Underestimated Prevalence of Chronic Heart Failure among the Elderly Residing in Care Homes in Aruba

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ABSTRACT

Objective: *Diagnosing chronic heart failure (CHF) is important, since subsequent treatments by medication and cardiac intervention improve quality of life. However, accurate CHF diagnosis in the elderly residing in care homes (residents) is hampered by suboptimal diagnostic tools, co-morbidity and physician's unawareness of CHF. We sought to estimate the CHF prevalence among Aruban residents.*
Methods: *All eligible residents were clinically assessed and screened for CHF signs and symptoms. The diagnosis of CHF was made by final judgment of a cardiologist. Plasma B-type-natriuretic peptide (BNP) levels were determined.*
Results: *Of the 235 residents, 184 (78%) were excluded, mostly because of decreased cognition. The remaining 51 included residents with a mean age of 78 ± 8 years; 57% was female, 59% had diabetes mellitus Type 2 and 71% had renal dysfunction (< 60 mL/min/1.73 m^2). Sixteen (31%) had CHF, of which five (31%) were aware of their diagnosis and 11 (69%) were being diagnosed for the first time. Two (29%) residents were previously incorrectly diagnosed with CHF. Most residents with CHF (94%) also had renal dysfunction and 75% had diabetes mellitus Type 2. At a BNP cut-off value of 100 pg/mL, the sensitivity, specificity and predictive values of positive and negative tests were 0.75, 0.69, 0.52 and 0.86, respectively.*
Conclusion: *The CHF prevalence in Aruba residents is high (31%) and underestimated. The high CHF prevalence may be related to the high occurrence of diabetes mellitus Type 2 in Arubans. The use of BNP at a cut-off value of 100 pg/mL adds value to the diagnostic work-up of CHF in the elderly residing in care homes.*

Keywords: Aruba, care homes, chronic heart failure, B-type natriuretic peptide, elderly, prevalence

Subestimación de la Prevalencia de la Insuficiencia Cardiaca Crónica en las Personas Mayores en Hogares de Ancianos de Aruba

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RESUMEN

Objetivo: *El diagnóstico de la insuficiencia cardíaca crónica (ICC) es importante, ya que los tratamientos subsecuentes mediante medicamentos e intervención cardiaca mejoran la calidad de vida. Sin embargo, el diagnóstico preciso de ICC en los residentes de los hogares de ancianos resulta difícil debido al carácter sub-óptimo de las herramientas de diagnóstico, la comorbilidad, y la falta de concienciación en torno al ICC entre el personal médico. Buscamos realizar una estimación de la prevalencia de ICC entre los residentes de Aruba.*
Métodos: *A todos los residentes elegibles se les realizó una evaluación clínica y un pesquizaje para detectar síntomas y signos de ICC. El diagnóstico final de ICC se realizó mediante el dictamen de un cardiólogo. Se determinaron los niveles de péptido natriurético tipo B (BNP) en plasma.*
Resultados: *De los 235 residentes, 184 (78%) fueron excluidos, principalmente a causa de cognición disminuida. Los restantes 51 residentes incluidos tenían una edad promedio de 78 ± 8 años; 57% eran*

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mujeres; 59% tenían diabetes mellitus tipo 2, y 71% tenían disfunción renal (< 60 mL/min/1.73 m^2). Dieciséis (31%) padecían ICC, y de ellos, cinco (31%) tenían conciencia de su diagnóstico y 11 (69%) fueron diagnosticados por primera vez. Dos (29%) residentes fueron diagnosticados incorrectamente con ICC. La mayoría de los residentes con ICC (94%) padecía también disfunción renal y 75% tenían diabetes mellitus tipo 2. Para un valor de corte de BNP de 100 pg/mL, la sensibilidad, especificidad y valores predictivos de las pruebas positivas y negativas fueron 0.75, 0.69, 0.52, y 0.86, respectivamente.

***Conclusión:** La prevalencia de ICC en residentes de Aruba es alta (31%) y esta subestimada. La alta prevalencia de ICC puede estar relacionada con la alta incidencia de diabetes mellitus tipo 2 en los arubenses. El uso de BNP dado un valor de corte de 100 pg/mL añade valor al trabajo de diagnóstico de ICC en los ancianos que residen en los hogares.*

Palabras claves: Aruba, hogares de ancianos, insuficiencia cardíaca crónica, péptido natriurético tipo B, ancianos, prevalencia

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INTRODUCTION

Chronic heart failure (CHF) requires objective evidence of structural or functional abnormalities of the heart at rest in the presence of appropriate signs and symptoms (1). Diagnosing CHF is important, because treatment of underlying disorders by medication and special cardiac interventions can relieve symptoms (1). The CHF diagnosis relies on clinical judgment and is based on medical history, physical examination and additional tests (1).

The added value of natriuretic peptides as B-type-natriuretic peptide (BNP) for the diagnosis of CHF has been amply demonstrated (1). However, BNP is less often used in care homes, because co-morbidity, a widespread characteristic of its residents, complicates the interpretation of the BNP outcomes (2). For example, misinterpretation may be caused by renal dysfunction, acute coronary syndrome, pulmonary embolism, obesity, age, gender and critical illness. Chronic heart failure in residents is frequently overlooked because of the non-specific presentation of its symptoms. For instance, residents often attribute fatigue and breathlessness to 'old age'. In addition, signs and symptoms of CHF in residents are often obscured by physical and psychological disabilities. These render CHF diagnosis difficult and were found to contribute to the observed underestimation of CHF in Dutch community-dwelling elderly and residents (2).

In view of the findings in The Netherlands, we hypothesized that there would be a high prevalence of undiagnosed and misjudged CHF cases among residents of care homes in the Caribbean island of Aruba. We therefore aimed to examine the CHF prevalence, the number of undetected and misdiagnosed cases with CHF and to evaluate the sensitivity and specificity of BNP in the elderly in care homes in Aruba.

SUBJECTS AND METHODS

This study was designed as a multi-centre cross-sectional trial on the prevalence of CHF in residents living in Aruban care homes. From February 2009 until August 2009, we studied the residents living in care homes of the "Stichting Algemeen Bejaardenzorg Aruba" at locations in San Nicolas, Savaneta and Oranjestad. All 235 residents were invited to participate. Exclusion criteria were subjects with cognitive impairment such as dementia (Korsakov's syndrome included) and those who did not understand the potential impact of the study on their well-being, or had aphasia, serious psychiatric or neurological disorders, or terminal illness.

Those who participated had their serum BNP measured. One of the authors (ES) collected data on the medical history and medication. All retrieved data were anonymized and coded. The general practitioner among us (HJB) examined the residents for CHF symptoms and cardiovascular abnormalities, and measured blood pressure and heart rate. A 12-lead electrocardiogram (ECG) was done at rest. As is often the case, local echocardiography was unavailable. The cardiologist (JDC) decided on the final diagnosis of CHF based on all collected information. The study protocol was in agreement with the Helsinki agreement on human rights and all included subjects signed informed consent.

Non-fasting blood samples were collected in tubes containing lithium heparin and EDTA. Samples were immediately cooled and analysed within four hours in the Aruba Public Health Laboratory. Sodium, potassium, urea, creatinine, thyroid-stimulating hormone, BNP, haemoglobin, haematocrit and mean corpuscular volume were determined from samples. B-type-natriuretic peptide was determined with the Triage BNP assay (www.biosite.com) using a Beckman Coulter Unicel DxC 600i immunoassay system (www.beckmancoulter.com). The coefficient of variation was of < 7% in the 5–4970 pg/mL range. The estimated glomerular filtration rate (eGFR mL/min/1.73 m^2) was calculated by the Modification of Diet in Renal Disease formula.

The PASW Statistics 20 software was used. The characteristics of residents with and without CHF were compared with the Student's *t*-test; the χ^2 test was used for

parametric binominal variables and the Mann-Whitney test for nonparametric data. Sensitivity, specificity and predictive values of the BNP test were calculated at cut-off points varying from 50–200 pg/mL. Influences of age, gender, angiotensin-converting enzyme inhibitor (ACE-i) and eGFR on the outcomes of BNP were examined with linear regression analyses following log transformation. All statistical comparisons were two-tailed. A *p*-value below 0.05 was considered statistically significant.

RESULTS

Of the 235 residents, 184 (78%) were excluded: 146 based on cognitive and 38 on non-cognitive exclusion criteria. The remaining 51 (22%) were investigated. Mean age of the included residents was 78 (range: 56–93) years (Table 1). There were 29 females and 22 males. The majority were immobilized and wheelchair or bed bound (55%) as a result of late complications of diabetes mellitus Type 2 (59%) such as leg amputation and cerebrovascular accidents (31%). The mean eGFR was 53 (range: 6–121) mL/min/1.73 m^2.

Chronic heart failure was diagnosed in 16 (31%) of the 51 included residents, of which five (31%) were already known to have CHF and 11 (69%) were previously unknown to have CHF. Of the 35 residents without CHF, two (6%) were previously diagnosed with CHF, but did not turn out to have CHF. These latter two residents had BNP values of 61 and 83 pg/m and eGFRs of 44 and 41 mL/min/1.73 m^2, respectively (Fig. 1).

Table 1: Characteristics of the 51 care home residents included the study

	Dimensions	All residents n = 51	Residents without CHF n = 35 (69%)	Residents with CHF n = 16 (31%)	*p*-value
Anthropometry					
Age[1]	years (SD)	78 (8)	78 (8)	79 (9)	0.460
Female	n (%)	29 (57)	18 (51)	11 (69)	0.246
Wheelchair/bed bound	n (%)	28 (55)	21 (60)	7 (44)	0.279
Medical history					
CVA	n (%)	16 (31)	12 (34)	4 (25)	0.507
Coronary artery disease	n (%)	3 (6)	1 (3)	2 (13)	0.298
Diabetes mellitus Type 2	n (%)	30 (59)	18 (51)	12 (75)	0.112
Hypertension	n (%)	25 (49)	16 (46)	10 (63)	0.266
Medication					
Antihypertensives	n (%)	40 (78)	18 (51)	12 (75)	0.112
Anticoagulants	n (%)	32 (63)	19 (54)	13 (81)	0.065
Signs and symptoms					
Dyspnoea	n (%)	24 (47)	12 (31)	13 (81)	0.002
Fatigue	n (%)	33 (65)	19 (54)	14 (88)	0.021
Oedema	n (%)	13 (25)	5 (14)	8 (50)	0.007
Systolic tension[1]	mm Hg	134 (20)	133 (16)	135 (28)	0.737
Diastolic tension[1]	mm Hg	75 (12)	78 (9)	72 (11)	0.294
Heart rate[1]	bpm	77 (10)	78 (9)	74 (11)	0.133
Increased central jugular pressure	n (%)	15 (29)	5 (14)	10 (63)	0.000
Cardiomegaly	n (%)	2 (4)	0 (0)	2 (13)	0.033
Pacemaker	n (%)	7 (14)	3 (9)	4 (25)	0.114
Electrocardiogram					
Normal ECG	n (%)	22 (43)	19 (54)	3 (19)	0.017
LVH	n (%)	4 (8)	0 (0)	4 (25)	0.002
Atrial fibrillation	n (%)	4 (8)	2 (6)	2 (13)	0.403
Ischaemia	n (%)	6 (12)	4 (11)	2 (13)	0.912
Other	n (%)	16 (31)	10 (29)	6 (38)	0.524
Laboratory					
BNP[2]	pg/mL	84 (9–1029)	156 (9–191)	59 (72–1029)	0.000
BNP > 100 pg/mL	n (%)	23 (45)	11 (31)	12 (75)	0.004
Hb[1]	mmol/L	12 (2)	8 (1)	7 (1)	0.290
eGFR[1]	mL/min/1.73 m^2	53 (27)	58 (24)	33 (21)	0.004
eGFR < 60 mL/min/1.73 m^2	n (%)	36 (71)	21 (60)	15 (94)	0.014
TSH[1]	mU/L	2 (1)	2 (1)	1 (1)	0.325

CHF – chronic heart failure CVA – cerebrovascular accident; ECG – electrocardiogram; LVH – left ventricle hypertrophy; BNP – B-type natriuretic peptide; Hb – haemoglobin; eGFR – estimated glomerular filtration rate; TSH – thyroid-stimulating hormone; [1]mean (SD); [2]median (range).

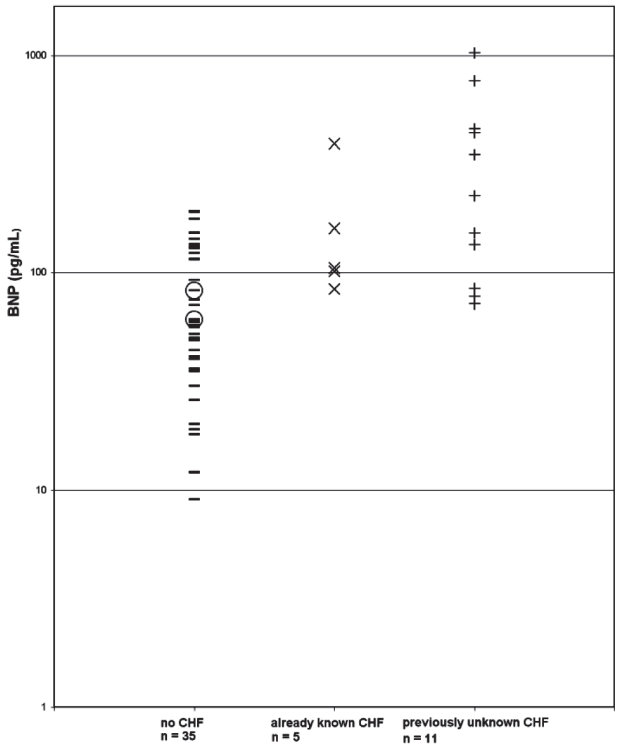

Fig. 1: Plasma B-type natriuretic peptide (BNP) of residents without chronic heart failure (CHF) [left], already diagnosed with CHF [middle] and previously undiagnosed with CHF [right].
*Two residents were previously incorrectly diagnosed with CHF (BNP levels: 61 and 83 pg/mL, respectively).

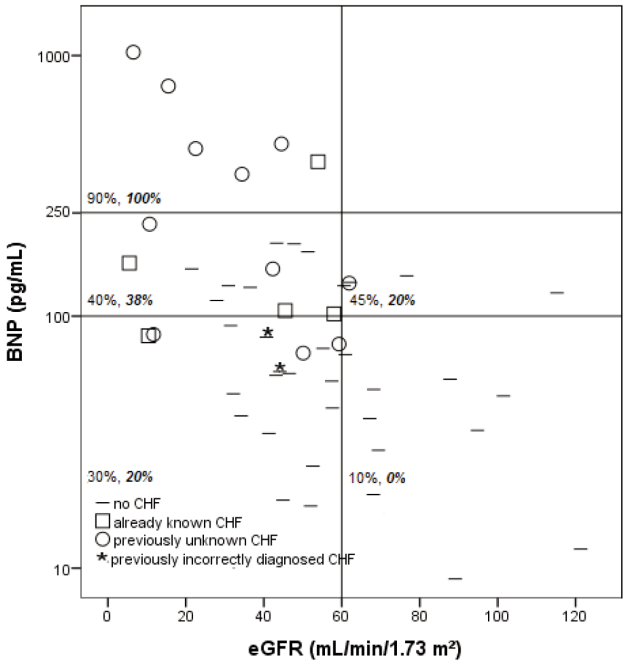

Fig. 2: Relation between the estimated glomerular filtration rate (eGFR) and B-type natriuretic peptide (BNP) for all 51 included residents.
eGFR and BNP were subdivided into eight categories (*ie* < 100, 100–249 and > 250 pg/mL (250–500 and ≥ 500 pg/mL pooled) for BNP and ≥ 60 and < 60 mL/min/1.73 m^2 for eGFR (dichotomized) according to Dhar *et al* (5). Of note, the 500 pg/mL line is not depicted. The prevalence percentages in each category on the left are from Dhar *et al* (5); those in italic bold on the right derive from the current study. CHF – chronic heart failure.

The characteristics of the 16 residents with CHF were compared with those of the 35 without CHF. The residents with CHF more often had dyspnoea, fatigue, oedema, increased central jugular pressure, cardiomegaly, abnormal ECG and left ventricular hypertrophy (Table 1). Residents with CHF had higher BNP levels and lower eGFRs.

The BNP of the entire group was negatively related to the eGFR (β = -0.49, p = 0.002; Fig. 2). This was the only observed confounder. Since both elevated BNP and N-terminal pro-brain natriuretic peptide (NT-proBNP) may occur in conjunction with low eGFR in the absence of CHF (4), we tested whether the present CHF diagnoses might have become seriously confounded by their low eGFR *per se*. For this, the residents were classified according to their BNPs (< 100, 100–249 and pooled > 250–500 and > 500 pg/mL) as employed by Dhar *et al* (5) and their eGFRs dichotomized according to ≥ 60 and < 60 mL/min. Figure 2 shows the CHF prevalence of the eight subgroups, together with that of the data of Dhar *et al* (5). We found that the distribution of the prevalence was similar. The sensitivity, specificity, positive and negative predictive values (PPV and NPV) of BNP were calculated at cut-off points from 50 up to 200 pg/mL and are presented in Table 2.

Table 2: Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) at various B-type natriuretic peptide (BNP) cut-off values

BNP cut-off value (pg/mL)	Sensitivity	Specificity	PPV	NPV
50	1.00	0.37	0.37	1.00
75	0.94	0.60	0.52	0.95
100	0.75	0.69	0.52	0.86
125	0.63	0.74	0.53	0.81
150	0.56	0.89	0.69	0.82
175	0.44	0.91	0.70	0.78
200	0.44	1.00	1.00	0.80

DISCUSSION

We determined the CHF prevalence in Aruban care home residents and also the percentage of residents who were unknown with CHF and who were incorrectly diagnosed with CHF. Among the eligible 51 residents, we found that 16 (31%) had CHF, of which five (31%) were already known to have CHF and 11 (69%) were previously unknown with CHF. Of the residents without CHF, two (29%) were previously incorrectly diagnosed with CHF. For the frequently

used BNP cut-off value at 100 pg/mL (1, 3), we calculated a sensitivity of 0.75, a specificity of 0.69, a PPV of 0.52 and a NPV of 0.86.

The majority of residents (78%) were excluded from participation. This outcome is much higher compared with similar studies in The Netherlands, where only 31–38% of the invited participants were excluded (2, 6). The discrepancy is not caused by differences in age and gender between the Aruban and Dutch residents, but is rather on account of the indications of admission. In the Dutch study, one-third of the residents were admitted for short stay, such as for rehabilitation for orthopaedic operations and cerebrovascular accidents.

The encountered CHF prevalence of 31% exceeds the 23% CHF prevalence of the studies in both The Netherlands (2) and the United Kingdom [UK] (7). This difference might be explained by the high prevalence in Aruba of diabetes mellitus Type 2, which is a well-known CHF risk factor (8). The prevalence of diabetes mellitus Type 2 among the residential elderly in Aruba was 59%, and thereby twice the prevalence of 25% and 19% in the Dutch (2) and UK (7) nursing homes, respectively. In line with this presumption, we found a higher prevalence of diabetes mellitus Type 2 among the residents with CHF in Aruba (75%), compared with The Netherlands [38%] (2). The diabetes prevalence in the nursing homes may reflect the estimated prevalence in the general population, of which 12.7% (Aruba) and 5.4% (The Netherlands and UK) might have this disease (9).

The high percentage of care home residents with previously unknown CHF (69% of all residents with CHF) proved in good agreement with the encountered 62% of previously unknown CHF in the afore-mentioned study in The Netherlands (2). Masking of CHF symptoms by co-morbidity, mild symptoms, and also unfamiliarity of general practitioners with the diagnostic value of the BNP may explain the underestimation. Of the 11 previously unidentified residents with CHF, eight had BNP outcomes above the cut-off value of 100 pg/mL (Fig. 1). Conversely, the incorrect diagnosis of CHF in two residents might have been prevented by the finding of ECGs without significant abnormalities and normal serum BNP (Fig. 1). It is unlikely that any CHF-like symptoms of these residents were moderated by treatment for CHF, since one of them was untreated and the other only received a low dose antihypertensive medication.

In contrast with the afore-mentioned studies on the prevalence of CHF in Dutch (2) and UK (7) care home residents, we have neither employed echocardiography nor a panel of cardiologists for the diagnosis. The lack of echocardiographic information might have overemphasized the diagnostic importance of the BNP, especially in residents with poor kidney function (eGFR < 60 mL/min/1.73 m^2). It is well known that both elevated BNP and NT-proBNP may occur in conjunction with low eGFRs in the absence of CHF (4). This issue continues to be a potentially serious confounder, since patients with CHF often have renal insufficiency and *vice versa* (10). Dhar *et al* (5) investigated the relations between CHF, eGFR and BNP. Their data were derived from the 'Breathing Not Properly Multinational Study' that employed echocardiography and chest X-ray for the diagnosis of CHF. The high degree of similarity between the present CHF prevalence and that of Dhar *et al* (5) [Fig. 2], suggested that the CHF diagnoses in the current study were not confounded by low eGFR and the lack of echocardiographic information.

The sensitivity (0.75) and specificity (0.69) at the cut-off value for BNP of 100 pg/mL were similar to those found in other studies conducted in nursing homes (2). The current sensitivity and specificity are considerably lower than those reported in the brochure of the BNP test manufacturer (*ie* sensitivity 0.82 and specificity 0.92). The discrepancy is likely to be on account of the higher age and the higher prevalence of low eGFR in the present study.

We conclude that, within the limitation of the current small study group, the prevalence of CHF in Aruba care home residents is substantial and underestimated: 31% of the included residents had CHF and in 69% of them, CHF was previously undetected. The frequent occurrence of CHF might be related to the high prevalence of diabetes mellitus Type 2 in the Aruban population. The majority (94%) of patients with CHF also had low eGFR, but it is unlikely that poor renal function constituted a serious CHF confounder. Measurement of BNP with employment of a cut-off value of 100 pg/mL is of great value for the diagnosis of CHF in elderly care homes.

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