



# The sociodemographic characteristics and social determinants of visual impairment in a homeless population in the Montreal area

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## Abstract

**Objective** Homelessness is a serious social and public health concern in Canada. Individuals experiencing homelessness face numerous health problems and barriers in accessing health services. Visual impairment can exacerbate the lower quality of life experienced by people who are homeless, but its incidence among this population has been poorly documented in the literature. Our study aimed to describe health and sociodemographic characteristics and determine their association with visual impairment, ocular pathology and uncorrected refractive errors in a homeless population in Montreal, Canada.

**Methods** This cross-sectional study was conducted between May 2019 and September 2020 in eight homeless shelters selected using a stratified random sampling approach on the island of Montreal. An eye examination was performed on all participants, who were also administered a survey on social determinants of health. Descriptive analysis was used to analyze survey data, and logistic regression was used for each of the three study outcomes.

**Results** A total of 124 individuals experiencing homelessness (93 men, 31 women) were recruited. Participants were mostly Caucasian (> 70%) with an average age of 48 years (standard deviation = 13 years). Our sample reported a high level of education (68% had a high school diploma or higher), a high level of health insurance coverage (77%), social assistance benefits (71%), and social support (over 50%). There was a high prevalence of chronic conditions including diabetes (14%), hypertension (25%), and HIV/AIDS (3%). Results from eye examinations showed a high prevalence of visual impairment (22%), ocular pathology (23%), and uncorrected refractive error (75%). Age was statistically significantly associated with each outcome variable.

**Conclusion** Despite a high level of social and health support, individuals experiencing homelessness in Montreal, Canada, experience high levels of chronic conditions and visual impairment. Our study highlights the unmet need for eye healthcare among homeless populations, and that eye health can be a unique entry point for intervening with homeless populations.

## Résumé

**Objectif** L'itinérance est un problème social et de santé publique important au Canada. Les personnes en situation d'itinérance font face à plusieurs problèmes de santé et d'accès aux soins de santé. La déficience visuelle est un problème de santé moins documenté chez cette population, mais qui peut grandement nuire à la qualité de vie. Notre étude visait à décrire les caractéristiques sanitaires et socio-démographiques et à déterminer leur association avec la déficience visuelle, les pathologies oculaires et les erreurs de réfraction non corrigée, dans une population d'itinérants à Montréal, au Canada.

**Méthodologie** Une étude transversale a été réalisée entre mai 2019 et septembre 2020 auprès de 8 refuges pour itinérants à Montréal, sélectionnés par échantillonnage aléatoire stratifié. Les participants ont tous reçu un examen de la santé oculo-visuelle et il leur a été administré un questionnaire sur les déterminants sociaux de la santé. Une analyse descriptive a été utilisée pour analyser les données de l'enquête et une régression logistique a été utilisée pour chacun des trois variables dépendantes.

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**Résultats** Au total, 124 itinérants (93 hommes, 31 femmes) ont participé à l'étude. Les participants étaient caucasiens (>70 %) avec un âge moyen de 48 ans ( $\pm 13$  ans). Notre échantillon a déclaré un niveau d'éducation élevé (68 % avaient un diplôme d'études secondaires ou plus), un niveau élevé de couverture d'assurance maladie (77 %), d'aide sociale (71 %) et de soutien social (plus de 50 %). La prévalence des maladies chroniques était importante, notamment le diabète (14 %), l'hypertension (25 %) et le VIH/sida (3 %). Il y avait aussi une prévalence élevée de déficience visuelle (22 %), de pathologies oculaires (23 %) et d'erreurs réfractives non corrigées (75 %). L'âge était significativement associé à chacune des 3 variables dépendantes.

**Conclusion** Malgré un niveau élevé de soutien social et de santé, les itinérants de Montréal font face à un niveau élevé de maladies chroniques et de déficience visuelle. Notre étude met en évidence le niveau élevé des besoins non comblés en matière de soins de santé oculaire parmi les populations itinérantes, et le fait que la santé oculaire peut être un point d'entrée unique pour intervenir auprès de ces populations.

**Keywords** Homeless · Homelessness · Health · Visual impairment · Social determinants of health · Montreal · Canada

**Mots-clés** Itinérants · situation d'itinérance · santé · déficience visuelle · déterminants sociaux de la santé · Montreal · Canada

## Introduction

Approximately 235,000 Canadians experience homelessness each year, and recent studies suggest that this number may be increasing, particularly among younger age groups, due to lack of affordable housing and an economic shift towards low-wage, insecure employment (Employment and Social Development Canada, 2019; Gaetz et al., 2016; Strobel et al., 2021). While homelessness itself is an important social and human rights issue, it is also associated with a number of deleterious health implications. Individuals experiencing homelessness in Canada encounter numerous barriers to good health including lower socioeconomic status, sleeping outside or in crowded shelters (thereby increasing disease transmission), lack of a strong social support system, and insecure diet and/or inadequate nutritional intake. Compounding the problem is the fact that they face increased difficulties in accessing healthcare, as they may lack current health insurance coverage, have limited access to transportation, and fear stigmatization from healthcare providers (Campbell et al., 2015; Homeless Hub Public Health Care and Service Delivery Canadian Observatory on Homelessness, n.d.; Ramsay et al., 2019). Previous studies in Canadian cities including Toronto and Winnipeg have demonstrated that, compared to the general population, homeless populations are at greater risk for hepatitis C, asthma, diabetes, cardiovascular issues and arthritis (Homeless Hub Public Health Care and Service Delivery Canadian Observatory on Homelessness, n.d.). They are also at greater risk for mental health issues and substance abuse (Hwang, 2001; Peragallo et al., 2013; Picking & Kendall, 2016).

One area of health and well-being often overlooked among homeless populations is that of visual impairment (VI). VI is when a person has problems with vision upon examination, such as loss of visual acuity (VA) or loss of visual field, that can or cannot be corrected to a "normal" level (Centers for

Disease Control and Prevention, 2020). According to the World Health Organization (World Health Organization, 2021), approximately 2.2 billion people worldwide suffer from some form of VI, and over 1 billion of these cases are preventable. VI may be due to uncorrected refractive errors, cataracts, age-related macular degeneration, glaucoma, or diabetic retinopathy and is associated with reduced quality of life, decreased mobility, reduced independence, poor mental health, and increased risk of injury and falls (Morelli et al., 2018; Welp et al., 2016; World Health Organization, 2021).

Due to their higher burden of disease and poor lifestyle factors, homeless populations may be at greater risk of VI. Many of the chronic diseases for which they are at increased risk, including diabetes, hypertension, heart disease, hepatitis and respiratory conditions, are associated with visual problems (Centers for Disease Control and Prevention, 2020). Evidence suggests that the prevalence of VI may also be unusually high among homeless populations, even in countries with universal healthcare systems. In Germany, an estimated 32% of the homeless population have eye problems such as cataracts, optic nerve atrophy and amblyopia (Pitz et al., 2005). In the United Kingdom, an estimated 14% of the homeless population have eye health problems, compared to 1% of the general population (Homeless Link, 2014). Similar findings are emerging within Canada. A 2015 study in Toronto found that 34% of homeless participants had at least one abnormal finding from their eye examinations, and over 25% had a functional visual disability, four times higher than the rate for the general North American population (Noel et al., 2015). Similarly, a recent study in Montreal found that the male homeless population had four times the prevalence of VI compared to the general Canadian population (Yelle et al., 2022).

As one of Canada's largest urban centres, Montreal (in the province of Quebec) is home to a large homeless population with recent estimates set at over 3000 individuals (Latimer &

Bordeleau, 2019). However, most studies on the health of homeless populations in Canada have been based in the cities of Toronto and Vancouver. Although the city of Montreal conducted a study enumerating individuals experiencing homelessness across the city and assessing sociodemographic characteristics such as ethnicity and sexual orientation (Latimer & Bordeleau, 2019), many dimensions pertaining to their health and well-being were not captured. There is still a dearth of research examining the social determinants of health and health status, including VI, in homeless populations in Montreal, especially women experiencing homelessness.

This study focuses on the male and female homeless population in Montreal and pursues three objectives: (1) to describe sociodemographic characteristics, self-reported health condition, and psychoactive substance use; (2) to calculate the prevalence of VI, refractive errors, and ocular pathologies; and (3) to explore the associations between health conditions, psychoactive substance use and sociodemographic characteristics on one side, and the prevalence of VI, refractive error and ocular pathologies on the other side.

## Methods

### Study design and recruitment

To conduct this cross-sectional study, we first piloted our protocol in April 2019 at a homeless shelter for men in Montreal to validate the feasibility of the research (e.g. time, procedure for eye examination and survey) and adapt the survey instrument. We then proceeded to recruit individuals experiencing homelessness from eight homeless shelters (four men's shelters, three women's shelters, and one mixed shelter) on the island of Montreal. Male participants were recruited from shelters between May and August 2019, while female participants were recruited between June 2019 and September 2020. Shelters were recruited using a simple stratified sampling approach, where we constructed a list of male and female homeless shelters in the Montreal area. In each list, shelters were randomly selected to be approached, using weighted probability based on the maximal capacity of each shelter. We first contacted these shelters by e-mail or telephone to explain the study and invite them to participate. The first eight shelters that were approached gave their consent at first contact, and there was thus no need to go further down our randomized list. Once a shelter representative gave consent, we discussed with each shelter the optimal way to randomly recruit participants based on their internal operations. For example, in some shelters, every third person in the queue for daily admission was approached and explained the objectives and nature of the study, irrespective of their health or visual needs. In order to be eligible to participate, individuals had to be over the age of

18 years, not employed by the shelter, and able to communicate in English or French. Individuals who could not speak English or French or who were unable to give free and informed consent were excluded. Because our recruitment of female participants mainly took place during the COVID-19 pandemic amid various containment measures, it was difficult to recruit a higher number of women. The tenets of Helsinki were observed, approval for research ethics was obtained from the Comité d'éthique de la recherche clinique from Université de Montréal, and all participants gave their informed consent prior to participating.

### Clinical and survey procedures

On the scheduled date and time of data collection, the research team would arrive at the shelter and set up the necessary equipment in a private room. Data collection consisted of a comprehensive eye examination and a short survey that took approximately 10 min to administer, as described in a previous work of ours (Yelle et al., 2022). The eye examination was administered by co-author BI, a qualified optometrist and professor of optometry at the Université de Montréal, along with co-authors BY, KB, SE and DS, fourth- and fifth-year supervised optometry interns at the Université de Montréal. The following tests were administered: distance and near visual acuity (measured using an LED ETDRS chart and pinhole as needed), pupillary reflexes (to assess for optic nerve or oculomotor nerve damage), a biomicroscopy (to assess the health of the anterior segment and to rule out cataracts), Perkins tonometry (to assess intraocular pressure and glaucoma risk), a confrontation visual field (to detect gross central and peripheral vision anomalies), an assessment of the posterior pole (under pupil dilation, using 1% tropicamide, and slit lamp ophthalmoscopy) and the use of an autorefractometer (to assess for refractive errors in post-mydriatic state).

The survey covered three areas representing potential risk factors for VI: (1) socioeconomic and demographic characteristics, (2) health conditions, and (3) substance use. Trained research assistants with previous experience in quantitative research and who are doctoral candidates within the Université de Montréal's School of Public Health administered the survey, using the platform Hosted in Canada Surveys (<https://www.hostedincanadasurveys.ca/>), by reading each question from a tablet and then logging participants' responses. Wherever possible, relevant questions were taken from the Canadian Community Health Survey or other questionnaires previously developed and used (Bradley et al., 2014; Homeless Link, 2014; Institut de la statistique du Québec, 2001; Statistics Canada, 2019). For socioeconomic and demographic characteristics, the survey included questions on age, ethnicity, Indigenous identity, highest level of education obtained, enrollment in both Medicare and welfare, and levels of social support. For health

conditions, participants were asked whether they had ever been diagnosed with diabetes, hypertension, HIV/AIDS or cardiac problems, and if they were currently being treated with medication for any of these conditions. Participants were also asked to rate their perceptions of their own physical and mental health. Finally, participants were also asked how many meals and snacks they had eaten per day, on average, for the previous week, as a proxy for nutritional intake. Regarding substance use, participants were asked about their cigarette, alcohol and drug consumption, including frequency and amount of consumption and types of substances used. For alcohol, we recorded how much alcohol each participant consumed on an average day and then converted this to standardized units (Éduc'alcool, n.d.). We then classified these amounts into the following categories: none, light to moderate consumption (1–2 units/day), heavy consumption (3–4 units/day) and binge drinking (5 or more units/day) (Abel et al., 1998). For cigarette usage, we asked participants how many cigarettes they smoked on a typical day and then classified this information into the following categories: non-smoker, light smoker (1–10 cigarettes/day), moderate smoker (11–19 cigarettes/day) and heavy smoker (20 or more cigarettes/day) (Government of Canada, 2008).

Upon completion of the study protocol, each participant was given a summary of their ocular health status and given a \$10 CAD gift certificate to a local chain of coffee shops. If a participant had any ocular pathology, they were referred to the appropriate resource (i.e. ophthalmology, general medicine). For the participants with uncorrected refractive errors or other primary eye care needs, follow-up visits were organized with the Université de Montréal's mobile outreach optometry clinic, *Regard Collectif* (Tousignant, 2018), for primary eye care and refractive services. If the participants required secondary or surgical care, they were referred to local hospital ophthalmology departments, facilitated by case workers in each shelter.

## Study outcomes

Results from the eye examinations were then used to calculate the three dependent variables: visual impairment, presence of refractive errors, and presence of eye diseases (i.e. ocular pathologies). The definitions used for levels of VI were the criteria based on the presenting VA of the best eye, from the 11th International Disease Classification (World Health Organization, 2018): mild (presenting VA < 20/40), moderate (presenting VA < 20/60), severe (presenting VA < 20/200) and blind (presenting VA < 20/400) (World Health Organization, 2018). Refractive error was defined as the presence of myopia (sphere  $\geq 1.00$ D), hyperopia (sphere  $\geq +2.00$ ), astigmatism (cylinder  $\geq -1.00$ D), or presbyopia (near VA < 20/40 with distance VA  $\geq 20/40$ ). Crystalline lens changes decreasing VA to 20/30 or worse were considered to be cataracts. Participants were classified as having glaucoma or

suspected glaucoma if they met any one of the following criteria: intraocular pressure > 21 mmHg in either eye; narrow anterior chamber angles in either eye; any secondary glaucoma signs (pigment dispersion, pseudoexfoliation and angle neovascularization); cup-to-disc ratio > 0.7 vertically in one eye; Drance hemorrhage; and visible glaucomatous alterations of the neuro-retinal rim in either eye. Participants with at least one retinal microaneurysm or any other signs of diabetic retinal changes were classified as having diabetic retinopathy. Stage 3 AREDS criteria were used to diagnose participants with age-related macular degeneration.

## Statistical analysis

Data cleaning and analysis were completed in Stata version 14 and SPSS version 25. Bivariate associations were explored between each of the three binary study outcomes and a set of factors related to sociodemographic characteristics, health conditions and substance use. Selection of these factors as potential covariates was informed by review of existing literature. Chi-square tests, or Fisher's exact test if any cell value was less than ten, were used to identify potentially associated variables (0.1 set as the threshold for statistical significance). Continuous variables (e.g. age, number of cigarettes used) were recoded according to categories commonly used in the literature.

Associations between the factors and the study outcomes were further examined by fitting three separate logistic regression models. A backward stepwise approach was followed; all potential covariates were initially included, then the least significant variable dropped until all remaining variables showed a  $p$  value < 0.1. The relationship with sex of the participants was systematically explored, disregarding the statistical significance. Collinearity and interactions between the variables included in the final models were assessed and ruled out.

## Results

### Socioeconomic and demographic characteristics

A total of 126 individuals (95 men, 31 women) participated; however, two men participated only in the eye exam portion and not the survey portion. Thus, the analyses and results described herein are for 124 individuals (93 men, 31 women). Table 1 presents all findings related to the sociodemographic characteristics of our sample. The average age of our sample was 48.1 years (standard deviation (SD) = 13.14 years, range 18–81 years). The majority of our sample, for both sexes, was Caucasian (77%), with nearly 13% identifying as Indigenous (14% for men, 10% for women). Almost two thirds (64%) of our sample had a high school education or less; however, this proportion was significantly higher among the men than among the women (70% vs. 47%,  $p = 0.015$ ). Nearly 80%

**Table 1** Socioeconomic and demographic characteristics of the participants, by sex

Characteristics		Men		Women		Test of difference <i>p</i> value
		<i>n</i>	%	<i>n</i>	%	
Total		93		31		
Age (years)	18–29	6	6.5	2	6.5	0.896
	30–39	21	22.6	10	32.3	
	40–49	21	22.6	6	19.4	
	50–59	26	28.0	7	22.6	
	≥ 60	19	20.4	6	19.4	
Ethnicity	White/Caucasian	73	78.5	21	72.4	0.633
	Black	8	7.5	5	17.2	
	Mixed	8	8.6	1	3.4	
	Other (Latino, Asian, etc.)	5	5.4	2	6.9	
Self-identifying as Indigenous (status and non-status)		13	14.0	3	9.7	0.895
Education (highest level completed)	Primary or less	35	37.6	5	16.7	0.015
	Secondary	30	32.3	9	30.0	
	Certificate or CEGEP	21	22.6	8	26.7	
	University	7	7.5	8	26.7	
Holds a health insurance card	No	21	22.6	5	16.1	0.317
	Yes—RAMQ (Quebec)	69	74.2	26	83.9	
	Yes—card from other province	3	3.2	0	0.0	
Receives social assistance benefits	No	19	20.4	3	9.7	0.396
	Yes	64	68.8	24	77.4	
	Not eligible (65 years and older)	10	10.8	4	12.9	
Reports having social support for: <sup>¶</sup>	Well-being	58	62.4	15	48.4	0.023
	Important decisions	63	67.7	16	51.6	0.019
	Emergency	65	69.9	20	64.5	0.2
Snack intake (per day)	1	51	55.4	23	76.7	0.082
	2	25	27.2	3	10.0	
	≥ 3	16	17.4	4	13.3	
Meal intake (per day)	1	19	20.4	3	9.7	0.129
	2	36	38.7	10	32.3	
	≥ 3	38	40.9	18	58.1	

<sup>¶</sup> Answer categories are non-mutually exclusive

RAMQ Régie de l'assurance maladie du Québec, CEGEP Collège d'enseignement général et professionnel

of participants had valid public health insurance coverage, and 71% were receiving social assistance (welfare) benefits at the time of the study. The proportion of participants who reported having some sort of social support for their well-being or having someone with whom they could discuss important decisions was significantly lower among women (48% and 52%, respectively) than among men (62% and 68%, respectively). Finally, ~ 45% of participants reported having three meals a day.

## Health conditions

Findings related to the prevalence of health conditions in our sample are presented in Table 2. There were no statistically significant differences between men and women. Overall,

most participants reported feeling good or very good about their general health (71%) and their mental health (67%). Regarding chronic conditions, the self-reported prevalence of diabetes, hypertension, HIV/AIDS and cardiovascular diseases in our sample was 14%, 25%, 3% and 15%, respectively.

## Substance use

Findings related to substance use are presented in Table 3. The likelihood of reporting current use of alcohol, drug, or tobacco was significantly higher among men than among women. The majority of participants engaged in some form of substance use occasionally to regularly, with 66% of participants drinking alcohol, 56% using

**Table 2** Self-reported health conditions by the participants, by sex

Health status		Men		Women		Test of difference <i>p</i> value
		<i>n</i>	%	<i>n</i>	%	
Total		93		31		
Self-perceived physical health	Poor	27	29.7	8	27.6	0.167
	Good	30	33.0	5	17.2	
	Very good/excellent	34	37.4	16	55.2	
Self-perceived mental health	Poor	29	31.5	11	39.3	0.742
	Good	27	29.3	7	25.0	
	Very good/excellent	36	39.1	10	35.7	
Diabetes mellitus	No	77	84.6	25	92.6	0.287
	Yes	14	15.4	2	7.4	
Systemic hypertension	No	65	73.0	23	79.3	0.500
	Yes	24	27.0	6	20.7	
HIV/AIDS	No	86	96.6	30	96.8	0.969
	Yes	3	3.4	1	3.2	
Cardiovascular condition	No	77	84.6	25	86.2	0.834
	Yes	14	15.4	4	13.8	

illicit drugs, and 71% smoking cigarettes. Compared to women, men were significantly more likely to binge drink (44% vs. 13%), to use illicit substances (63% vs. 32%) and to smoke every day (66% vs. 46%). The three types of drugs most frequently used by both male and female participants were cannabis, cocaine and amphetamines.

## Ocular health

Findings related to participants' ocular health are presented in Table 4. The age-sex standardized prevalence of VI, ocular pathology and uncorrected refractive error reached 20%, 24% and 66%, respectively, and were not statistically different in men and women. Men were more likely than women to report having seen an eye care professional in the previous 12 months (19% vs. 3%,  $p = 0.03$ ). When considering the last 2 years for the same outcome, the gap between men and women increased (66% vs. 17%,  $p < 0.001$ ). Finally, a similar proportion of men and women (~ 39%) in our sample reported owning spectacles.

## Factors associated with ocular health

After adjusting for sex, we did not find any significant association between most sociodemographic characteristics, health conditions and substance use, and our dependent variables of visual impairment, ocular pathologies and refractive errors. Age was found to be the only variable statistically significantly associated with the three study outcomes. The risk of VI (OR = 1.79, 95% CI 1.19–2.70), ocular pathologies (OR = 1.63, 95% CI 1.10–2.41) and refractive errors (OR =

2.47, 95% CI 1.55–3.95) increased with age category (final models are displayed in Appendices 1–3). There was no evidence of statistically significant difference between men and women. Visual interpretation of the predicted risk suggests a gradient according to age, especially for the ocular pathologies and refractive errors (Fig. 1).

## Discussion

Our study is one of the first to assess a wide range of socio-demographic characteristics of a homeless population in the city of Montreal, and to examine their relation to the prevalence of visual health problems. More than 60% of our sample were men, which is comparable to the situation in Canada; reports indicate that 50–70% of the homeless population in Canada is male (Employment and Social Development Canada, 2019; Hwang, 2001). The sociodemographic characteristics of the participants of this study are similar to those obtained by Noel et al. (2015) in Toronto, Canada, including the average age (48 years), ethnicity (over 70% Caucasian) and high level of education (high school and above). In our sample, 13% of participants identified as Indigenous, compared to less than 1% of the general Montreal population (Montreal: Service du développement économique, 2018). This over-representation of Indigenous among the homeless is consistent with findings across Canada, where Indigenous persons account for approximately 30% of all individuals experiencing homelessness, compared to just 5% of the general Canadian population (Gaetz et al., 2016). While the prevalence of 13% in our sample is less than 30%, this could be because Indigenous persons may be less likely to frequent

**Table 3** Self-reported use of substances (alcohol, drug, tobacco) among the participants, by sex

Substance use		Men		Women		Test of difference <i>p</i> value
		<i>n</i>	%	<i>n</i>	%	
Total		93		31		
Alcohol consumption (any in last 12 months)	No	28	30.1	18	58.1	0.005
	Yes	65	69.1	13	41.9	
Frequency of alcohol consumption	Never	28	30.1	14	46.7	0.067
	Every month	25	26.9	11	36.7	
	Every week	30	32.3	3	10.0	
	Daily	10	10.8	2	6.7	
Level of daily alcohol consumption	None	28	30.4	18	58.1	0.008
	Light to moderate (1–2 units/day)	12	13.0	6	19.4	
	Heavy (3–4 units/day)	12	13.0	3	9.7	
	Binge drinking ( $\geq 5$ units/day)	40	43.5	4	12.9	
Current illicit drug consumption (any)	No	34	36.6	21	67.7	0.002
	Yes	59	63.4	10	32.3	
History of illicit drug consumption (any)	No	28	29.7	16	51.6	0.027
	Yes	66	71.3	15	49.4	
Past or present consumption of illicit drug <sup>¶</sup>	Cannabis	63	67.7	12	38.7	0.001
	Cocaine	42	45.2	9	29.0	0.207
	Heroin	15	16.1	3	9.7	0.466
	Amphetamine	30	32.3	9	29.0	0.956
	Tranquilizer	14	15.1	2	6.5	0.270
	New psychoactive substances	7	7.5	1	3.2	0.452
	Ecstasy	16	17.2	4	12.9	0.696
	Topic substances	4	4.3	0	0.0	0.382
	Medications non prescribed	11	11.8	1	3.2	0.195
	Current cigarette use	Never	21	22.6	13	50.0
Sometimes		11	11.8	1	3.8	
Everyday		61	65.6	12	46.2	
Current frequency of cigarette use	Non smoker	15	16.1	13	41.9	0.028
	Light smoker (1–10 per day)	27	29.0	7	22.6	
	Moderate smoker (11–19 per day)	12	12.9	2	6.5	
	Heavy smoker ( $\geq 20$ per day)	39	41.9	9	29.0	

<sup>¶</sup> Answer categories are non-mutually exclusive

shelters (Hwang, 2001). This could also explain the predominantly Caucasian nature of our sample; immigrants and refugees may be more likely to live in “hidden homelessness”, such as couch surfing or sharing accommodations with other families, instead of in homeless shelters (Keung, 2012).

Over three quarters (77%) of our sample had a valid health insurance card, a higher percentage than was found in a similar study conducted across three homeless shelters and drop-in centres in Toronto, Canada, where it was less than 50% (Hwang et al., 2000). This high rate of coverage could be related to the high levels of social support we also found among our sample; despite experiencing homelessness, many

reported having people in their lives they could rely on for help. Such help could include navigating the administrative processes of renewing one’s health insurance or applying for a replacement card if it was lost or stolen. A reverse association is also plausible: services for individuals experiencing homelessness may help them to increase their social network. Another possibility is that, compared to Toronto, many homeless services in the city of Montreal are more geared towards longer-term objectives of social reinsertion rather than short-term or emergency shelter interventions (Derworiz, 2021).

Our sample also had a high level of education (68% had completed high school or more), which is comparable to what

**Table 4** Ocular health conditions among participants, by sex

Ocular health conditions	Men		Women		Test of difference <i>p</i> value	
	<i>n</i>	%	<i>n</i>	%		
Total	93		31			
Visual impairment	None	70	75.3	26	83.9	0.588
	Mild	13	14.0	2	6.5	
	Moderate	9	9.7	3	9.7	
	Severe	1	1.1	0	0.0	
Ocular pathology	No	69	74.2	26	83.9	0.270
	Yes	24	25.8	5	16.1	
Uncorrected refractive error	No	20	21.5	11	35.5	0.119
	Yes	73	78.5	20	64.5	
Consulted eye care professional (last 12 months)	No	75	80.6	30	96.8	0.030
	Yes	18	19.4	1	3.2	
Time since last eye examination	Never	12	13.2	4	13.3	< 0.001
	< 2 years	60	65.9	5	16.6	
	≥ 2 years	19	20.9	21	70.1	
Current possession of spectacles	No	56	62.2	18	58.1	0.682
	Yes	34	37.8	13	41.9	

has been observed in Toronto, Canada (Noel et al., 2015). However, this proportion is lower than in the general population in Quebec (84%), a province with one of the lowest tuition fees for post-secondary education in all of Canada (Macdonald & Shaker, 2012; Statistics Canada, 2017). In addition, this may be an over-estimation of the education level of the homeless population in Montreal, as homeless persons who visit shelters may have a higher education than those who remain in the streets (Slomovic et al., 2021).

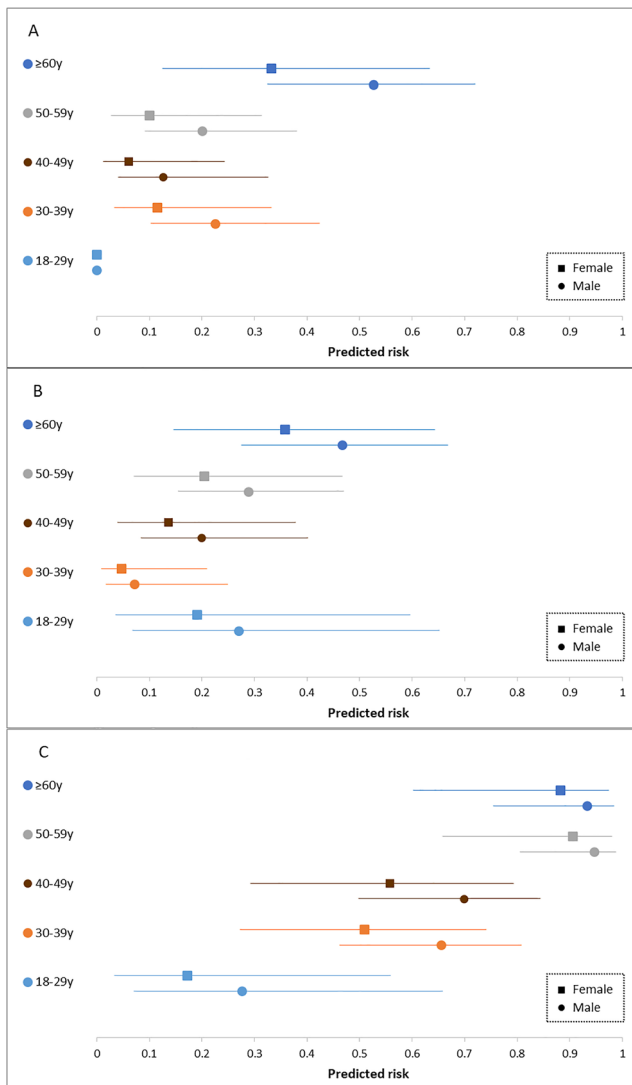
The prevalence rates of chronic health conditions in our sample, including diabetes (14%), hypertension (25%), cardiovascular disease (15%) and HIV/AIDS (3%), are similar to what has been found in other homeless populations in Canada (Employment and Social Development Canada, 2019; Noel et al., 2015) and in the United States (Morelli et al., 2018). When compared with Quebec's general adult population, the prevalence of hypertension was similar (24%) (Blais et al., 2014), but the prevalence of other chronic conditions was higher. Only 7% and 11% of the Quebec population are affected by diabetes and cardiovascular diseases, respectively, while less than 1% of the Canadian population is affected by HIV/AIDS (HIV/AIDS prevalence in Quebec unavailable) (Blais & Rochette, 2018; Challacombe, 2021; Statistics Canada, 2018). The higher likelihood of these chronic conditions in our sample reflects a high prevalence of smoking, inadequate nutrition despite regular meal intake, and substance abuse (including injectables like heroin), as well as other contributing factors such as the daily stress of being without a home. It is noteworthy that the majority of those who reported being affected by these conditions were receiving treatment: 100% for diabetes and HIV/AIDS and 70% for hypertension. This could be partly due to

Montreal's high rate of health coverage and high levels of social support, and the fact that our participants were visitors of homeless shelters, which provide a certain level of stability, support, and referrals to needed services, including healthcare. The untreated burden is arguably larger among the homeless population, given that a high proportion of these conditions remain undiagnosed.

Consistent with what has previously been found in the literature, substance use was higher among male than among female participants (Grinman et al., 2010; Hwang, 2001). While drug consumption combined with excessive alcohol use and cigarette smoking is a well-known risk factor for visual health, there was no strong or significant association between substance use and ocular health in this study. However, it is interesting to note that male participants had a higher prevalence of visual impairment, refractive errors and ocular pathologies than female participants. The high use of cigarettes, drugs and alcohol in the homeless population remains concerning, given these are important risk factors for numerous physical and mental health issues (Sayal et al., 2021).

In terms of eye health, our findings are consistent with those of previous studies of homeless populations that have found an elevated prevalence of VI compared to in the general population (Noel et al., 2015; Sayal et al., 2021; Yelle et al., 2022). In our sample, 20% of participants had some form of VI, compared to 6% of the general Canadian population (Aljied et al., 2018). We also found a high percentage of unmet needs in terms of uncorrected refractive error (66%), which is treatable by the prescription of spectacles. While approximately 40% of the participants reported already owning spectacles, 70% of those who reported not having





**Fig. 1** Predicted risk of each of the three study outcomes by age category and sex. Each panel corresponds to one of the three study outcomes (**A** visual impairment; **B** ocular pathology; **C** refractive error). Predicted risks are derived from a logistic regression model, after performing an inverse logit transformation of the linear predicted probabilities. Predicted risks are displayed with their 95% confidence interval

spectacles were found to need them. This finding is perhaps unsurprising given that one third of participants had not had an eye examination in at least 2 years (or ever). While eye examinations are fully covered for those who have healthcare coverage and welfare benefits, there is an important distinction between having availability and accessibility of healthcare services. Barriers such as fear of stigmatization from healthcare professionals, transportation difficulties, bureaucracy within the public healthcare system, lack of understanding of their rights, and eye health being a low priority for homeless individuals can contribute to this gap (Cernadas & Fernández, 2021; Ramsay et al., 2019). Individuals experiencing homelessness may not seek treatment until an issue incapacitates them, as other survival needs, including food and

shelter, take precedence (Cernadas & Fernández, 2021; Hwang, 2001). As such, in order to reduce health inequities among individuals experiencing homelessness, healthcare delivery, including optometry services, may have to be adapted for and targeted towards such individuals. Potential ideas include mobile health clinics, such as the mobile eye clinic initiated by co-author BI (Tousignant, 2018); shelter-based clinics; or more multidisciplinary approaches involving greater case management, such as the involvement of social workers to facilitate coordination between different health and social issues (Institute of Medicine (US) Committee on Health Care for Homeless People, 1988).

Age was strongly associated with VI, ocular pathologies, and uncorrected refractive errors, which was not surprising since age is one of the most important risk factors in both the general and homeless populations (Ackland et al., 2017; Nia et al., 2003). Surprisingly, no other factor was associated with the study outcomes, including health and socio-demographic characteristics that have been shown to be contributory factors in previous studies (Cumberland & Rahi, 2016; Silverberg et al., 2021). There are several hypotheses that can explain this. First, the effect size of the associations with health and sociodemographic characteristics are modest, and our sample size may not have been large enough to detect them with statistical significance. This was compounded by the characteristics of our sample, too heterogeneous regarding some of these determinants (e.g. education level, food consumption, alcohol and cigarette usage) and too homogeneous regarding others. For example, the predominantly Caucasian nature of our participants made it difficult to detect whether an association exists between ethnicity and visual impairment. Some proxy variables may not have accurately measured what we had intended to measure, especially given the cross-sectional nature of the study. For instance, it is imprecise to assess nutritional deficiencies in a questionnaire, although an accurate assessment would be of high relevance since they can contribute to VI (Lawrenson & Downie, 2019). One variable we did not assess that could be associated with VI is the length of time participants have experienced homelessness, as those who have been homeless or marginally housed for longer may be at higher risk of poor health. Prior to designing our questionnaire, we conducted a literature review to determine what health and sociodemographic factors have been linked with ocular health in homeless populations. Length of homelessness did not emerge as an important factor. However, this could be due to the inherent difficulties in assessing length of homelessness. Homelessness is often not linear or chronic but episodic, with individuals transitioning in and out of homelessness, and it is those experiencing episodic homelessness who are over-represented in shelters (Gaetz et al., 2014).

There are some limitations pertaining to the recruitment of participants. Because participants were specifically recruited from homeless shelters, certain segments of the Montreal

homeless population may have been excluded, such as those who choose to not frequent shelters. This selection bias might have influenced our results; for example, it has previously been found that Indigenous individuals experiencing homelessness are less likely to visit shelters (Hwang, 2001). Furthermore, while every effort was made to adhere to our random sampling approach within each shelter (i.e. every third person in line), some arrangements had to be made at times to work with shelters' own internal logistics and procedures. Finally, as previously mentioned, our recruitment of female participants was hampered by the pre-vaccination phase of the COVID-19 pandemic and our sample of women was smaller than expected.

Nevertheless, our findings are important; not only do they provide a sociodemographic portrait of the homeless population in Montreal, they also highlight the often overlooked issue of VI. Vision plays a key role in many everyday activities of the homeless population, including mobility, reading, facial recognition, getting food, and using the telephone (Welp et al., 2016; West et al., 2002). VI has been associated with depression, anxiety, and lower levels of life satisfaction (Brown & Barrett, 2011). Individuals experiencing VI are also less likely to be employed and, when employed, earn significantly less than their non-visually impaired counterparts (Lennie & Van Hemel, 2002). The unmet need for spectacles we observed is important to highlight, since high VI may increase the risk of trauma and sexual assault and make it increasingly difficult to negotiate food, employment and shelter (Morelli et al., 2018). Having uncorrected eye problems may therefore exacerbate the situation that individuals experiencing homelessness find themselves in, making it increasingly difficult to break through the cycle of poverty and instability. Because eye problems can also serve as red flags for other underlying conditions (e.g. thyroid disease, diabetes, multiple sclerosis), ensuring routine eye examinations among homeless populations could also help promote their overall health and thus quality of life.

Additional studies are required to build upon our findings and provide additional insights. Similar research with larger sample sizes is needed, particularly regarding women experiencing homelessness, as homelessness has long been regarded as a predominantly male issue and research on homelessness has favoured male participants while overlooking gender as an important consideration (Bretherton, 2017; Clarke, 2019). Although logistically challenging, it would be ideal to conduct similar research with individuals experiencing homelessness who do not frequent shelters and to compare their eye health with individuals experiencing homelessness within shelter environments, to determine whether they are at greater risk for eye problems. Finally, based on our finding that the majority of our sample had not visited an eye care professional recently despite having health insurance coverage, research exploring

the barriers to accessing eye care and how to promote eye health as a priority among homeless populations is important.

## Conclusion

This study is one of the few to present a detailed account of the health and sociodemographic characteristics of a homeless population in Montreal, Canada. Our study found high levels of education, health insurance coverage, social assistance benefits, and social support among participants. Despite this, we also found a higher prevalence of chronic conditions including diabetes, cardiovascular problems and HIV/AIDS, as well as an elevated prevalence of VI, compared to in the general Canadian population. There was also a high unmet need among our sample for spectacles. These findings suggest that greater efforts to detect and treat health issues, particularly eye problems, among homeless populations are needed. Additional governmental support for glasses or screening for elderly homeless populations should be a priority.

## Contributions to knowledge

What does this study add to existing knowledge?

- This study is one of the few to present a detailed account of the social determinants of health of a homeless population in Montreal, Canada. While we found high levels of education, health insurance coverage, social assistance benefits, and social support, there was a high prevalence of self-reported substance use and some chronic conditions.
- Self-perceived physical and mental health was poor, and prevalence of visual impairment issues was higher among the participants than among the general population.

What are the key implications for public health interventions, practice or policy?

- There are important unmet needs for spectacles in the homeless population. This is highly problematic because having visual impairment issues exacerbates the situation in which individuals experiencing homelessness find themselves, and increases their risk of trauma, sexual assault, depression and anxiety, and decreases their likelihood of finding work or housing.
- Greater efforts to detect and treat health issues, particularly eye problems, among homeless populations are needed. Since the majority of our sample had not visited an eye care professional recently despite having health insurance coverage, outreach visual health services are essential.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.17269/s41997-022-00676-y>.

**Author contributions** BT and TD conceived the study. MCE, SM, BY, KB, PJ, SE, DS, BT and TD were involved in data collection. BY, KB, PJ, SE, DS and BT conducted clinical examinations. MCE, SM, BT and TD analyzed the survey data. MCE and SM drafted the first version of the manuscript. All authors approved the final manuscript.

**Availability of data and material** All anonymized data can be made available by contacting the corresponding author under reasonable request.

**Code availability** All Stata scripts used for the analyses can be made available by contacting the corresponding author under reasonable request.

## Declarations

**Ethics approval** This study received ethical approval from the University of Montreal's institutional review board (Comité d'éthique en recherche clinique #CERC-19-010-P).

**Consent to participate** All participants gave informed written consent to participate. If the individual could not sign, oral consent was recorded and countersigned by a witness.

**Consent for publication** Not applicable.

**Conflict of interest** The authors declare no competing interests.

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