# First Population-Based Screening of Abdominal Aortic Aneurysm in Portugal

*Ricardo Castro-Ferreira,[1,2] Rosa Barreira,[3] Pedro Mendes,[3] Pedro Couto,[3] Fabiana Peixoto,[3] Margarida Aguiar,[3] Marina Neto,[1,2] Dalila Rolim,[2] José Pinto,[1,2] Alberto Freitas,[3] Paulo Gonçalves Dias,[2] Armando Mansilha,[1,2] José Fernando Teixeira,[2] Sérgio Moreira Sampaio,[2,4] and Adelino Leite-Moreira,[1] Porto, Portugal*

**Background:** The incidence of abdominal aortic aneurysm (AAA) repairs in Portugal is one of the lowest mentioned in the literature. This phenomenon can be justified either by a low prevalence of the disease or by its low detection rate. To date, the prevalence of the pathology is unknown. The objective of the study was to estimate the prevalence of AAA and its associated risk factors, in men aged ≥65 years and to evaluate the population's disease awareness.

**Methods:** All males aged ≥65 years registered in a Portuguese primary health care unit were invited to participate. The abdominal aorta was measured by ultrasound (inner to inner method). Concomitant risk factors and patient's AAA awareness were also assessed. An aortic diameter >30 mm was considered aneurysmatic.

**Results:** Nine hundred thirty-three patients were invited for the screening. Of these, 715 participated in the study (participation rate of 76.6%). The AAA prevalence in this sample was 2.1%. Eighty-five percent of the evaluated patients had never heard of the disease before. The mean age of the assessed population was 72.3 years; Multiple logistic regression analysis showed a positive association between AAA and history of smoking (odds ratio [OR] 8.8, $P = 0.037$) and history of dyslipidemia (OR 9.6, $P = 0.035$). A negative association was found between diabetes and AAA (OR 0.33, $P = 0.045$).

**Conclusions:** The found prevalence shows that a significant number of potentially fatal AAAs remains to be diagnosed in Portugal. These results highlight the need for an effective program of AAA detection in Portugal. The lack of awareness in the Portuguese population for this pathology should also prompt reflexion.

## INTRODUCTION

It is widely recognized that abdominal aortic aneurysm (AAA) is a progressive disease that frequently remains asymptomatic until rupture.[1–4] Therefore, the question about the potential applicability of a screening program in terms of detection, managing, and repair of AAA before rupture has long been raised. In fact, several studies have shown benefits

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*[1]Departamento de Cirurgia e Fisiologia, Unidade de Investigação Cardiovascular, Faculdade de Medicina da Universidade do Porto, Porto, Portugal.*

*[2]Serviço de Angiologia e Cirurgia Vascular, Centro Hospitalar São João, Porto, Portugal.*

*[3]Unidade de Saúde Familiar de Valongo, ACES Maia-Valongo, Porto, Portugal.*

*[4]Centro de Investigação e Tecnologia de Informação em Sistemas de Saúde (CINTESIS) e Departamento de Ciências da Informação e da Decisão em Saúde, Faculdade de Medicina, Universidade do Porto, Porto, Portugal.*

*Correspondence to: Ricardo Castro-Ferreira, MD, Departamento de Cirurgia e Fisiologia, Faculdade de Medicina da Universidade do Porto, Alameda Prof. Hernâni Monteiro, 4200—319 Porto, Portugal; E-mail: cferreira.ricardo@gmail.com*

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of population screening for AAA,[5,6] by a significant reduction in specific and all-cause mortality and cost-effectiveness of the screening.[6] Notably, it is already recommended in men aged over 65 years by the leading international vascular surgery societies—European Society for Vascular Surgery (level 1 recommendation)[7]—and Society for Vascular Surgery (SVS) (level 1 recommendation).[8,9] According to this, in countries such as Sweden, United Kingdom (UK), and United States of America (USA), population-based screening programs have been implemented and linked to valuable effects in AAA management.[10–12]

Its numbers are steadily decreasing, with a described prevalence in the Swedish screening between 2.2 and 1.7% in males aged ≥65 years,[13,14] three times lower than that in the 80s and 90s.[15] This epidemiological shift, despite not yet completely understood, has been widely attributed to lower smoking and greater overall control of cardiovascular risk factors.[15] There is a lack of information regarding the numbers of AAA in Portugal, but the same modification might be occurring as the smoking prevalence has decreased significantly in the past 10 years.[16] The indications for treatment of AAA are currently well defined with the 2018 SVS guidelines recommending elective repair if diameter reaches 5.5 cm in males and 5.0 cm in females.[9] As for monitoring smaller AAA, there is consensus that the rescreening interval is inversely related to the aneurysm diameter, but optimal rescreening intervals remain to be established.[7] The current SVS guidelines endorse ultrasound scan every 3 years if between 3.0 and 3.9 cm, every year if 4.0 to 4.9 cm, and every 6 months if between 5.0 and 5.4 cm.[9]

Being the guidelines for AAA correction similar and well documented,[9] it could be assumed that there would be a similarity between the number of elective AAA repairs in western countries. In fact, extrapolating the available information regarding the total number of AAA surgeries in several countries can lead to that assumption—the yearly incidence of elective repairs per 100,000 habitants was 9.5 in Sweden,[17] 9.1 in Denmark,[17] and 13.3 in the USA.[18] These data are in stark contrast to those available from the Portuguese administrative database of health care, a mandatory registry for hospital reimbursement. After assessing that registry, it was possible to estimate that the yearly incidence of elective AAA repairs in Portugal was, in 2010, 2.7 per 100,000 inhabitants.[19] In that way, Portugal is treating three to four times fewer AAA than other western countries. This discrepancy is not observed in ruptured AAA, where there were 1.5 per 100,000 hospital admissions in Portugal in 2015, a number fairly comparable to the 1.7 described in the USA[18] and Finland.[20] Furthermore, after consulting the available information from the National Statistics Institute, the Portuguese mortality due to ruptured AAA remained stable from 2000 to 2015—2.89 per 100,000 inhabitants aged ≥50 years per year (unpublished data)—in stark contrast to that described in Sweden, where a 45% decrease was described in the same period.[21] The reasons for this disparity can be related to different prevalence or due to a severe diagnostic deficit of the disease in Portugal. To date, there is no information regarding the AAA prevalence in Portugal. There is also no available information concerning the population willingness to participate in AAA screening and the feasibility of such program.

The present study aims to fill the lack of information regarding AAA prevalence in Portugal and, by doing so, to clarify the reasons behind apparent insufficient treatment of this disease to Portuguese.

## METHODS

In January 2016, a list of all patients registered in a suburban primary health care facility was obtained electronically. All the inhabitants in that geographical area are registered in the database. The target population were males aged ≥65 years. Exclusion criteria were any form of incapacity to autonomous consent and a high degree of dependency, which led to inability to move to the health unit. Patients were invited to participate in the screening by both phone and formal written letter. After signing a written informed consent, an interview was conducted by the general practitioner, and the infrarenal abdominal aorta was measured by ultrasound by an ultrasound proficient vascular surgeon. In the interview, concomitant risk factors were assessed and crosschecked with the electronic information on the subject: family history of AAA, history of smoking (current or past smoker), hypertension, diabetes, dyslipidemia, and cardiovascular disease (coronary artery disease, cerebrovascular disease, and peripheral artery disease); the patient's awareness regarding AAA was also evaluated by questioning if the disease was known to them. The age and risk factors of the patients that fulfilled criteria for inclusion in the screening but did not participate were evaluated electronically and compared with the assessed population. The screening took place in the primary health care facilities. A NextGen LOGIQ e Ultrasound (GE

healthcare) with an abdominal transducer (2–5 MHz) was used in the examination. The inner to inner method of measurement was used. An aortic diameter >30 mm was considered aneurysmatic. Patients with aortic diameters >45 mm were referred to the vascular surgery department, and patients with aortic diameters between 3.0 and 4.5 cm had an annual ultrasound recommended. Every general practitioner responsible for the newly diagnosed patients with AAA was instructed to prescribe abdominal ultrasound evaluation to all first-degree relatives. The protocol was approved by the local ethics committee.

Statistical analysis was conducted with SPSS software (SPSS 22.0 for *Windows* Inc, Chicago, Illinois, USA). A *P* value below 0.05 was considered significant.

## RESULTS

From a total of 15,320 patients registered in the primary health care facility, a population of 933 fulfilled the criteria and was invited to participate in the screening. Of these, 715 partaken in the study (participation rate of 76.6%). The mean age of the assessed subjects was 72.3 years (95% CI 70.1 to 74.5). The mean aortic diameter was 19.17 mm (±28). The AAA prevalence in this population was 2.1% (95% CI 1.2% to 3.4%), with a total of 15 newly diagnosed AAA. Five patients had an aortic diameter requiring referral to the vascular department (>4.5 cm), two of them with indication for surgical repair (>5.5 cm). The later were successfully treated by EVAR. Eighty-five percent of the evaluated patients had never heard of the disease before. In all AAA-affected subjects, no family history of AAA was known by the individual. Sixty percent had smoking history (10% current smokers), 73% had hypertension, 58% had dyslipidemia, 33% were diabetic, and 21% had established cardiovascular disease (Table I). The main reasons for nonassessment in eligible subjects ($n = 218$) were failure to contact—due to wrong address or phone number ($n = 125$, 57%), impossibility to attend the available assessment dates ($n = 52$, 24%), failure to attend the scheduled appointment ($n = 29$, 13%), and refusal to participate ($n = 12$, 6%). By consulting the available electronic records, it was possible to conclude that the age and risk factors in the nonassessed population was similar to the evaluated citizens (Table I). None of the nonevaluated had any description of AAA in previous records. Multiple logistic regression analysis showed a positive association between AAA and history of smoking (odds ratio [OR] 8.8, $P = 0.037$) and history of dyslipidemia (OR 9.6, $P = 0.035$). A negative association was found between diabetes and AAA (OR 0.3, $P = 0.045$) (Table II).

## DISCUSSION

''This study described 2.1% prevalence of AAA, while outlining that the great majority of the Portuguese population is unaware of the pathology.'' The disease is particularly easy to diagnose by ultrasound and fulfills every major criteria for population screening recommended by the World Health Organization.[22] Several meta-analysis,[6,23] including a Cochrane review,[4] achieved fairly similar conclusions regarding the benefits of screening in the AAA-related mortality in men. In this work, we demonstrate that AAA screening seems feasible and would potentially have a high compliance rate in the Portuguese population. In fact, the 76.6% participation rate in our population is comparable to that observed in the UK (77%),[24] Sweden (83.7%),[12] and significantly higher than that described in the USA.[10] This high compliance may be related to the fact that the screening took place at the patient's primary care unit. To achieve this, a close collaboration between the primary health care unit and the vascular department was of utmost importance and should constitute the fundamental base of any future systematic screening.

In this study, a suburban population was assessed, with possible differences in lifestyle and risk factors in relation to rural residents. In that regard, a comparison between our group and the available information for the same risk factors in the national population (same gender and age group) was conducted. Interestingly, no significant variances were found in the prevalence of diabetes,[25] hypertension,[26] dyslipidemia,[27] and smoking history[16] (Table I). Regarding smoking, the results are in particular agreement with the data available for tobacco consumption in the Portuguese population, with 7% of the population aged 65–74 years being current smokers and 59.6% of men admitted to being smokers or exsmokers.[16] One can therefore hypothesize that the prevalence of AAA found in this study might be a good indicator for the nation-wide numbers.

This work described a prevalence of 2.1% in the evaluated population, a percentage fairly similar to the 2.2% observed in the Swedish screening[13] and fairly higher to the 1.34% detected in the UK.[11,28] The lower numbers described in Britain are probably age related as the UK screening just invites

**Table I.** Population and risk factors

| Risk factor | Assessed population ($n = 715$) | Nonassessed population ($n = 218$) | Portuguese population (same age group) |
|---|---|---|---|
| Age | 72.3 | 73.1 | - |
| Smoking history (%) | 60 | Unk | 62 |
| Hypertension (%) | 73 | 71 | 75 |
| Diabetes (%) | 33 | 31 | 30 |
| Dyslipidemia (%) | 58 | 60 | 61 |
| Cardiovascular disease (%) | 21 | 23 | Unk |

Unk, Unknown due to missing relevant data.

**Table II.** Association between risk factors and AAA (multiple logistic regression)

| Risk factor | Odds ratio (95% CI) | *P* |
|---|---|---|
| Smoking history (%) | 8.8 (1.1−68.5) | 0.037 |
| Hypertension (%) | 7.8 (0.6−38.7) | 0.142 |
| Diabetes (%) | 0.3 (0.1−0.9) | 0.045 |
| Dyslipidemia (%) | 9.6 (1.2−77.9) | 0.035 |
| Cardiovascular disease (%) | 0.8 (0.4−3.5) | 0.770 |

man aged 65 years and our protocol included all men aged ≥65 years with a mean age of 72.3 years. With an apparently analogous prevalence, one might conjecture that the incidence of AAA elective treatment might likewise be comparable between countries. In fact, by assessing the VASCUNET database[17] and the National Vascular Registry of UK (2015),[29] it is possible to discern that the number of elective AAA repairs was 9.5 per 100,000 citizens in Sweden and 7.8 in the UK. However, the incidence of treatment in Portugal is strikingly dissimilar. From the national administrative database of health care, a mandatory registry for public hospital refunding in Portugal, it is possible to observe that the yearly number of elective AAA repairs was 2.7 per 100,000 citizens in 2010.[19] If the prevalence is comparable and the incidence of treatment is significantly lower, a significant number of potentially lethal AAAs probably remains to be diagnosed and treated in Portugal. For this, low incidence of treatment can contribute the low level of alertness of the population for this disease. In fact, an interesting finding in this work was the unawareness level of the screened citizens, with 85% of inquired subjects stating that they had never heard of the disease before the interview. This fact might be related to several reasons. A major contributor could be the low health literacy of the Portuguese population, which was already highlighted by European Health Literacy Survey.[30] Low general practitioners' awareness, who are a privileged source for health information, could be another contributor.[31] Finally, this pathology has had a chronic lack of attention by national social media, another important source of health information.

The specific number needed to treat to save one life was not possible to obtain with this transversal study. However, some degree of approximation can be performed by comparing our data to the long-term results of MASS trial.[32] In this trial, the authors concluded that 216 men need to be invited to screening to save one death over 13 years.[32] This number was obtained considering 4.9% prevalence and 6% mortality after elective surgery for an aneurysm.[32] In that regard, with the 2.1% AAA prevalence described by this study, and 5% overall mortality in elective AAA surgery,[19] the number needed to screen to save one live should be approximately 450−500 patients.

Most studies evaluating the cost-effectiveness of AAA screening were conducted with the prevalence of AAA described by earlier studies, particularly the MASS trial,[5] that described the pathology in 4% of the evaluated people. However, in the past decade, a general decline in AAA prevalence has been reported in western countries,[15] with actual numbers approximately halving those observed in the past.[13,33,34] Changes in diet and lifestyle, namely smoking habits, and general application of preventive treatments for hypertension and hypercholesterolemia are all likely to have contributed to the reduction in AAA numbers.[15] This epidemiological shift raises the question for the potential cost-effectiveness of any future national AAA screening programs.[35] Nevertheless, estimates from Netherlands and Norway indicate that AAA screening, as presently described, may remain cost-effective with incidence rates as low as 1%.[36] Furthermore, an evaluation of the Swedish

screening program suggests that it will remain cost-effective up to a prevalence of 0.5%.[14] In that regard, our reported prevalence of 2.1% remains largely within the cost-effectiveness boundaries. Furthermore, due to the lower wage burden of Portuguese health workers, it is expected that the cost of a national screening would come at a significantly lower cost than that referred by other European countries, further reinforcing the cost-effectiveness of the program.

There were several methodological difficulties encountered when building this study. Those would have to be specifically addressed to implement a wide screening program. First, the logistics and human resources available to evaluate population outside hospital setting are limited. A specific place to assess the population close to their geographical area had to be arranged, and the ultrasonographer had to be provided from another institution with the support of the Portuguese Society for Vascular Surgery. Trying to contact 933 patients required significant workload, the burden of which was carried by voluntary medical and administrative personnel. A wider screening program will require dedicated logistics and staff. The authors propose a moving van equipped with ultrasonographer or the creation of specific rooms in several primary health care facilities throughout the country. The aortic measurement was executed by volunteer vascular surgeons, which would not be feasible in a wider national screening. The authors suggest dedicated vascular technicians for a future protocol. In addition, contacting the target population was unexpectedly complicated. The initial objective of inviting patients just by letter was met with an important rate of nonparticipation, which led the authors to also include a phone contact. The address and phone numbers available were in several cases obsolete and had to be cross-checked with the municipal database, which was considerably time consuming. In fact, failure to contact the subject was the main reason for nonparticipation in this experimental screening, accounting for 125 of the 218 nonparticipants (57%). Finally, the overwhelming majority of the assessed population was unaware of the pathology, which could lower the motivation for participating in the screening. In that way, highlighting the importance of AAA and the benefits of early detection and treatment were an integral part of the phone interaction with proposed participants. The strategy was successful so that only 12 patients (1.3%) openly refused to participate in the screening.

## CONCLUSION

This study illustrates that with a close collaboration between vascular departments and primary health care units, AAA screening is feasible and would have a high compliance rate. This pathology prevalence in the evaluated population is in line with the described ones by other national screenings and well within the range of favorable cost-effectiveness. The level of awareness for this pathology in the evaluated subjects is particularly low, which may be contributing to the low treatment rate. The prevalence that we found in this study suggests that a large number of AAAs remains to be diagnosed and treated in Portugal.

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