Population screening for chronic kidney disease: a survey involving 38,721 Brazilians

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Abstract

Background. It is known that chronic kidney disease (CKD) is continuously increasing all over the world, but the available numbers of affected subjects are mostly collected from renal replacement therapy services and they correspond to individuals with end-stage renal disease. The aim of the present study was to diagnose CKD in its earliest stages in the general population based on detection of proteinuria.

Methods. In public prevention campaigns, from 2005 to 2010, 38,721 inhabitants were evaluated in the state of Sao Paulo (Brazil). Screening procedures included a dipstick test, blood pressure measurement and application of a medical questionnaire.

Results. In the whole population, urine samples of 37,771 individuals (mean age: 44.59 ± 21.70, 55.74% females) were evaluated, 7.3% presented proteinuria (1+ or more) in the screening test and 85.5% of them had no previous knowledge of this urinary abnormality. Those individuals were referred for further clinical evaluation in order to confirm the detected alterations. Considering being diabetic and/or hypertensive as important risk factors for CKD, it was observed that they corresponded to 9.7 and 28.4% of the population screened for proteinuria, respectively. Newly detected cases of possible CKD, diabetes and hypertension corresponded to 6.2, 0.3 and 6.5%, respectively.

Conclusions. This initiative provided information on proteinuria and possible cases of CKD based on a large sampling of the Brazilian population. Proteinuria was detected in 7.3% of these individuals, and such prevalence is similar to that previously described in developed countries.

Keywords: chronic kidney disease; diabetes; hypertension; proteinuria

Introduction

The available numbers of individuals affected by chronic kidney disease (CKD) are mostly collected at their entrance in renal replacement therapy services, and they correspond in fact to the incidence of end-stage renal disease (ESRD) [1–3]. Nevertheless, the screening programs developed worldwide in order to call attention to the increasing prevalence of CKD as a public health problem may represent a first step to have a frequency overview of other phases of this disease and promote effective early diagnosis [4].

In Brazil, a nationwide campaign of CKD prevention (‘Previna-se’ Campaign) is being implemented since 2003 [5, 6], although other initiatives were locally developed in the past. It is of note that part of the authors of the present study also began a community renal health program since 1990.

In the present study, we have evaluated proteinuria as a diagnostic tool for detection of CKD. Nevertheless, it is important to make clear that the diagnosis of CKD involves measurement of estimated glomerular filtration rate (GFR) and/or structural or functional damage [4]. In fact, proteinuria is one of the most reliable markers of the latter involvement and is widely recognized as a useful test for diagnosis of CKD and follow-up of treatment. Moreover, as concerned to prognosis, proteinuria has been identified as an important risk factor not only for ESRD but also for cardiovascular events [7].

Here, we present CKD screening results of the most populous Brazilian state involved in the cited prevention campaign, Sao Paulo, based on detection of proteinuria. Considering the expressive number of screened individuals, this survey probably reveals a representative frequency of early CKD in our country.

Materials and methods

This report includes data from 38,721 Brazilians submitted to CKD screening during health campaigns, from November 2005 to November 2010, and assisted by the same main team of professionals and volunteers under the supervision of the first group, in different cities of the State of Sao Paulo, in a total of 123 health events. These CKD prevention campaigns were developed either as a specific CKD campaign or as
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part of a wider event with several simultaneous health and/or cultural activities.

Previously to each CKD prevention campaign, the professionals were given instructions by the chief of the team in order to standardize data collection and procedures. Data were collected by the integrants of the team utilizing a standard questionnaire, which included demographic information, previously diagnosed diseases (hypertension, kidney and cardiovascular diseases, diabetes and others) and familial history of hypertension, diabetes, kidney and cardiovascular diseases as well as current medications. It is necessary to make clear that participants were asked about a previous diagnosis and family history of CKD, and reports of kidney stones and urinary tract infection were not recorded as CKD. The results of diagnostic tests performed at that time (urine dipstick, capillary blood glucose) as well as blood pressure levels were also registered in this form.

Whether urinary abnormalities were detected or risk factors for CKD were identified, people with such conditions were referred to local health centres, usually previously identified and informed about the planned screening.

A non-selected population was submitted to the screening in each campaign. Public invitation to come to these events was always performed by different mediads (newspapers, radios, TVs and folders). So there was no kind of selection of the individuals by the medical team, and these particular events were not restricted to risk groups for CKD.

A dipstick test (ChoiceLine 10; Roche Diagnostics Ltd, UK) was performed to check the presence of albumin and erythrocytes/haemoglobin in the urine samples. This procedure was performed in front of the participants, immediately after the urine sample was brought by each of them. Dipstick was read manually by a group of professionals trained for this purpose, and final result of each reagent strip was confirmed by two of them, as they worked in pairs. They followed a standardized procedure, according to the instructions provided by the manufacturer, including the use of a stopwatch with countdown timer. In addition, traces of proteinuria were not considered as an abnormal result for this study purpose, and a supervisor was available whenever there was any doubt.

In fact, proteinuria and haematuria were defined by a reading of 1+ or more of protein or blood on dipstick. Individuals with haematuria and/or other urinary abnormalities in dipstick were evaluated and oriented by the medical team, but they were not included in the present study that considered only cases of proteinuria (1+ or more, corresponding to 150 mg/L or more; +, ++, +++ and ++++ corresponding to 300 mg/dL in dipstick reading).

Diagnosis of hypertension was based on current anti-hypertensive treatment and/or observation of blood pressure levels >140/90 mmHg.

Diagnosis of diabetes in this survey was based on the information provided by the participant of being under treatment for diabetes (dietetic and/or medicamentous therapy) due to a previous well-established diagnosis. We considered as suspicious of having diabetes those subjects with non-fasting results of capillary blood glucose >200 mg/dL.

Besides the tests performed and information provided by the volunteers, a total of 100 500 educational folders and brochures were distributed to screened individuals and others.

Results

Since November 2005 to November 2010, 38 721 individuals were screened in 123 field campaigns developed by the same group of nephrologists. The number of volunteers that collaborated in assisting this public was variable (15–176 per campaign) and it was individualized according to the expected needs of each site.

General characteristics of the studied population are shown in Table 1. The mean age of the whole screened population was 44.47 ± 21.65 years, and there was a predominance of females (62.8%). Among the people that looked spontaneously for assistance during the campaigns, hypertension was reported as previously diagnosed by 27.7%; diabetes mellitus by 9.5% and CKD by 8.4% of them. Newly detected cases of possible CKD, diabetes and hypertension corresponded to 6.2, 0.3 and 6.5%, respectively.

Data from important risk groups (composed by elderly and/or the above-mentioned conditions) in this screened population are shown in Table 2.

From the whole population, 37 771 individuals (mean age: 44.59 ± 21.70 years, 55.74% females) were submitted to urine screening with dipstick. All areas of the dipstick were evaluated and significant abnormalities were registered and communicated to each person by a physician, that also oriented them, and when necessary referred to adequate assistance. Nevertheless, it was considered as a possible new case of CKD, only those subjects without previous diagnosis of CKD that presented proteinuria (1+ or more, as shown in Table 3) in the current screening. Overall, the frequency of proteinuria reached 7.3% of the tests performed, and 85.5% of those individuals were not aware of having proteinuria before this screening.

Discussion

Recent surveys have revealed that the prevalence of CKD, particularly in initial silent stages, is alarmingly high in the general population [8]. Then for early detection of CKD, it is necessary a wide health education campaign and screening of the general population [9].

Screening results in field campaigns may be a source of information on global prevalence of CKD, and this was the reason for showing these results, obtained by trained health professionals using the same data collection questionnaire, same criteria of urinary abnormalities and the same reagent strip for urine tests.

The authors reinforce that some demographic information provided by the present study should be interpreted with caution, as the subjects were involved in this survey as they looked for information or assistance in a prevention campaign and there was no kind of randomization. For instance, although there is a true predominance of females in the Sao Paulo state population (in a proportion of 100/95) [10], we hypothesized that a major

### Table 1. Clinical and laboratory characteristics of the whole study population

<table>
<thead>
<tr>
<th>Total population: 38 721</th>
<th>Urine tests performed</th>
<th>Abnormal urine tests</th>
<th>Prot. without previous CKD</th>
<th>Evidence of DM (new cases)</th>
<th>Evidence of hypertension (new cases)</th>
<th>Previously known DM</th>
<th>Previously known hypertension</th>
<th>Previously known CKD</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>37 771*</td>
<td>14 657</td>
<td>2741</td>
<td>2343</td>
<td>122</td>
<td>2516</td>
<td>3672</td>
<td>10 734</td>
</tr>
<tr>
<td>%</td>
<td>97.4</td>
<td>38.8*</td>
<td>7.3*</td>
<td>6.2*</td>
<td>0.3</td>
<td>6.5</td>
<td>9.5</td>
<td>27.7</td>
</tr>
</tbody>
</table>

*Results related to a total of 37 771 urine screenings; prot., proteinuria, DM, diabetes mellitus.
participation of young females could be also related to their time availability, concerns on health care and previous awareness of being part of risks groups for CKD. If this suspicion is confirmed, it may also have an impact in the high frequency of family history of CKD observed by us.

Our screening was based on the detection of proteinuria by urine dipstick tests, and the frequency in which such laboratorial marker of CKD was detected in our population is similar to that reported in other countries, with proteinuria (in a single random sample) being observed in 7.3% of the screened population. This prevalence was even higher in particular age groups; for instance, 20.1% of all cases of proteinuria were in the age range of 50–59 years and 19.8% in the range of 40–49 years, with lower frequencies in the remainder; although it is of note that the absolute numbers of screened individuals in the age ranges >80 years and <10 years were markedly inferior to the others.

It is of note that before our study, some nationwide as well as small population surveys in Latin America revealed a high prevalence of proteinuria, usually superior to 8% [11].

In Europe, the PolNef study [12] showed a higher frequency of albuminuria that increased gradually among the evaluated age groups in men, from 8.8% in the youngest group to 21.7% among individuals with 50–59 years and up to 32% in the oldest group. In women, the frequency varied from 18% in the youngest age group to 15% in the oldest women.

On the other hand, in the Netherlands [13], the study ‘Groningen Prevention of Renal and Vascular End-Stage Disease’ revealed a prevalence of albuminuria of 7% in the general population, a percentage similar to that detected by us. The same pattern was observed in the ‘Australian Diabetes, Obesity and Lifestyle Study’, a nationwide community-based survey, involving 11 247 adults that found ~7% of albuminuria [8]. In general, population-based studies have detected 6–7% of albuminuria [14]. On the other hand, the prevalence of CKD is higher (16%) when those individuals at risk, including relatives of patients with the disease, are screened [15].

Mass population screening for CKD, with tests such as urinalysis, is considered by experts neither practical nor likely to be successful or cost effective, although it is valuable. In fact, most clinical practice guidelines recommend identifying those at risk [4].

It is also of note that screening of urine samples with dipsticks for proteinuria is useful as long as it is

<p>| Table 2. Population submitted to urine screening (37 771) and subgroups (including CKD risk groups) classified according to age ranges and gender |</p>
<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Gender</th>
<th>Total (n, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>4-9</td>
<td>10-19</td>
</tr>
<tr>
<td>Proteinuria</td>
<td>34 (55.74)</td>
<td>27 (44.26)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>34 (68.75)</td>
<td>27 (58.70)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>34 (68.75)</td>
<td>27 (58.70)</td>
</tr>
</tbody>
</table>

<p>| Table 3. Approximate proteinuria ranges observed in the whole screened population according to urine dipstick manufacturer instructions |</p>
<table>
<thead>
<tr>
<th>Proteinuria</th>
<th>Equivalent proteinuria levels</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>&lt;150 mg/L</td>
<td>32 999</td>
<td>87.37</td>
</tr>
<tr>
<td>Trace</td>
<td>150 mg/L</td>
<td>2031</td>
<td>5.38</td>
</tr>
<tr>
<td>+</td>
<td>&gt;150 to 300 mg/L</td>
<td>2059</td>
<td>5.45</td>
</tr>
<tr>
<td>++</td>
<td>&gt;300 mg/L to 1 g/L</td>
<td>492</td>
<td>1.30</td>
</tr>
<tr>
<td>+++</td>
<td>&gt;1 L to 3 g/L</td>
<td>147</td>
<td>0.39</td>
</tr>
<tr>
<td>++++</td>
<td>&gt;3 to 10 g/L</td>
<td>43</td>
<td>0.11</td>
</tr>
<tr>
<td>Proteinuria (&gt;150 mg/L)</td>
<td>2741</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population tested with urine dipstick</td>
<td>37 771</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
confirmed by further quantitative urine analysis (as spot urine albumin:creatinine ratio or protein:creatinine ratio) [4]. In the present study, this first screening was performed and the subjects with proteinuria were referred to medical evaluation, with instructions to investigate if there was in fact an abnormal loss of protein in urine by an additional confirmatory test.

For the authors, evaluating individuals at risk is certainly a priority versus mass screening programmes, but this last approach is also a way to reach ‘awareness of population’ and authorities to the CKD as a public health problem. In addition, efforts of prevention have proved to be an ‘effective tool for controlling’ the increasing CKD incidence, as already demonstrated in screening and ‘successful treatment programmes’ over the last few years [16, 17].

In order to facilitate ‘effective planning by health care authorities and providers’, information on CKD patient numbers is urgently necessary, as the available numbers of patients with CKD are usually and inadequately those of ESRD, collected in renal replacement therapy services. Most times, the prevalence of all stages of CKD is not well established, it is estimated based on the frequency of ESRD, collected in renal replacement therapy services. So the current epidemiological study of the Sao Paulo population can be useful to plan prevention programmes in Brazil and eventually in other developing countries, where these data are still unknown or scarce.

We believe that data from screening campaigns performed with CKD prevention purposes provide relevant initial information on the global prevalence of CKD. As it is expected that the vast majority of the global CKD burden will occur in developing countries [18], practical policies need to be established in such areas. From our point of view, proteinuria screening is more easily applicable for early detection of CKD than measuring estimated GFR in the general population, when both are not available. So the current epidemiological study of the CKD situation performed along 6 years in a sample of Sao Paulo population can be useful to plan prevention programmes in Brazil and eventually in other developing countries, where these data are still unknown or scarce.

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Conflict of interest statement. None declared.

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