Physiology & Behavior 168 (2017) 91–97

Contents lists available at ScienceDirect

Physiology & Behavior

journal homepage: www.elsevier.com/locate/phb

Psychiatric correlates of blood pressure variability in the elderly: The Three City cohort study

Phillip J. Tully, PhD, MPsych(Clin) [a,b,*], Christophe Tzourio, MD, PhD [a,c]

[a] Bordeaux Population Health, University of Bordeaux, France
[b] Freemasons Foundation Centre for Men's Health, Discipline of Medicine, School of Medicine, The University of Adelaide, Australia
[c] INSERM, Neuroepidemiology, UMR897, F-33000 Bordeaux, France

HIGHLIGHTS

- Modifiable factors associated with BPV are still being established.
- 1454 elderly participants underwent HBPM and serial BP measures over 8 years.
- GAD was associated with systolic BPV over 8 years.
- The GAD association with systolic BPV was consistent for morning and evening measures.
- GAD but not depression was associated with increased systolic BPV over 8 years.

ARTICLE INFO

Article history:
Received 5 August 2016
Received in revised form 24 October 2016
Accepted 25 October 2016
Available online 4 November 2016

Keywords:
Blood pressure
Hypertension
Blood pressure monitoring, home
Anxiety disorders
Depression

ABSTRACT

Background: The modifiable factors associated with blood pressure variability (BPV) are still being established and their clinical relevance is poorly understood. Generalized anxiety disorder (GAD) and depression have been implicated with higher BPV in the short term (e.g. hours, days) however their effects on BPV over longer periods are unknown.
Methods: In a prospective cohort study, 1454 elderly participants (age 78.5 ± 3.78 years, 59% women) underwent structured interview for GAD and major depression. Participants performed home blood pressure monitoring (HBPM) over 3 consecutive days and underwent serial clinic BP measures on 4 separate follow-ups over an 8 year period. Systolic and diastolic BPV was calculated using the coefficient of variation (CV) and standard deviation method. Generalized linear models assessed the association between GAD and depression with BPV over an 8 year period.
Results: GAD was associated with significantly increased systolic BPV over 8 years in age, sex and mean systolic BP ($\beta = 0.25$, SE = 0.09; $p = 0.007$) and fully adjusted models ($\beta = 0.23$, SE = 0.10; $p = 0.017$). BPV from HBPM was strongly associated with 8 year systolic BPV in age-sex ($\beta = 3.10$, SE = 0.82; $p < 0.001$) and fully adjusted models ($\beta = 3.09$, SE = 0.84; $p < 0.001$). The association between GAD and longer term BPV was consistent when analyzing morning and evening HBPM measures of BPV. There was no association between diastolic BPV over 8 years with GAD or depression.
Conclusions: GAD but not depression was associated with increased systolic BPV over an 8 year period controlling for HBPM. GAD has clinical relevance for control of systolic BPV in elderly participants.

1. Introduction

Blood pressure (BP) varies within individuals over time [1]. An increase in BP variability (BPV) is an emerging focus in clinical and epidemiological studies because of links to incident and recurrent stroke [2–4] and major cardiovascular outcomes [5–8] independent of mean systolic BP. The clinical relevance of BPV beyond the effects of mean BP remains controversial and poorly understood [7,9]. Increased BPV is associated with decreased arterial compliance and complex parasympathetic, behavioral and psychological processes [1,10]. It is unclear which factors leading to higher BPV can be modified, if any. Among potentially modifiable risk factors, generalized anxiety disorder (GAD) and major depression have been implicated with higher BPV in the short term (e.g. hours and days) [11–13], however their effects on BPV over longer periods (i.e. years) is lesser reported. Clarifying the long term association between GAD, major depression and BPV is imperative

* Corresponding author at: Bordeaux Population Health, University of Bordeaux, France, 146 rue Léo Saignat - Case 11, 33076 Bordeaux cedex, France.
E-mail address: phillip.tully@adelaide.edu.au (P.J. Tully).

http://dx.doi.org/10.1016/j.physbeh.2016.10.024
0031-9384/

because persons with these disorders have higher healthcare costs [14] and are at a high risk of stroke and cardiovascular events [15–19]. Moreover, BPV is one plausible mechanism portending an increased cardiovascular morbidity risk [2,20].

A body of empirical work documents the cross-sectional association between depression and anxiety with BPV derived from beat-to-beat, ambulatory and home BP measures [11–13,21]. One limitation of the extant evidence is the paucity of longitudinal research describing how GAD and depression relate to BPV measured over longer periods. This is necessary to clarify because of the longer intervals whereby BP is typically measured in clinical practice [22] and the equivocal findings as to whether BPV increases or decreases over time [22–25]. A second limitation of the extant research is the use of predominantly younger and healthy participants who are at a lower stroke risk than elderly populations. This is an important limitation to reconcile since both GAD and major depression are among the most common psychiatric disorders in elderly persons [26,27].

The current study adds to the extant literature by examining BPV in relation to GAD and major depression in a prospective cohort of elderly individuals who underwent home blood pressure monitoring (HBPM) on three consecutive days, and clinic visits over 8 years. The aim of this study was to assess the association between GAD and major depression with BPV over an 8 year period, controlling for HBPM BPV.

2. Materials and methods

2.1. Population

The Three-City (3C) Study is a French prospective cohort study investigating the determinants of stroke and dementia [28]. Briefly, 9294 noninstitutionalized community dwelling adults aged 65 years or older were recruited and underwent baseline neurological examinations. The cohort was monitored for major cardiovascular disease and neurological outcomes. The current analyses use only participants from the Dijon center at the 2nd wave of follow-up who were invited to participate in a HBPM study. Serial follow-up was performed thereafter at years 2, 5, and 8. Persons with confirmed stroke history were excluded because GAD and depression are more common in the post-stroke period [29] and BPV may decline over time after stroke. From 2085 participants invited to participate in HBPM, 1814 agreed (87% acceptance rate), 1737 had at least 12 HBPM readings and 1454 returned for the 8 year follow-up. Participants who were not eligible for the study or lost to follow-up were generally older, more likely female and lower BMI, and less likely to have cardiovascular disease, otherwise characteristics were similar. The study protocol has been approved by the Ethical Committee of the University Hospital of Kremlin-Bicêtre and each participant provided signed and informed consent (Fig. 1).

2.2. Blood pressure measurement and variability

The methods of HBPM have been reported previously [30]. Briefly, at the study center, participants were given instructions on how to measure their own BP with the validated digital electronic tensiometer OMRON M4 (OMRON Corp., Kyoto, Japan). They had one individual supervised demonstration, and they were assigned the same device for use at home. A booklet with simplified instructions and a logbook to record their BP measures were also provided. HBPM was scheduled on 3 consecutive days and participants instructed to record their BP 3 times in the morning and 3 times in the evening (6 readings p/day up to a maximum of 18 HBPM readings). Each of the three BP measures were separated by 2 min after the subject rested at least 5 min in a seated position, with an adaptable sized cuff placed on the left arm. Morning measures had to be performed <1 h after awaking and before taking any drug. Evening measures had to be realized close to bedtime. Patients were asked to keep a record of all BP readings in a logbook.

Clinic BP was measured according to a standardized protocol after at least 5 min of rest in a seated position, with an appropriately sized cuff placed on the left arm. Clinic visits were performed prior to HBPM, and again at year 2, 5, and 8. Participants BP was measured in the left arm (3 readings p/year up to a maximum of 12 BP readings). BPV was calculated separately for HBPM and clinic visits. BPV was calculated using 3 methods with possible prognostic association with stroke [31].

Coefficient of variation: $CV = \frac{SD}{Mean}$

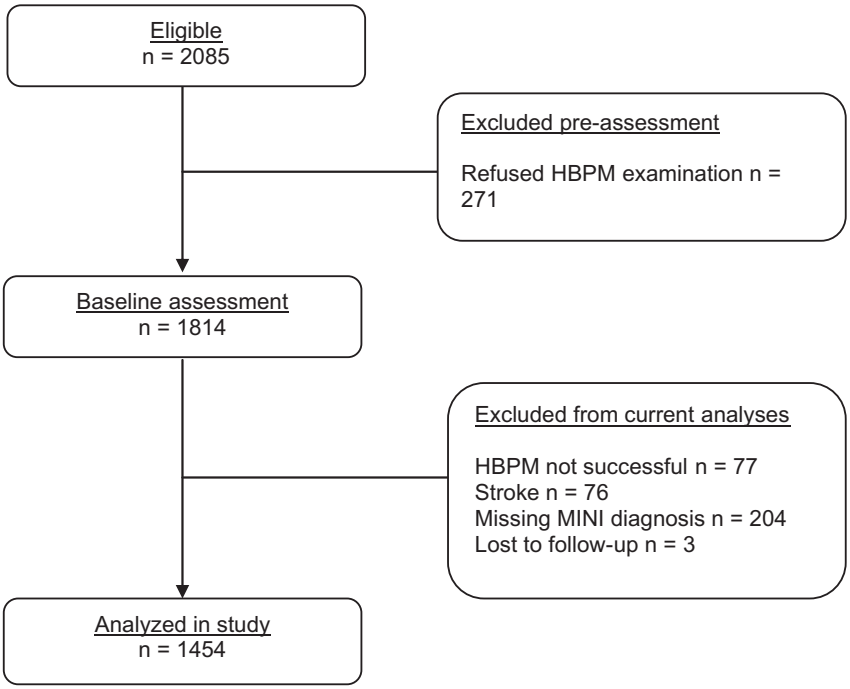

Fig. 1. Flow chart of participants through the study.