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Original Article

Gender Differences in the Role of Social Support for Hypertension Prevention in Canada: A Population-Based Cross-Sectional Study of the Canadian Longitudinal Study on Aging Cohort

Zeinab Hosseini, PhD,[a,b] Abdollah Safari, PhD,[c] Nadia A. Khan, MD, MSc,[d,e] Gerry Veenstra, PhD,[f] and Annalijn I. Conklin, MPH, PhD[a,e]

[a] *Collaboration for Outcomes Research and Evaluation (CORE), Faculty of Pharmaceutical Sciences, University of British Columbia, Vancouver, British Columbia, Canada*

[b] *College of Kinesiology, University of Saskatchewan, Saskatoon, Saskatchewan, Canada*

[c] *Data, Analytics, Statistics and Informatics (DASI), Faculty of Pharmaceutical Sciences, University of British Columbia, Vancouver, British Columbia, Canada*

[d] *Department of Medicine, University of British Columbia, Vancouver, British Columbia, Canada*

[e] *Centre for Health Evaluation and Outcome Sciences (CHÉOS), St. Paul's Hospital, Vancouver, British Columbia, Canada*

[f] *Department of Sociology, University of British Columbia, Vancouver, British Columbia, Canada*

ABSTRACT

Background: The relationship between social support and hypertension is poorly understood in women and men. We investigated whether multiple measures of social support are linked to blood pressure levels differentially by gender.

Methods: Cross-sectional study of 28,779 middle-age and older-age adults (45-85 years) in the baseline Canadian Longitudinal Study on Aging comprehensive cohort. Stratified multivariable regression models estimated the role and relative contribution of 4 types of support to blood pressure in women and men.

Results: The highest levels of perceived availability of informational, tangible, emotional, and belonging support were significantly associated with the lowest mean level of systolic blood pressure (SBP) but not diastolic blood pressure, independent of known confounders and

RÉSUMÉ

Contexte : La relation entre le soutien social et l'hypertension est mal comprise chez les femmes et les hommes. Nous avons tenté de déterminer si diverses mesures de soutien social sont liées aux valeurs de la pression artérielle différemment selon le sexe.

Méthodologie : Étude transversale menée chez 28 779 adultes d'âge moyen ou plus avancé (45-85 ans) au sein de la cohorte globale initiale de l'Étude longitudinale canadienne sur le vieillissement. Des modèles stratifiés de régression à variables multiples ont servi à estimer le rôle et la contribution relative de quatre types de soutien sur la pression artérielle chez les femmes et les hommes.

Résultats : Les niveaux les plus élevés de disponibilité perçue d'un soutien informationnel, tangible, émotionnel et axé sur l'appartenance étaient associés de façon significative à la plus faible valeur moyenne

Increased systolic blood pressure (SBP) is the leading cause of death and disability in Canada and worldwide.[1,2] Diseases associated with elevated SBP have a substantial economic impact, as annual costs of hypertension alone were expected to reach $20.5 billion in 2020.[3] The level of hypertension control in older women is declining in Canada and is now below 50% for the first time in 20 years.[4] The underlying reasons for worsening control of hypertension, especially among elderly women, are unknown. Social isolation has been strongly linked to hypertension in older adult populations around the world.[5,6] Social deficits have also been associated with markers of metabolic health.[7] However, the role of social support in elevated blood pressure has yet to be conclusively established, and gender differences in this area have yet to be considered.

The evidence is clear that social ties impact mortality, with effects being distinct for structural (quantity) vs functional (self-perceived) types of social ties.[8,9] The impact of social ties on longevity is similar in magnitude to the effect of smoking on

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Corresponding author: Dr Annalijn I. Conklin, Faculty of Pharmaceutical Sciences, Collaboration for Outcomes Research and Evaluation, The University of British Columbia, 2405 Wesbrook Mall, Office 4623, Vancouver, British Columbia V6T 1Z3, Canada. Tel: +1-604-827-4258.

E-mail: aconklin@mail.ubc.ca

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other support types. However, associations were small, and their directions were more consistent in women. The lowest levels of informational support, relative to the highest, were associated with higher odds of hypertension in women (odds ratio [OR] = 1.20 [95% confidence interval {CI}: 1.06, 1.36]), more so than in men (OR = 1.16 [95% CI: 1.03, 1.32]). The lowest levels of emotional support were similarly associated with the odds of hypertension (OR = 1.08 [95% CI: 1.00, 1.17] in women and OR = 1.08 [95% CI: 1.00, 1.15] in men), relative to the highest. Larger differences in mean SBP in women, compared with men, were seen for informational support (2.43 and 1.18 mm Hg, respectively) and emotional support (1.60 and 0.74 mm Hg, respectively). Findings were unaltered by sensitivity analyses.

Conclusions: Informational and emotional support were inversely associated with SBP, more so in women than men. Further longitudinal investigation is warranted, as results suggest that specific supports may help prevent hypertension and lower cardiovascular risk, especially in women.

de la pression artérielle systolique (PAS), mais pas de la pression artérielle diastolique (PAD), indépendamment des facteurs de confusion connus et des autres types de soutien. Toutefois, les associations étaient faibles et leurs tendances étaient plus constantes chez les femmes. Les plus faibles niveaux de soutien informationnel, par rapport aux plus élevés, étaient associés à un plus grand risque d'hypertension chez les femmes (rapport de cotes [RC] = 1,20 [intervalle de confiance [IC] à 95 % : 1,06, 1,36]), et ce plus que chez les hommes (RC = 1,16 [IC à 95 % : 1,03, 1,32]). De même, les plus faibles niveaux de soutien émotionnel étaient associés au risque d'hypertension (RC = 1,08 [IC à 95 % : 1,00, 1,17] chez les femmes et RC = 1,08 [IC à 95 % : 1,00, 1,15] chez les hommes), par rapport aux plus élevés. Des différences plus importantes des valeurs moyennes de la PAS ont été observées chez les femmes comparativement aux hommes relativement au soutien informationnel (2,43 et 1,18 mm Hg, respectivement) et au soutien émotionnel (1,60 et 0,74 mm Hg, respectivement). Les résultats n'ont pas été modifiés par les analyses de sensibilité.

Conclusions : Le soutien informationnel et le soutien émotionnel étaient inversement associés aux valeurs de la PAS, et ce plus chez les femmes que chez les hommes. Une investigation longitudinale est nécessaire pour approfondir le sujet, car les résultats donnent à penser que certaines formes de soutien peuvent contribuer à prévenir l'hypertension et à réduire le risque cardiovasculaire, en particulier chez les femmes.

mortality.[8,9] It has been hypothesized that social ties impact mortality and cardiovascular disease (CVD) risk through physiological dysregulation of established CVD risk factors, including hypertension.[10] However, research is limited on the link between social ties and hypertension in various populations,[11-15] and this evidence lacks data related specifically to women and to different types of social support (eg, informational).

Gender is an important but understudied CVD risk factor,[16] and it is particularly relevant to understanding the physiological pathway linking social ties to health: the lived realities of older women and men vary in both the quantity and quality of social relationships[17] and in their effects on health.[18,19] Specifically, differences in socialization experiences and social roles lead women to maintain more emotionally supportive ties, mobilize more social supports in time of stress, and provide more frequent and timely social support than men.[20,21] This study sought to investigate which types of perceived social support are associated with cardiovascular outcomes among older Canadian women and men. Our hypothesis was that lack of each type of support is independently associated with hypertension, that greater perceived support is associated with lower hypertension, and that these associations are stronger in women than men.

Methods

Study design and population

This population-based study employed baseline Canadian Longitudinal Study on Aging (CLSA) comprehensive cohort data (version 4.2, 2012-2015). The CLSA collects self-reported information on social, physical, and psychological factors and clinical measures from English- or French-speaking, non-institutionalized residents aged 45-85 years who are living within a 25-50−km radius of the established data collection sites, which were located in major academic centres in the 10 provinces across Canada.[22,23] Provincial healthcare registration databases and random-digit dialing were used as sampling frames in the CLSA.[23] Excluded from the CLSA were the following: Canadian Armed Forces full-time members; residents from federal First Nations reserves and other First Nations settlements, the 3 territories, and some remote regions; those living in institutions at recruitment; individuals with cognitive impairment at recruitment; and residents unable to respond in French or English.[23] Complete data on perceived social support, blood pressure, and covariates were available for 28,779 participants. All CLSA participants provided written informed consent. The University of British Columbia's Behavioural Research Ethics Board approved this study (H19-00971).

Outcomes

Clinical measurements of SBP and diastolic blood pressure (DBP) were taken while patients were seated, using the BpTRU BPM200 Blood Pressure Monitor (VSM MedTech Ltd, Vancouver, Canada), a fully automated blood pressure device validated for accuracy.[23] We used the last 5 (of 6) measurements to calculate a mean SBP or DBP and constructed a binary outcome for hypertension based on SBP $\geq$ 140 mm Hg and/or DBP $\geq$ 90 mm Hg (for patients with diabetes: $\geq$ 130/80 mm Hg),[24,25] self-reported diagnosis of hypertension, or use of medication for hypertension.

Social support (functional ties)

The CLSA assessed perceived availability of emotional, informational, tangible, and belonging support using questions from the Medical Outcomes Study (MOS) Social

Support Survey,[26] with 5 response categories (none, a little, some, most of the time, and all of the time).[23] Emotional-support questions were related to having a person to confide in and with whom to share and express affection. Information-support questions concerned having a person to get advice or information from to help with a problem. Tangible-support questions referred to having someone to help with activities of daily living (eg, prepare meals, provide travel to appointments). Belonging-support questions were focused on having someone to relate to, relax or have a good time with, or do fun activities with. All 4 social-support measures from the MOS survey instrument were constructed as a continuous score with varying ranges—typically 4 to 20 points—following the MOS instructions for summing the 5-point Likert responses for each social-support question. Each social-support score based on the summed questions was then categorised into 1 of 4 quartiles. The maximum score was assigned as the "highest" (Q4) as the reference group, and the remaining distribution was put into tertiles by using gender-specific cut-points to construct the "middle-highest" (Q3), "middle-lowest" (Q2), and "lowest" (Q1) quartiles.

Covariables

Covariables for known confounders[9] included the following: age, age-squared, smoking status (ever/never), province, and education (less than secondary school; secondary school; some postsecondary education including degree/diploma; university degree). Additional covariables for sensitivity analysis included the following: health-behavioural factors (physical activity,[27] alcohol intake, nutritional intake, sleep quality and quantity); psychological factors (depression scale,[28] relevant medications, and life satisfaction); chronic conditions (condition/diseases, relevant medications used, and health-related quality of life); weight status (body mass index [kg/m^2], waist circumference); Indigenous status; and women's reproductive status (number of biological children, menopause status, and hormone replacement therapy use).

Statistical analysis

Descriptive statistics summarized sociodemographic characteristics and crude levels of each continuous and binary outcome variable across types of social support, and relevant statistics tested interrelationships among social supports. A series of multivariable linear and logistic models were used to examine which social supports are linked to cardiovascular outcomes in women and men. Main associations were adjusted for age, age squared, education, smoking, and province; independent associations were mutually adjusted for the other ties and confounders. However, due to the high multicollinearity between social supports (variance inflation factors > 5), we used principal component regression models to analyze the *independent* associations.[29] This analysis consists of 3 main steps: (i) obtain principal components (PCs) on correlated covariates (functional ties here); (ii) fit a regression model on PCs and other independent covariates; (iii) transform the estimated coefficient of the PCs in the model back into the coefficient of the original correlated predictors by using the PCs' scores. To reduce multicollinearity between the correlated covariates, and therefore obtain more reliable coefficients estimates, a subset of PCs was used in step ii. We used the root mean squared error of prediction (RMSEP) and R^2 to determine how many PCs should be excluded (usually the last one or two PCs) from the regression model in step ii.[30] Gender-specific estimates were obtained by stratifying on self-reported male or female gender; results are reported as odds ratios (ORs) or adjusted means, with a 95% confidence interval (CI). Sensitivity analyses tested the robustness of the independent associations to additional confounding. Analyses were carried out using R 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Our sample was 51% women, with an average age of 62.8 years (standard deviation = 10.2; Table 1; gender-specific in Supplemental Table S1). Almost half (46%) had obtained a bachelor's degree, one third were nonsmokers (32%), and approximately half had hypertension (49.2%). Those with the highest perceived availability of social support had the lowest prevalence of hypertension and lower levels of SBP (but not DBP), although the magnitudes for each of the different types of social support varied.

Main and independent associations of social supports with blood pressure, by gender

In covariable-adjusted models, the mean levels of SBP appeared to be higher, with higher levels of each type of social support in women, but they varied among quartiles of support in men, with a clear inverse association only for perceived emotional support (Fig. 1). Patterns of associations changed, especially for women, after considering each type of support independently of the other types. The independent associations for each type of social support showed a strong inverse trend of lower levels of SBP being associated with higher levels of support in women and also in men (Fig. 1). In both women and men, the largest differences in mean SBP were observed in relation to informational support (2.43 and 1.18 mm Hg, respectively) and then emotional support (1.60 and 0.74 mm Hg, respectively). By contrast, adjusted mean levels of DBP did not appear to be associated with any type of social support in either women or men in models of both main (covariable-adjusted) and independent (plus other types of support-adjusted) relationships (Fig. 2).

Main and independent associations of social supports and hypertension, by gender

Table 2 shows that the lowest amount of the 3 types of social support was associated with higher odds of hypertension in both women and men, after it was conditioned on known confounders. Informational support showed the strongest associations in both women (OR = 1.24 [95% CI: 1.12, 1.36]) and men (OR = 1.14 [95% CI:1.04, 1.25]), followed by emotional support and then belonging support (Table 2). After mutually adjusting for multiple types of social support, the odds of hypertension were significantly greater in both genders reporting the lower quartiles of informational support (OR = 1.20 [95% CI: 1.06, 1.36] in women [Q1]; OR = 1.16 [95% CI: 1.03, 1.32] in men [Q1]) and emotional support (OR = 1.08 [95% CI: 1.00, 1.17] in women [Q1] and OR = 1.08 [95% CI: 1.00, 1.15] in men [Q2]) relative to the highest quartile.

Table 1. Descriptive characteristics across social supports in Canadian Longitudinal Study on Aging (2012-2015)

Support type and level	Sample size, n	Women	Age, y	Highest education level	Nonsmoker	SBP, mm Hg	DBP, mm Hg	Hypertension*
Total	28,779	14,627 (50.82)	62.73 (10.18)	13,123 (45.60)	9107 (31.64)	120.98 (16.63)	73.87 (9.98)	14,171 (49.24)
Informational[†]								
Highest, Q4 (20)	7650	4024 (52.60)	61.58 (9.87)	4014 (52.47)	2681 (35.05)	120.20 (16.31)	73.99 (9.68)	3454 (45.15)
Middle-high, Q3 (18-19)	5917	3108 (52.53)	62.35 (10.13)	2795 (47.24)	1870 (31.60)	120.76 (16.16)	73.88 (9.93)	2873 (48.55)
Middle-low, Q2 (16-17)	6874	3633 (52.85)	62.53 (10.07)	3096 (45.04)	2158 (31.39)	120.67 (16.79)	73.71 (9.92)	3306 (48.09)
Lowest, Q1 (4-15)	8338	3862 (46.32)	64.23 (10.42)	3218 (38.59)	2398 (28.76)	122.1 (17.05)	73.90 (10.33)	4538 (54.43)
Tangible[‡]								
Highest, Q4 (20)	8685	3827 (44.06)	62.47 (9.81)	4517 (52.01)	2884 (33.21)	120.68 (16.18)	73.97 (9.71)	4190 (48.24)
Middle-high, Q3 (18-19 W; 19 M)	5219	3271 (62.67)	62.66 (10.13)	2295 (43.97)	1694 (32.46)	120.77 (16.57)	73.32 (9.7)	2524 (48.36)
Middle-low, Q2 (16-17 W; 17-18 M)	5872	2968 (50.54)	62.51 (10.29)	2634 (44.86)	1814 (30.89)	121.19 (16.53)	74.07 (10.13)	2878 (49.01)
Lowest, Q1 (4-15 W; 4-16 M)	9003	4561 (50.66)	63.18 (10.49)	3677 (40.84)	2715 (30.16)	121.25 (17.15)	73.97 (10.29)	4579 (50.86)
Emotional[§]								
Highest, Q4 (35)	7125	3552 (49.85)	61.57 (9.88)	3628 (50.92)	2442 (34.27)	120.25 (16.23)	74.02 (9.74)	3238 (45.45)
Middle-high, Q3 (33-34)	5573	2846 (51.07)	62.24 (10.14)	2624 (47.08)	1826 (32.77)	120.75 (16.11)	73.93 (9.71)	2710 (48.63)
Middle-low, Q2 (29-32 W; 28-32 M)	8325	4034 (48.46)	62.97 (10.24)	3682 (44.23)	2495 (29.97)	121.21 (16.46)	74.02 (9.94)	4157 (49.93)
Lowest, Q1 (7-28 W; 7-27 M)	7756	4195 (54.09)	63.9 (10.29)	3189 (41.12)	2344 (30.22)	121.57 (17.49)	73.54 (10.42)	4066 (52.42)
Belonging[‖]								
Highest, Q4 (20)	8026	3913 (48.75)	61.92 (9.82)	4003 (49.88)	2643 (32.93)	120.65 (16.21)	74.06 (9.68)	3744 (46.65)
Middle-high, Q3 (18-19)	5954	2996 (50.32)	62.76 (10.1)	2673 (44.89)	1891 (31.76)	121.1 (16.28)	74.03 (9.87)	2985 (50.13)
Middle-low, Q2 (16-17)	6916	3689 (53.34)	62.63 (10.22)	3192 (46.15)	2118 (30.62)	120.73 (16.58)	73.75 (9.88)	3319 (47.99)
Lowest, Q1 (4-15)	7883	4029 (51.11)	63.63 (10.51)	3255 (41.29)	2455 (31.14)	121.45 (17.32)	73.68 (10.44)	4123 (52.3)

Values are n (%), except for age, diastolic blood pressure (DBP) and systolic blood pressure (SBP), which are mean (standard deviation).
M, men; Q, quartile; W women.
* Hypertension was determined based on SBP ≥ 140 mm Hg and/or DBP ≥ 90 mm Hg (except patients with diabetes [≥ 130/80 mm Hg]), self-reported diagnosis of hypertension, or use of medication for hypertension. Highest education level: minimum is having a bachelor's degree from a university, or higher.
[†] Information-support levels for men and women: Q4 (20), Q3 (18-19), Q2 (16-17), Q1 (4-15).
[‡] Tangible-support levels for women: Q4 (20), Q3 (18-19), Q2 (16-17), Q1 (4-15); and tangible-support levels for men: Q4 (20), Q3 (19), Q2 (17-18), Q1 (4-16).
[§] Emotional-support levels for women: Q4 (35), Q3 (33-34), Q2 (29-32), Q1 (7-28); and emotional-support levels for men: Q4 (35), Q3 (33-34), Q2 (28-32), Q1 (7-27).
[‖] Belonging-support levels for men and women: Q4 (20), Q3 (18-19), Q2 (16-17), Q1 (4-15).

Further adjustment for other potential confounders minimally altered the results for the independent association between informational support and the odds of hypertension in both women and men. Emotional support remained independently associated with hypertension only after it was conditioned on Indigenous identity (both) or adiposity (women), but not after including health behaviours, psychological factors, chronic conditions, or women's reproductive status (Supplemental Tables S2 and S3). Results of the principal component regression model (standard deviation for each component and rotation of principal component analysis) are given in Supplemental Tables S4-S15.

Discussion

This population-based study assessed the role (main effects) and relative contribution (independent effects) of 4 types of social support for hypertension among older Canadian women and men. Only lack of informational support and lack of emotional support were significantly linked to hypertension, with informational support more strongly associated in women. Additionally, a strong inverse trend was observed between levels of each type of social support and mean SBP that showed a clearer pattern in women, after adjusting for all other types of support. Overall, findings were more consistent in women, and our hypothesis that lack of each type of support was independently associated with hypertension and with stronger effects in women is partly supported by our results. Our significant results of a difference of 1 to 2 mm Hg is congruent with the SBP population increases that are linked to increased-sodium diets, weight gain, and nonsteroidal anti-inflammatory use.[31-33] In addition, previous literature supports the association of a greater risk of CVD with an increase of 2 mm Hg in SBP.[34] These findings may have public health and clinical implications, particularly for interventions using informational support in preventive cardiology. Although the observed differences were small, the variation in SBP associated with informational support in women was comparable to some non-pharmaceutical interventions that have been shown to lead to an estimated population-level decrease of 2 mm Hg SBP.[31-34]

Findings in the context of previous research

Previous studies on social support and blood pressure are difficult to compare because they use a global measure of social relationships (both structure and function), consider only one support type rather than all 4, include younger populations, and/or have very small sample sizes.[11-14,35] Existing research comes mostly from the US,[5,11,13,14,35] and one United Kingdom study.[15]

The clear association between each type of support and mean SBP in women in this study is consistent with findings

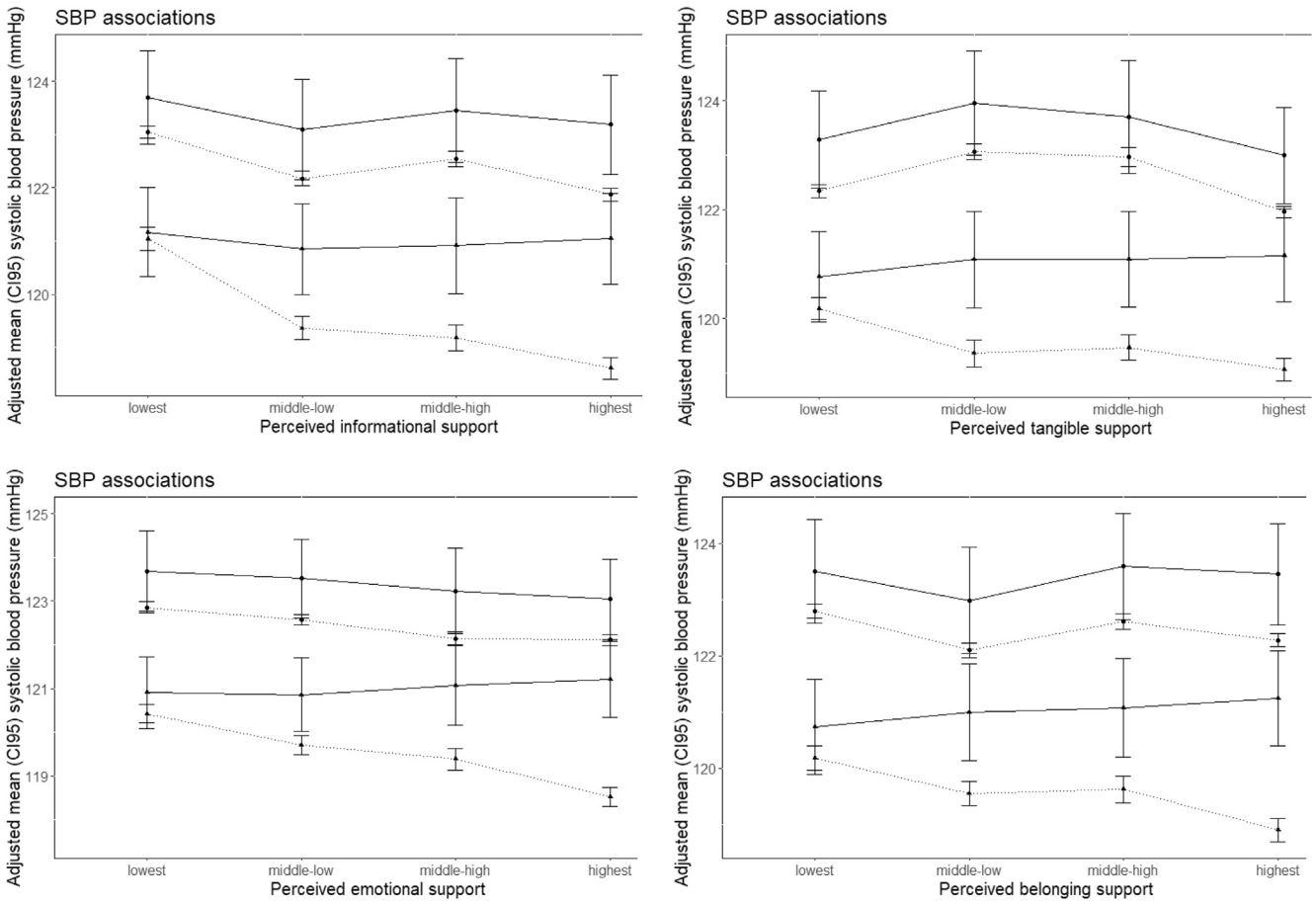

Figure 1. Main and independent associations between types of social support and predicted mean systolic blood pressure (SBP) in older women and men in the Canadian Longitudinal Study on Aging (2015-2019). **Solid lines** are predicted mean values for main associations between social support and SBP (adjusted only for covariables). **Dashed lines** are predicted mean values for independent associations between social support and SBP (adjusted for covariables and all other supports). **Triangle**—women; **circle**—men. CI95, 95% confidence interval.

from a smaller US study of 94 married couples.[35] Although that study showed no significant associations with ambulatory blood pressure using a *composite* index of these 4 types, both informational support and emotional support were significantly associated with ambulatory SBP when analyzed separately (not sex-/gender-specific).[35] The need is clear for investigation of each and all types of social support, noting that the relative contribution of informational support may be clinically relevant. Separate types of social support have been linked to both SBP and DBP in younger-aged (25-50 years) African-Americans, specifically, instrumental and emotional support[12]; and greater emotional support was prospectively associated with lower SBP in 1600 similarly aged seniors (57-91 years) in the US.[5] Notably, the authors measured emotional support as a composite index of parent support, friend support, and school cohesion.[5]

Current literature shows mixed results, with small cross-sectional studies of seniors commonly reporting no significant association between social support and SBP[11] when constructing an index from the Interpersonal Support Evaluation List[36,37] to combine informational, tangible, and belonging types of support.[11] Similarly, the lack of a cross-sectional association between emotional support and hypertension in British older adults is likely due to emotional support being assessed using only 3 questions[15] rather than the 7 included in this study.

Research is very limited on gender-based differences in the role or relative contribution of social support in regard to hypertension. The majority of studies add a covariable for male/female and thus report only overall results.[5,11,12,15] Nevertheless, some limited work has demonstrated stronger or more consistent associations in women, compared with men.[35,38] In US women, both emotional support[35] and instrumental (tangible) support[38] were strongly associated with blood pressure, and emotional support was also linked to men's blood pressure, as in the current study. Neither of these US studies examined other types of support in relation to blood pressure. Key reasons for differences observed between women and men include sex-based differences in physiological pathways connecting social ties with CVD, and gender-based differences in the socialization of girls/women and boys/men.[13,35]

Blood pressure is considered to be one hypothetical pathway through which social support can impact CVD, and there are likely many direct and indirect pathways linking social support to blood pressure, such as lifestyle, psychosocial factors, and biological pathways.[10,12,36,39] Higher social

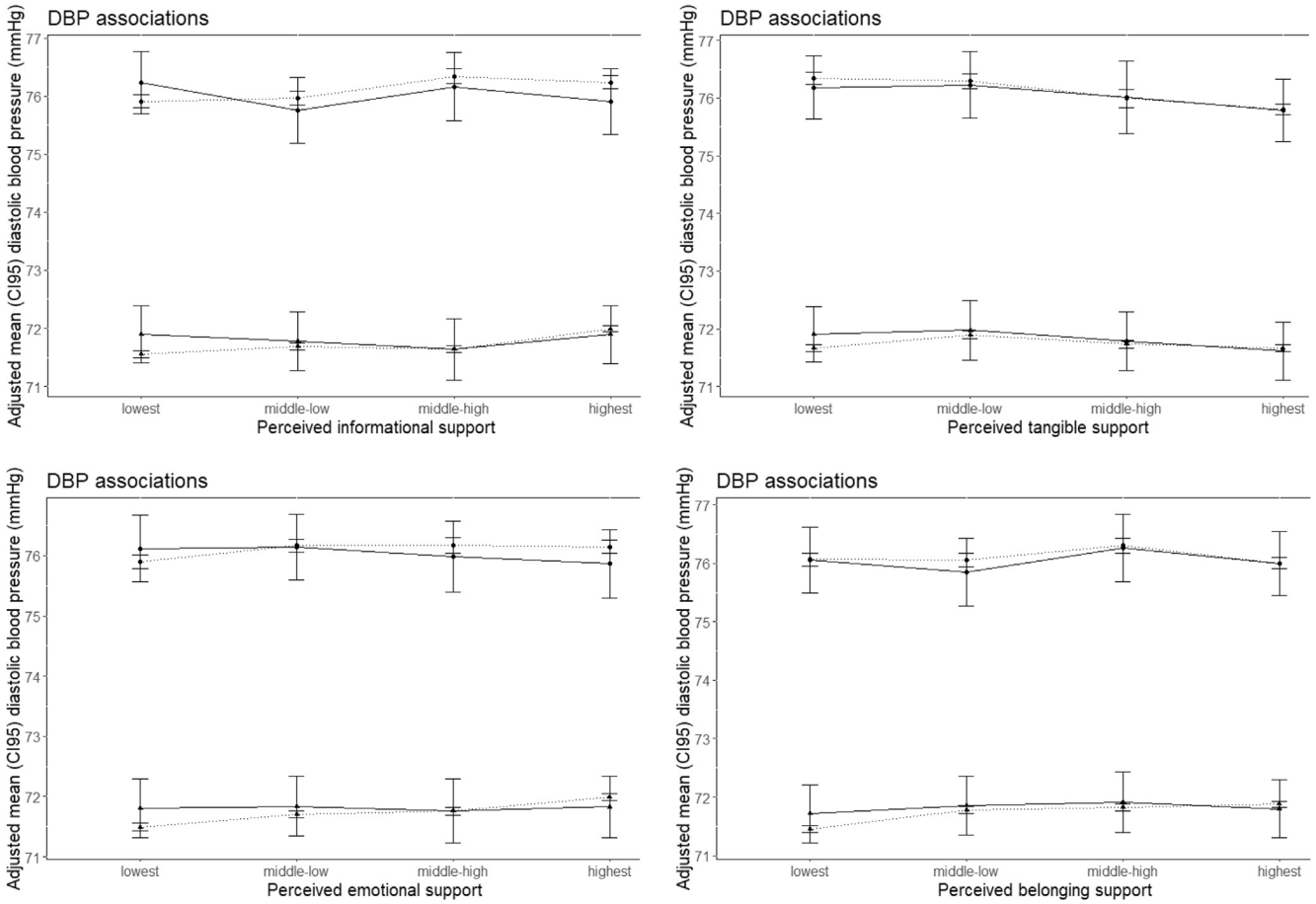

Figure 2. Main and independent associations between social support and predicted mean diastolic blood pressure (DBP) in older women and men in the Canadian Longitudinal Study on Aging (2015-15). **Solid lines** are predicted mean values for main associations between social support and DBP (adjusted only for covariables). **Dashed lines** are predicted mean values for independent associations between social support and DBP (adjusted for covariables and all other supports). **Triangle**—women; **circle**—men. CI95, 95% confidence interval.

support can lead to better lifestyle factors (eg, smoking behaviour, physical activity, adhering to health recommendations or medications) that in turn protect against high blood pressure.[12,39] Lack of social support may result in psychological stress, depression, and anxiety, thereby activating the sympathetic nervous system, the renin–angiotensin system, vasopressin, and atrial natriuretic peptide.[12,36,39] Other stress research has shown that people with lower social support have higher levels of interleukin-6 in response to stressful situations.[40] In fact, the stress-buffering role of social support is among the main hypothesized mechanisms for how social support may impact morbidity and mortality. This hypothesis is explained by the effective role of social support in critical situations, such as illness or loss.[36,39] Equally, more-personal factors, such as genes and personality traits, may play a role in linking social support to hypertension.[39] This hypothesis may also explain the differences among the 4 types of social support in relation to blood pressure. For example, emotional support promotes higher levels of interdependence through psychological features such as affirmation and empathy that affect health.[35] Separately, previous literature has demonstrated the important role of education (informational support) in the management of chronic diseases, including hypertension.[41-43]

Methodological considerations

Our study's cross-sectional design limits any causal inferences relating to these results, and more robust longitudinal research is needed. As an observational study, the current work also carries potential for residual confounding of unmeasured factors; however, our results were robust to multiple sensitivity analyses of a wide range of known confounders. Self-reported data on social support are limited by measurement error and bias, although validated surveys were used in the CLSA; and nonbinary gender information was not collected. Although gender is a multidimensional construct that includes a range of self-identity positions and expressions, the CLSA question asked only "Are you male or female?," so we cannot determine if responses are based on sex assigned at birth and/or gender identity. Given that available data indicate that only 0.4% of American women and men identify their gender as different from their sex,[44] we consider estimates generated based on self-reported sex/gender to accurately represent the experiences of women, compared with men, in Canada. Lastly, our results are generalizable to only White-European populations who are in their middle or older ages who are healthy and living near metropolitan areas in community settings in developed

Table 2. Main and independent associations between social supports and odds of hypertension, by gender, in Canadian Longitudinal Study on Aging (2012-2015)

	Main effects		Independent effects*	
Support type and level	Women	Men	Women	Men
Informational †				
Highest, Q4	Ref	Ref	Ref	Ref
Middle-high, Q3	1.08 (0.98, 1.20)	1.09 (0.98, 1.21)	1.05 (0.95, 1.17)	1.08 (0.97, 1.2)
Middle-low, Q2	1.03 (0.94, 1.14)	1.06 (0.96, 1.17)	1.01 (0.90, 1.13)	1.07 (0.95, 1.2)
Lowest, Q1	**1.24 (1.12, 1.36)**‡	**1.14 (1.04, 1.25)**§	**1.20 (1.06, 1.36)**§	**1.16 (1.03, 1.32)**‖
Tangible ¶				
Highest, Q4	Ref	Ref	Ref	Ref
Middle-high, Q3	1.06 (0.95, 1.17)	1.03 (0.92, 1.16)	1.02 (0.91, 1.14)	0.99 (0.88, 1.11)
Middle-low, Q2	1.10 (0.99, 1.22)	0.99 (0.90, 1.09)	1.04 (0.92, 1.17)	0.93 (0.83, 1.04)
Lowest, Q1	1.10 (1.00, 1.21)	1.03 (0.95, 1.13)	0.97 (0.86, 1.10)	0.94 (0.83, 1.06)
Emotional**				
Highest, Q4	Ref	Ref	Ref	Ref
Middle-high, Q3	1.07 (0.96, 1.19)	**1.11 (1.00, 1.24)**‖	1.05 (0.95, 1.15)	1.08 (0.99, 1.19)
Middle-low, Q2	1.07 (0.97, 1.18)	1.10 (1.00, 1.20)	1.04 (0.97, 1.12)	**1.08 (1.00, 1.15)**‖
Lowest, Q1	**1.18 (1.07, 1.3)**§	**1.13 (1.02, 1.25)**‖	**1.08 (1.00, 1.17)**‖	1.05 (0.97, 1.14)
Belonging ††				
Highest, Q4	Ref	Ref	Ref	Ref
Middle-high, Q3	1.11 (1.00, 1.23)	1.08 (0.98, 1.19)	1.05 (0.93, 1.18)	1.02 (0.91, 1.15)
Middle-low, Q2	1.03 (0.94, 1.14)	1.00 (0.91, 1.10)	0.94 (0.83, 1.07)	0.93 (0.81, 1.06)
Lowest, Q1	**1.16 (1.06, 1.28)**§	**1.10 (1.00, 1.21)**‖	1.00 (0.87, 1.16)	1.01 (0.87, 1.18)

Gender-specific odds ratios (95% confidence interval) estimated by multivariable logistic regression analysis of sample (women: n = 14,627; men: n = 14,152), adjusted for age, age^2, education, smoking, and province. Boldface indicates significance.

Q, quartile; Ref, reference.

* The principal component regression model was used to eliminate multicollinearity between 4 types of social supports in the analysis of independent effects.

† Information-support levels for men and women: Q4 (20), Q3 (18-19), Q2 (16-17), Q1 (4-15).

‡ $P < 0.001$.

§ $P < 0.01$;

‖ $P < 0.05$

¶ Tangible-support levels for women: Q4 (20), Q3 (18-19), Q2 (16-17), Q1 (4-15); and tangible support levels for men: Q4 (20), Q3 (19), Q2 (17-18), Q1 (4-16).

** Emotional-support levels for women: Q4 (35), Q3 (33-34), Q2 (29-32), Q1 (7-28); and emotional-support levels for men: Q4 (35), Q3 (33-34), Q2 (28-32), Q1 (7-27).

†† Belonging-support levels for men and women: Q4 (20), Q3 (18-19), Q2 (16-17), Q1 (4-15).

countries.[45] This study is strengthened by the following: use of objective measures of blood pressure, the larger sample size, the gender-sensitive analysis, the measurement of 4 types of social support, multiple covariable adjustment and robustness checks, and the analysis of independent associations, not only main effects.

Our study of over 28,000 women and men in the middle- or older-age group indicated that different types of perceived social support may be important preventive factors for cardiovascular health, especially in women. Both informational support and emotional support were linked to lower odds of hypertension, with stronger associations in women for informational support. Novel insights can inform future research to improve CVD prevention and clinical management of hypertension.

Data Availability Statement

Due to privacy and confidentiality requirements, data can be made available only for researchers who meet the criteria for access. See the Canadian Longitudinal Study on Aging (CLSA) website, https://www.clsa-elcv.ca/data-access, for details. Although all authors had full access to all the data in the study, Z.H. takes responsibility for data integrity and analysis.

Disclaimer: The opinions expressed in this manuscript are the authors' own and do not reflect the views of the Canadian Longitudinal Study on Aging.

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Disclosures

The authors have no conflicts of interest to disclose.

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Supplementary Material

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