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Lower-limb hypopallesthesia: a risk factor for falls in cognitively intact non-diabetic older adults

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ABSTRACT

Peripheral neuropathies (PN) in older adults often involve altered vibrational perception, i.e. hypopallesthesia. The main objective of this cross-sectional study was to determine whether

age-related lower-limb hypopallesthesia is associated with a history of falls in cognitively intact non-diabetic older adults. The study population comprised 157 people (mean, 71.5 ± 3.8 years, 45.3% female, 19.7% with a history of falls). Fallers more often exhibited hypopallesthesia than non-fallers (13.3% versus 1.6%, $P=0.04$). Multiple logistic regression showed that hypopallesthesia (odds ratio (OR)=19.5 [95% confidence interval (CI): 2.7-143.7], $P=0.004$) was associated with the history of falls in this sample of cognitively intact non-diabetic older adults.

Keywords

Peripheral neuropathies, hypopallesthesia, fall history, older adults

INTRODUCTION

Falls are a major public health issue in older adults because of their high prevalence, their consequences in terms of morbidity and mortality, and their high cost (1). It is estimated that one third of those over 65 years, and half over 80, fall at least once a year (2). To prevent falls, it is crucial to identify and correct the risk factors as early as possible. However some risk factors remain unknown due to changes in the expression of diseases or in the clinical interpretation with aging (3).

Among the factors with modified expression are peripheral neuropathies (PN). PN in older adults are predominantly sensitive, marked by altered vibrational perception i.e. hypopallesthesia (4). The proportion of idiopathic PN increases with advancing age, ranging from 9-20% before age 80 to 40% beyond (5). While PNs are recognized as increasing the risk of falls in diabetic patients, their possible role in falling has not yet been explored among non-diabetic older adults to our knowledge (4).

We hypothesized that age-related hypopallesthesia could be an independent risk factor for falls. The objective of this cross-sectional observational study was to determine whether lower-limb hypopallesthesia is associated with the history of falls in cognitively intact non-diabetic older adults.

METHODS

The data were extracted from the French MERE cohort (ClinicalTrials.gov number, NCT01315704), which included older community-dwellers aged 60 and over consulting at the Memory Clinic of the University Hospital of Angers, France. Sampling and data collection procedures have been described and published (6). Participants were included in the present analysis when they had no history of diabetes mellitus and no cognitive impairment (Mini-Mental Status Examination score, MMSE > 24/30), and when they had a tuning fork test during the consultation. Participants were included after having given their informed consent. The study was conducted in accordance with the ethical standards set forth in the Helsinki Declaration (1983) and protocol was approved by the local Ethical Committee (2009/15).

An operator made vibrate a dedicated tuning fork placed successively on each tibial tuberosity in order to measure the vibratory sensitivity, with a score graded between 8 (vibratory sensation until the end of the vibration = no disorder) and 0 (no sensation = severe disorder). Hypopallesthesia was defined as a tuning fork score ≤ 2 bilaterally, likely to reflect PN.

History of falls assessed using a standardized questionnaire by interviewing participants and their families, was retained if at least one fall was reported during the preceding 12 months. A fall was defined as an event resulting in a person coming to rest unintentionally on the ground or another lower level, not as the result of a major intrinsic event or an overwhelming hazard.

The following covariates were used as potential confounders: age, sex, polypharmacy (i.e. using >4 different drugs per day), usual vitamin D supplementation, MMSE score, depression (i.e. 4-item Geriatric Depression Scale [GDS] score \geq 1), anemia defined as hemoglobin (Hb) level<13g/dL for men and 12g/L for women, and performance on postural tests (one-leg balance test [OLB; normal>5seconds] and five time sit-to-stand test [FTSS; normal<15seconds]).

A descriptive analysis of the participants' characteristics was firstly performed using effectives (n) and frequencies for qualitative variables, and means and standard deviations (SD) for quantitative variables. Comparisons were performed according to those with and without hypopallesthesia using chi² or Fisher exact test for qualitative variables, and Student *t*-test or Mann-Whitney U test for quantitative variables according to the normal distribution assumption, as appropriate. Multivariate models were obtained by backward selection, using a P-value>0.2 for removal from the model. Sex, age, Hb level, and vitamin D supplementation were forced into the model. P-values<0.05 were considered significant. Statistical analyzes were performed using SAS software version 9.4.

RESULTS

Among 912 participants in the cohort (mean age 72years, 45.3% female), the results of the tuning fork test were available for 400 participants, including 39 with diabetes mellitus, who were excluded. Of the 361 non-diabetic people, 157 had no cognitive impairment and were included in the analysis. Participants' characteristics are summarized in Table 1 (mean

age \pm SD, 71.5 \pm 3.8years; 35.7% female; 19.7% fallers). Fallers exhibited more often hypopallesthesia than non-fallers (13.3% versus 1.6%, $P=0.04$). In contrast, performance on postural tests did not differ between groups. The multiple logistic regression showed that hypopallesthesia was associated with the history of falls (odds ratio (OR)=19.5 [95% confidence interval (CI): 2.7-143.7], $P=0.004$). Female sex was also associated with the history of falls (OR=5.0 [95CI: 1.9-13.0], $P=0.001$).

DISCUSSION

Our results show that the finding of lower-limb hypopallesthesia, suggestive of PN, was associated with the history of falls in cognitively-intact non-diabetic older adults, irrespective of all studied potential confounders.

Clinical PN is a known risk factor for disability and mobility limitations in those with diabetes mellitus (7). However, advancing age is also a risk factor for PN, regardless of diabetes and our results suggest that this age-related PN is also associated to falls. Thus our findings encourage systematic testing of lower-limb hypopallesthesia in all subjects at risk of falls, even in the absence of diabetes mellitus.

Literature has reported that somatosensory information, including both tactile and proprioceptive systems, is responsible for maintaining balance. While standing, humans continuously oscillate and neurological integrity is needed to detect these oscillations to ensure efficient postural control. In the case of NP, more oscillations are needed, hence an increased fall risk (8).

Our study has some limitations. First, our study is observational with a cross-sectional design, which prevents any causal inference. Second, the study was monocentric with a limited number of participants who may be unrepresentative of all older adults. Third, falls were self-

reported, and up to 50% of self-reported falls may be forgotten. Fourth, balance disorders were assessed with clinical tests that are less accurate than spatial temporal gait measures.

In conclusion, we found a positive independent and possibly early association between lower-limb hypopallesthesia and history of falls in cognitively-intact non-diabetic older adults in whom postural tests were still unaltered. This result should be confirmed in larger and preferentially prospective studies, in order to determine with a higher level of evidence the potential role of PN as a risk factor for falls in older adults. If these results are confirmed, the measurement of hypopallesthesia could be systematized in ambulatory medicine to set up early fall prevention programs.

Contributors

Julie Morel contributed to study concept and design, acquisition of data, analysis and interpretation of data, and drafting of the manuscript, and has full access to the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analyses.

Armelle Gentric contributed to study concept and design, analysis and interpretation of data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, and study supervision.

Cédric Annweiler contributed to study concept and design, acquisition of data, and critical revision of the manuscript for important intellectual content.

Conflict of interest

The authors declare that they have no conflict of interest.

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Ethical approval

The study was conducted in accordance with the ethical standards set forth in the Helsinki Declaration (1983). Ethics approval was obtained from the Ethics Board of the University Hospital of Angers, France (2009/15). Informed consent was obtained at enrolment according to the protocol approved by the local institutional review board.

Provenance and peer review

This article was not commissioned. Peer review was directed by Teresa Liu-Ambrose independently of Cédric Annweiler, an author and *Maturitas* editor, who was blinded to the process.

Research data (data sharing and collaboration)

There are no linked research data sets for this paper. Data will be made available on request.

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Table 1. Characteristics of participants (n=157).

	Whole sample n = 157	No fall history n = 126	Fall history n = 31	P-value
Mean age (years), mean±SD	71.5 ± 3.8	71 ± 3.5	73.4 ± 4.5	0.0016
Female sex	56 (35.7%)	39 (31%)	17 (54.8%)	0.0129
Mean MMSE score (/30), mean±SD	28.4 ± 1.5	28.4 ± 1.51	28.5 ± 1.5	0.6716
Polypharmacy	74 (46.8%)	57 (44.8%)	17 (54.8%)	0.316
Number of drugs used per day, mean±SD	3.65 ± 2.26	3.39 ± 1.98	4.68 ± 2.98	0.0679
Vitamin D supplementation	25 (15.9%)	17 (13.5%)	8 (25.8%)	0.1047
Depression	21 (13.4%)	14 (11.1%)	7 (22.6%)	0.1361
GDS score (/4), mean±SD	0.2 ± 0.55	0.15 ± 0.46	0.39 ± 0.80	0.0797

Anemia	1 (0.8 %)	0 (0.0 %)	1 (3.8 %)	0.1955
Hypopallesthesia	6 (3.9%)	2 (1.6%)	4 (13.3%)	0.0139
Abnormal OLB test	19 (12.3%)	13 (10.5%)	6 (20%)	0.2115
Abnormal FTSS test	92 (60.5%)	72 (58.5%)	20 (69%)	0.3013
Time to perform FTSS (sec), mean\pmSD	13.17 \pm 3.22	13.00 \pm 2.86	13.88 \pm 4.43	0.6331

Results presented as n (%) where applicable; FTSS: five times sit-to-stand; GDS: Geriatric Depression Scale; OLB: one-leg balance; SD: standard deviation; significant P-value<0.05 in bold.

Highlights

- The main objective of this cross-sectional study was to determine whether age-related lower-limb hypopallesthesia is associated with a history of falls in cognitively intact non-diabetic older adults.
- This association was found in the sample of 157 people.
- Systematization of the measurement of hypopallestesia would be to the benefit of early fall prevention programmes.