screened 601 individuals for albuminuria using urine test strips, employing a door-to-door approach across the five regions of mainland Portugal (screening study), with 592 valid results included in the final analysis. In parallel, an awareness campaign distributed 17 000 urine test strips, with 704 participants submitting their results through an online platform (awareness study).

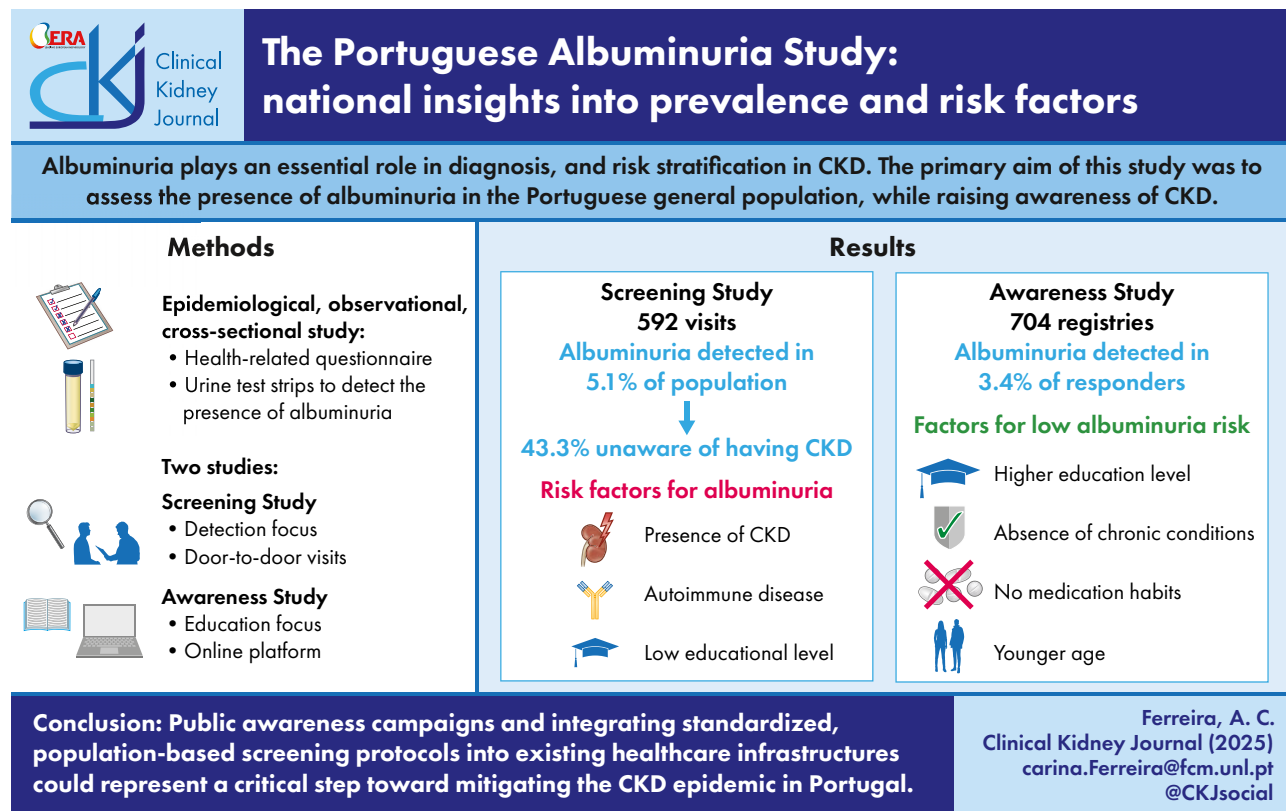
**Results.** The screening occurred in a healthy population, with >70% (screening study) and >87% (awareness study) of the individuals reporting no known personal health history. The presence of albuminuria was detected in 5.1% of the screening study population and 3.4% of the awareness study participants. In both studies, significant associations were found between albuminuria and risk factors, such as age, education level, CKD and non-steroidal anti-inflammatory drug use. Regional disparities were also observed. In the screening study, multivariate analysis identified education level ( $P = .011$ ), CKD ( $P < .0001$ ) and autoimmune diseases ( $P = .009$ ) as independent predictors of albuminuria.

**Conclusions.** These findings highlight albuminuria as a critical early marker for CKD and cardiovascular risks. The results support the need for targeted screening and public health initiatives, particularly in high-risk and younger populations.

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## GRAPHICAL ABSTRACT



**Keywords:** albuminuria, chronic kidney disease, screening

## KEY LEARNING POINTS

## What was known:

- Chronic kidney disease (CKD) is a global health problem, affecting 1 in 10 adults. Early detection is key to prevent CKD progression and related cardiovascular events.
- In Portugal, albuminuria screening is recommended for high-risk populations, such as individuals with hypertension and diabetes, potentially leaving undiagnosed cases in the general population.
- No prior national study has evaluated albuminuria prevalence and incidence in the Portuguese general population.

## This study adds:

- This was the first national study aiming to estimate the prevalence of albuminuria in the Portuguese general population, highlighting that 5% of individuals may have early kidney disease, including younger, lower-risk populations.
- The study identifies regional disparities in albuminuria prevalence, with the North most affected, supporting the need for regional tailored public health interventions.
- The awareness campaign performed in this study demonstrates the feasibility of combining public engagement with health data collection, offering a model for increasing CKD awareness and identifying undiagnosed cases.

## Potential impact:

- The findings reinforce albuminuria as a key marker of CKD and support the integration of routine screening, especially for high-risk individuals in primary care.
- The study provides robust national data to support national policies promoting early CKD detection and prevention.



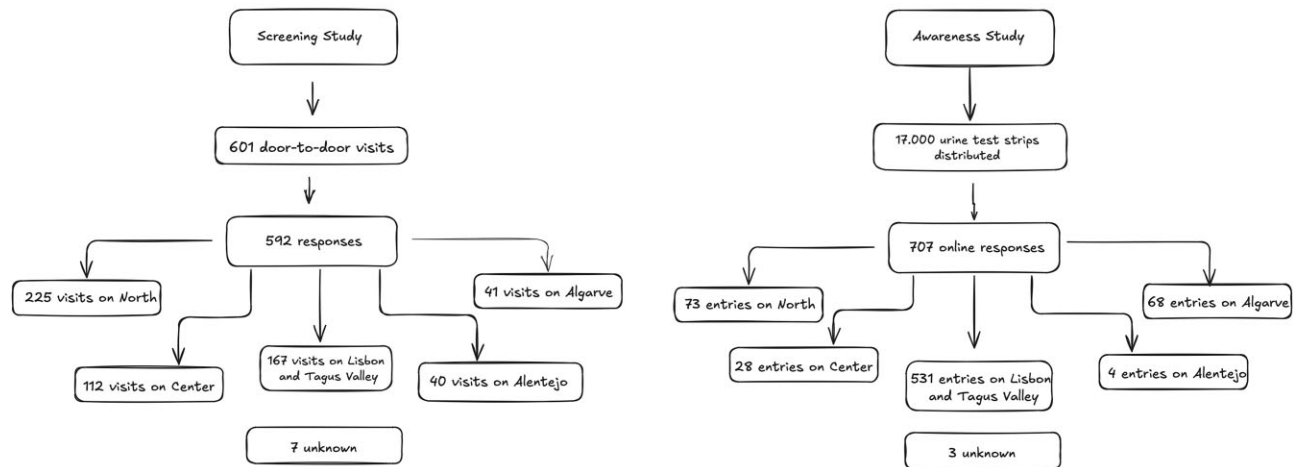


Figure 1: Flow chart of (a) the screening study and (b) the awareness study.

Table 1: Distribution by region, stratified by sex and age group in the screening study.

Age group (years)	Sex	Portugal mainland				
		North	Centre	LTV	Alentejo	Algarve
<40	Female	42	17	31	7	16
	Male	31	19	28	7	8
40–65	Female	51	23	32	7	4
	Male	36	21	30	7	5
>65	Female	32	16	25	6	4
	Male	33	16	20	6	4

LTV: Lisbon and Tagus Valley.

Missing values for Portugal regions,  $n = 7$ .

More than 70% of participants [ $n = 416$  (70.3%)] reported no known personal medical history, although autoimmune diseases [ $n = 78$  (13.2%)] and diabetes [ $n = 43$  (7.2%)] were the most frequently reported conditions among those who did. Regarding medication use, 13.2% reported taking non-steroidal anti-inflammatory drugs [NSAIDs;  $n = 78$  (13.2%)], while 6% were on sodium–glucose co-transporter 2 (SGLT2) inhibitors [ $n = 38$  (6.4%)].

Albuminuria was detected in 30 individuals, yielding a prevalence of 5.1%. Among these, >40% [ $n = 13$  (43.3%)] were unaware of having CKD. The highest regional prevalence was observed in the North (Table 3), and among individuals without a prior CKD diagnosis, albuminuria was more frequently observed in the Algarve and Centre regions (Table 4).

Univariate analysis (Table 5) revealed statistically significant associations between albuminuria and age group ( $P < .001$ ), education level ( $P < .001$ ), presence of CKD ( $P < .001$ ), autoimmune diseases ( $P < .001$ ), chronic infections ( $P < .001$ ) and use of NSAIDs ( $P < .001$ ). Absence of chronic conditions or no medications were both associated with a lower likelihood of albuminuria.

In multivariate logistic regression analysis, education level ( $P = .011$ ), CKD ( $P < .0001$ ) and autoimmune diseases ( $P = .009$ ) remained independently associated with the presence of albuminuria.

## Awareness study

The flow chart of the awareness study is presented in Fig. 1b.

A total of 17 000 urine test strips were distributed, resulting in 704 individuals registering their responses through the online platform. The population was predominantly younger, with 54.9% <40 years of age. The median age was 36 years (IQR 26–55). Women represented 56.7% of the participants and 42.1% had a bachelor's degree or higher. The median weight was 72 kg (IQR 64–80), the median systolic BP was 120 mmHg (IQR 120–130) and the median diastolic BP was 80 mmHg (IQR 70–85). Table 2 presents the sociodemographic and clinical characteristics of the population.

Participants reported a low prevalence of chronic conditions. More than 87% indicated no personal history of illness, with diabetes (3.4%) and autoimmune diseases (2.1%) being the most reported. Regarding medication use, 5% were on NSAIDs and 2.1% reported taking SGLT2 inhibitors.

Albuminuria was detected in 24 individuals, corresponding to a prevalence of 3.4%. Regional prevalence was highest in the North and in the Lisbon and Tagus Valley region. Among individuals unaware of having CKD, cases were primarily observed in Lisbon and Tagus Valley region (Tables 3 and 4).

Univariate analysis revealed significant associations between albuminuria and age group ( $P = .015$ ) and education level ( $P < .001$ ). Health-related factors associated with albuminuria included known CKD ( $P < .001$ ), diabetes ( $P = .04$ ) and cerebrovascular disease ( $P = .01$ ). In addition, the use of certain medications, such as angiotensin receptor blockers ( $P = .01$ ), SGLT2 inhibitors ( $P = .012$ ) and NSAIDs ( $P = .005$ ), showed statistically significant associations.

## DISCUSSION

This study represents the first national effort in Portugal to raise awareness of CKD and provide data-driven insights to support evidence-based public health policies.

Based on our findings, ≈5% of individuals in Portugal may have kidney disease, aligning with global CKD prevalence estimates [10]. The detection of albuminuria among individuals with no prior CKD diagnosis is particularly concerning, given that one-third of these individuals were <40 years of age. Younger individuals are frequently considered at low risk for

Table 2: Sociodemographic and clinical characteristics of the population in the screening study.

Variable	Category	Screening study, n (%)	Awareness study, n (%)
Age group (years)	<40	210 (35.5)	388 (54.9)
	40–65	218 (36.8)	207 (29.3)
	>65	164 (27.7)	112 (15.8)
Sex	Female	318 (53.7)	401 (56.7)
	Male	274 (46.3)	304 (43.3)
Education (Screening: missing values, n = 3)	Basic education	209 (35.3)	125 (17.5)
	Secondary education	206 (34.8)	268 (37.9)
	≥Bachelor's degree	174 (29.4)	298 (42.1)
Kidney disease	No	563 (95.1)	699 (98.9)
	Yes	29 (4.9)	8 (1.1)
Diabetes	No	549 (92.8)	683 (96.6)
	Yes	43 (7.2)	24 (3.4)
Dyslipidaemia	No	571 (96.5)	603 (99.4)
	Yes	21 (3.5)	4 (0.6)
Stroke	No	583 (98.5)	693 (98.0)
	Yes	9 (1.5)	14 (2.0)
Myocardial ischaemic disease	No	586 (99.0)	704 (99.6)
	Yes	6 (1.0)	3 (0.4)
Congestive cardiac disease	No	575 (97.1)	699 (98.9)
	Yes	17 (2.9)	8 (1.1)
Arterial disease	No	566 (95.6)	706 (99.9)
	Yes	26 (4.4)	1 (0.1)
Autoimmune disease	No	514 (86.8)	692 (97.9)
	Yes	78 (13.2)	15 (2.1)
Infections	No	586 (99.0)	703 (99.4)
	Yes	6 (1.0)	4 (0.6)
No disease	No	176 (29.7)	89 (12.6)
	Yes	416 (70.3)	618 (87.4)
Albuminuria	<0.08	341 (57.6)	457 (64.6)
	0.08	221 (37.3)	226 (32)
	0.12	30 (5.1)	24 (3.4)
Angiotensin-converting enzyme inhibitor	No	568 (96.0)	700 (99.0)
	Yes	24 (4.0)	7 (1.0)
Angiotensin receptor blocker	No	573 (96.8)	702 (99.3)
	Yes	19 (3.2)	5 (0.7)
SGLT2 inhibitor	No	554 (93.6)	692 (97.9)
	Yes	38 (6.4)	15 (2.1)
Calcium channel blocker	No	573 (96.8)	696 (98.4)
	Yes	19 (3.2)	11 (1.6)
NSAID	No	514 (86.8)	672 (95)
	Yes	78 (13.2)	35 (5)
No medication	No	131 (22.1)	64 (9.1)
	Yes	461 (77.9)	643 (90.6)

Table 3: Prevalence of albuminuria, stratified by region.

Region	Screening study prevalence, % (95% CI)	Awareness study prevalence, % (95% CI)
North	9.33 (5.87–13.91)	5.48 (1.51–13.44)
Centre	4.46 (1.48–10.20)	0
Lisbon and Tagus Valley	1.20 (0.15–4.39)	3.77 (2.32–5.76)
Alentejo	0	0
Algarve	4.88 (0.60–16.53)	0

Table 4: Prevalence of albuminuria in persons without known kidney disease, stratified by region.

Region	Screening study prevalence, % (95% CI)	Awareness study prevalence, % (95% CI)
North	2.90 (1.07–6.20)	0
Centre	3.85 (1.06–9.56)	0
Lisbon and Tagus Valley	0.63 (0.02–3.45)	3.42 (2.04–5.34)
Alentejo	0	0
Algarve	4.88 (0.66–16.53)	0

CKD and therefore are less likely to be screened, leading to missed opportunities for early intervention. Without timely diagnosis, early-stage kidney damage may progress to advanced CKD, ultimately resulting in dialysis or kidney transplantation and contributing to the growing economic burden of CKD man-

agement. These findings underscore the importance of targeting younger populations through CKD awareness campaigns and screening initiatives.

Table 5: Bivariate analysis of independent variables versus the presence of albuminuria in the screening study.

Variable	Category	Albuminuria		P-value
		No, n (%)	Yes, n (%)	
Age group (years)	<40	207 (36.8)	3 (10)	<.001
	40–65	212 (37.7)	6 (20)	
	>65	143 (25.4)	21 (70)	
Education	Basic	201 (35.8)	5 (16.7)	<.001
	Secondary	173 (30.8)	1 (3.3)	
	≥Bachelor's degree	2 (0.4)	1 (3.3)	
CKD	No	550 (97.9)	13 (43.3)	<.001
	Yes	12 (2.1)	17 (56.7)	
Autoimmune disease	No	499 (88.8)	15 (50)	<.001
	Yes	63 (11.2)	15 (50)	
Infection	No	559 (99.5)	27 (90)	<.001
	Yes	3 (0.5)	3 (10)	
NSAIDs	No	498 (88.6)	16 (53.3)	<.001
	Yes	64 (11.4)	14 (46.7)	
Disease	Without	413 (73.5)	3 (10)	<.001
	With	149 (26.5)	27 (90)	
Medication	Without	446 (79.4)	15 (50)	.001
	With	116 (20.6)	15 (50)	
Portugal regions	North	204 (36.3)	21 (70)	<.001
	Centre	107 (19)	5 (16.7)	
	Lisbon and Tagus Valley	165 (29.4)	2 (6.7)	
	Alentejo	40 (7.1)	0 (0)	
	Algarve	39 (6.9)	2 (6.7)	

In the awareness study, the prevalence of albuminuria was estimated at 3.4%. Although the response rate was 4.1%, slightly below the expected 5%, this component was primarily designed as an awareness-raising initiative rather than a diagnostic tool. Notably, our open, community-based approach contrasts with the structured methodology used in the Dutch THOMAS study [11], which achieved a participation rate of 44.3–59.4%, depending on the screening method used. While the THOMAS study demonstrated the feasibility of organized, mail-based screening, our findings highlight that decentralized, opportunistic distribution can still yield valuable epidemiological insights, especially when awareness is the primary goal.

It is important to recognize that large-scale screening efforts may increase the risk of false positives. This highlights the need for more sensitive and specific screening tools to ensure diagnostic accuracy and minimize the impact of false positive results, thereby optimizing healthcare resource allocation.

The use of a 0.12 g/l threshold for albuminuria based on urine test strip specifications offered a practical and standardized approach for large-scale screening. While this threshold may differ from clinical guidelines, it proved feasible for identifying potential cases in the population. Future research should compare these findings with laboratory-based analyses to validate their diagnostic accuracy and alignment with clinical thresholds.

The associations observed between albuminuria and established risk factors were consistent with the existing literature, reinforcing the need to prioritize high-risk groups for early and targeted screening. Importantly, lower education level was consistently associated with albuminuria across both studies and may serve as a surrogate marker for broader social and behavioural determinants of health, including sedentary lifestyle patterns, suboptimal dietary habits and reduced access to health-promoting resources.

Regional variation was also evident. Albuminuria prevalence was highest in the North. In those with unknown CKD, albuminuria was highest in the Algarve and Centre regions (screening study), and in Lisbon and Tagus Valley region (awareness study). These differences may reflect regional disparities in health-related behaviours, such as dietary patterns, or health practices. Differences in health access may justify the regional differences between known and unknown CKD. Addressing these differences could involve geographically tailored public health initiatives to mitigate risk and improve early detection.

This study had several limitations. First, the use of urine test strips, while suitable for large-scale screening, introduces inaccuracies and limitations in diagnostic precision due to their undefined sensitivity and specificity. This may have resulted in an overestimation of albuminuria prevalence. Further research is needed to validate these tools against laboratory-based diagnostics. Second, the door-to-door recruitment strategy may have introduced selection bias, excluding individuals who were not at home during data collection, potentially skewing the sample towards specific demographics. Likewise, the awareness study relied on convenience sampling, potentially overrepresenting individuals with pre-existing kidney health concerns. Lastly, the response rate in the awareness study was relatively low, with only 704 participants registering results out of the 17 000 test strips distributed. This limits the generalizability of our findings and underscores the need for improved community engagement strategies in future awareness efforts.

## CONCLUSIONS

This study highlights the importance of continued monitoring and targeted screening efforts, especially among high-risk populations, while also extending attention to individuals not traditionally considered at risk, as many remain undiagnosed with

conditions such as diabetes or hypertension, and because CKD may also occur beyond these comorbidities. The findings emphasize that investments in CKD awareness and preventive public health strategies hold significant potential to mitigate the burden of CKD in Portugal.

The implementation of routine albuminuria screening in primary care settings for high-risk individuals appears essential. This approach enables earlier detection and timely intervention, with the potential to slow CKD progression and reduce associated cardiovascular complications, ultimately improving patient outcomes. Public awareness campaigns and integrating standardized, population-based screening protocols into existing healthcare infrastructures could represent a critical step toward mitigating the CKD epidemic in Portugal.

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## AUTHORS' CONTRIBUTIONS

A.C.F. and A.F. drafted the article. A.C.F., A.F. and E.A. were responsible for the concept and design of the study, analysed the data, revised the article, approved the final version and agree with all aspects of the work.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available upon reasonable request to the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest. The results presented in this article have not been published previously in whole or part, except in abstract form. A.C.F. is an associate editor of CKJ.

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