How healthy is our healthcare workforce?

A cross-sectional study on physical and mental health of Canadian healthcare workers

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Competing interests
The authors declare that they have no competing interests

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Abstract

Background

Quality of patient care is affected by poor health of healthcare workers. However, research and health data are scarce on healthcare workers. We compared the physical and mental health status of Canadian healthcare workers to Canadian population data. We also compared physical and mental health data for healthcare workers in pediatric acute care (PAC) and residential long term care (LTC).

Methods

Our cross-sectional study used the SF-8 Health Survey™ to examine the health status of healthcare workers. In PAC, we surveyed 63 physicians, 747 registered nurses (RNs), 155 allied healthcare providers, 49 nurse educators, and 22 managers. In LTC, we surveyed 169 RNs, 139 licensed practical nurses, 1506 care aides, 145 allied healthcare providers, and 69 managers. After standardizing our data for age and sex, we applied descriptive statistics and analyses of variance, adjusted for multiple testing.

Results

LTC workers and PAC RNs had poorer mental health than the Canadian population. Scores were lowest for LTC RNs (mean difference = -4.4, [95% confidence interval -6.6; -2.6]). Physicians in PAC (4.4, [1.3; 7.5]) and allied healthcare providers in LTC (3.2, [1.1; 5.3]) had better physical health than the general population. We also found important differences in physical and mental health scores for care provider groups within and between care settings.

Interpretation

We found that mental health is especially poor among LTC workers, who care for a highly vulnerable and medically complex population of older adults. We need strategies to improve physical and mental health of healthcare workers, including optimized work environments to improve quality of patient care.

Introduction

As the world's population ages and grows, pressures on physicians and other skilled healthcare workers increase. Care provided in hospitals, and increasingly in non-acute settings such as residential long term care (LTC) facilities, becomes more complex. This generates higher demands both *for* and *on* healthcare workers. Demands are costly on healthcare workers' well-being (e.g., burnout, stress, job dissatisfaction, injury, abuse) and increase risk for both physical and mental health problems.[1-5] Resulting losses in workforce productivity (turnover, poor retention, absenteeism) are substantial costs to the healthcare system.[6-8] Simultaneously, care worker health is linked to safe, high quality patient care.[9-13] Understanding and measuring the health of the healthcare workforce is an initial and necessary aspect of delivering optimal patient care.[14]

We used the SF-8 Health Survey™, a short-form survey based on the longer SF-36, to evaluate and compare physical/mental health status of populations.[15] Most research reporting SF-8 survey data has focused on patient groups, measuring the impact of specific diseases on health status.[16,17] The SF-8 has also been used as a post-intervention outcome measure in specific patient populations (e.g., disease management,[18] exercise programs,[19,20] pharmacological[21-23] and clinical interventions[24,25]). Overall, however, little is known about the health status of our healthcare workers. This paper is the first step in a research program to better understand this gap and to develop and test improvement interventions.

Our primary objective was to describe the physical/mental health status of Canadian healthcare workers and compare it to the health status of the Canadian population.[26] Secondarily, we compared differences in physical/mental health status among healthcare workers in pediatric acute care (PAC) and residential long term care (LTC) settings and among provider groups: physicians, registered nurses (RNs), licensed practical nurses (LPNs), care aides, allied healthcare providers, nurse educators, and managers. Although previous studies reported on similar American[27] and European[28-31] populations, we are the first to report comparisons of (a) various care worker groups in different settings and (b) comparisons of normative data for Canadian physicians and other healthcare workers. Normative data are essential to determine the health status of Canadian healthcare workers, to provide a foundation from which to detect

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variance between sub-groups or between care workers and the general population, and for current

benchmarking.

Methods

Design

This was a cross-sectional analysis of survey data collected from care workers in two healthcare settings,

LTC and PAC. LTC data were collected in the Translating Research in Elder Care (TREC) program,[32] a

pan-Canadian, longitudinal program (2007–2022) of applied health services research. Data used in this

study were collected in TREC's second wave of surveys (07/2009–06/2010). PAC data were collected in

the Translating Research on Pain in Children (TROPIC) program (04/2006–03/2012).[33,34] Data used in

this study were collected between 04/2011 and 08/2011. Both research programs were funded by the

Canadian Institutes of Health Research (CIHR). We compared physical/mental health data collected in

TREC and TROPIC to Canadian normative SF-36 health data published in *CMAJ* in 2000.[26]

Settings and samples

TREC's setting was a representative, randomly selected sample of 30 urban LTC facilities in Canada,

stratified by province (Alberta, Manitoba, Saskatchewan), size category (small: <80 beds, medium: 80–

120 beds, large: >120 beds), and owner-operator model (public not-for-profit, voluntary not-for-profit,

private for-profit).[32] We included survey data from 169 RNs, 139 LPNs, 1,506 care aides, 145 allied

healthcare providers, and 69 managers.

TROPIC's setting were the 15 Canadian tertiary-level pediatric hospitals at the time of the study, 8 of

which were eligible and agreed to participate in TROPIC.[33,34] We included survey data from 63

physicians, 747 RNs, 155 allied healthcare providers, 49 nurse educators, and 22 managers on 32

independent hospital care units.

Measurements and outcomes

All healthcare workers completed online surveys, except care aides who completed computer assisted

structured personal interviews. We measured physical/mental health using the SF-8 Health Survey.[15] The

SF-8 is a shortened version of the SF-36, one of the most widely used health assessment tools.[26] As

demonstrated by its developers[35-38] and confirmed by numerous studies,[39-48] the SF-36 is rigorously

designed and psychometrically robust. The SF-8 measures 8 health domains, each rated using a 5- or 6-

point Likert scale (Table 1).[15] We scored the SF-8 using the proprietary algorithm obtained with the

scale.[15] We first assigned appropriate SF-36 scores, based on general US population data, to each

corresponding SF-8 item response category (Table 1). We then generated two summary scores with a

possible range of 0–100 (higher is better) for physical/mental health, by assigning regression-based

physical/mental weights to each SF-8 domain score and adding a physical or mental health intercept

constant.[15] With these standard scoring methods, SF-36 and SF-8 physical/mental component summary

scores are comparable.[15,49]

[Insert Table 1 about here]

Statistical analysis

We used SAS 9.4 for all statistical analyses. We calculated frequency counts and proportions for

categorical data and means and standard deviations for continuous data. To compare TREC, TROPIC,

and Canadian normative data, we standardized our SF-8 data for age and sex, using the same method

(simple direct standardization) and population (Statistics Canada data from 1999[50]) as a report on

Canadian normative SF-36 data.[26] Specifically, we weighted total means based on underlying population

characteristics. We calculated means, standard deviations, 95% confidence intervals (CIs), and

floor/ceiling effects for each SF-8 health domain, and calculated physical/mental component summary

scores by care provider group and healthcare setting. Floor and ceiling effects are defined as percent of

participants selecting the response option reflecting the worst or best possible health status, respectively.

We compared SF-8 physical/mental component summary scores of all care provider groups in both

settings with corresponding SF-36 scores in the Canadian population.[26] We used analyses of variance

(ANOVA) including pairwise post-hoc comparisons adjusted for multiple testing (Dunnett method).[51-53]

We compared SF-8 health domain scores and physical/mental component summary scores among

healthcare workers within each healthcare setting using ANOVA and including pairwise post-hoc

comparisons adjusted for multiple testing (Tukey-Kramer method).[53-55] Using the same statistical method,

we also compared SF-8 health domain scores and summary scores between both settings for RNs, allied

healthcare providers, and managers.

Ethics approval

We obtained ethical approvals for TREC from the Universities of Alberta (B-051007), Calgary (E-

21379), Saskatchewan (BEH08e165), and Manitoba (E2008:010). Operational approvals were obtained

from all relevant healthcare organizations. Ethical approvals for TROPIC were obtained from the Health

Research Ethics Boards of the appropriate Canadian universities (Pro00003308) and the participating

hospital ethics boards (where applicable).

Results

Our sample (Table 2) included a total of 3,064 healthcare workers (n=2,028 LTC; n=1,036 PAC). RNs

and allied healthcare providers in PAC tended to be younger, better educated, and more experienced than

their counterparts in LTC. Females were overrepresented in all provider groups (81%–96%), except for

physicians (52%).

[Insert Table 2 about here]

Comparison of SF-8 health domain scores within and between LTC and PAC

Table 3 shows the age- and sex-adjusted SF-8 sub-scores by care provider group and study setting. Floor

effects were minimal (zero or almost zero) across SF-8 sub-scores and care provider groups, but ceiling

effects varied substantially. Higher proportions of physicians and managers had maximum SF-8 health

domain scores. RNs in LTC settings had significantly lower age- and sex-adjusted scores for general

health, bodily pain, and mental health than RNs in PAC (Table 4). Allied healthcare providers in LTC had

higher general health and vitality scores and lower mental health scores than their counterparts in PAC.

LTC managers had lower general health scores than PAC managers.

[Insert Table 3 about here]

[Insert Table 4 about here]

Comparison of SF-8 summary scores between the Canadian population and healthcare workers

Compared to the Canadian population (Table 5), physicians and allied healthcare providers had statistically significantly higher overall physical health scores and care aides had lower overall physical health scores. Except for LTC managers, all LTC provider groups had lower overall mental health scores than the Canadian population. The same was true for PAC RNs. Overall, physical and mental health varied substantially among provider groups within each setting (Figure 1).

[Insert Table 5 about here]

[Insert Figure 1 about here]

Legend Figure 1:

Note: 95% CI = 95% confidence interval, Allied = allied healthcare providers, LPNs = licensed practical nurses, LTC = long term care, MD = mean difference (mean for reference minus mean for comparison), PAC = pediatric acute care, RNs = registered nurses

*P values are based on Analyses of variance (ANOVA), including Tukey-Kramer adjusted pairwise post-hoc comparisons

Comparison of SF-8 summary scores within and between LTC and PAC

Allied healthcare providers and managers in LTC had higher physical health scores than care aides and RNs. Physical health scores in allied healthcare providers were also higher than in LPNs (Figure 1A). Mental health scores in LTC were higher in care aides and managers than in LPNs and RNs (Figure 1B). In PAC, physicians and managers had higher physical health scores than RNs and allied healthcare providers (Figure 1C), and physicians had higher mental health scores than allied healthcare providers, RNs, and nurse educators (Figure 1D). Figure 2 illustrates health differences between LTC and PAC settings. RNs' physical and mental health scores were lower in LTC than in PAC, and allied healthcare providers' physical health scores were higher in LTC than in PAC.

[Insert Figure 2 about here]

Legend Figure 2:

Note: 95% CI = 95% confidence interval, Allied = allied healthcare providers, MD = mean difference (mean for long term care minus mean for pediatric acute care), RNs = registered nurses

*P values are based on Analyses of variance (ANOVA), including Tukey-Kramer adjusted pairwise post-hoc comparisons

Interpretation

This is the first study to provide normative (age-/sex-standardized) health data for physicians and other healthcare worker groups in Canada. To the best of our knowledge, this also is the first study to compare healthcare workers' physical/mental health across care settings, and to the physical/mental health of the Canadian general population.

Explanation of findings and comparisons with other studies

In PAC, physicians had higher health scores than RNs and allied healthcare providers. A Spanish study[56] found that physicians had more favourable physical health scores than RNs and other professionals. A Greek study[28] found that physicians and technical staff (mostly engineers) had scores 5–29 points higher than other participant groups in 6 of the 8 SF-36 health domains. An Italian study[30] found that physicians had scores 5–11 points higher than RNs in the social function, role–physical, and bodily pain domains. PAC physicians in our sample also had better physical health than the Canadian general population. Kay et al.[57] note that physicians have lower age- and sex-specific mortality rates than respective groups in the general population, supporting a common belief that physicians have better health than the general population. Conversely, evidence suggests that physicians have equally high or higher rates of physical and mental health problems than the general population.[58,59] However, these studies do not differentiate among physician work settings. We found no studies specifically comparing the health of physicians working in PAC with health of other healthcare workers in PAC, in any other setting, or in the general population.

Allied healthcare workers in LTC and managers in both settings had more favourable health scores than front-line staff providing 24-hour care (RNs, LPNs, care aides) in the respective settings. Allied healthcare workers in LTC also had better physical health than the Canadian population. We found only one study[28] comparing health scores of managers and RNs in acute care settings; manager scores were 3–14 points higher than RN scores in 6 of the 8 SF-36 health domains.

Front-line staff are at particularly high risk for health problems (best documented among nurses).[60,61] In the USA 18% of nurses have depressive disorders compared to 9% of the general population[13] Nurses are at greater risk of musculoskeletal injuries and blood-borne pathogens infections than other healthcare workers,[61] and at greater risk of breast cancer than other female healthcare workers. Nurses working in hospitals have a higher risk of tuberculosis.[61] In our study, nurses physical and mental health scores are lower than those of managers and physicians.

Care aides are unregulated healthcare workers with little formal training.[62-66] About 90% are female, most are over 40 years old, and almost half speak English as a second language.[62,65,66] They often work multiple jobs and most earn less than half the national median annual income.[66] They manage high workloads with frequent interruptions,[67] often encounter verbal/physical aggressive behaviour from residents with dementia,[62,66,68] and are at particularly high risk for job dissatisfaction[69] and burnout.[70] All these factors affect their physical and mental health.[4,71-73] However, while their physical health scores in our study are lower than the ones of LTC allied healthcare providers and managers, they are not significantly different from LTC nurses' physical health scores. Care aides' mental health scores are even higher than the ones of LTC nurses.

Mental health was especially poor in LTC healthcare workers; all groups except managers had lower scores than the Canadian population. LTC RNs had lower scores in both physical and mental health than RNs in PAC. LTC settings are highly stressful work environments. Over 50% of residents need assistance with almost all activities of daily living, at least two thirds have a diagnosis of dementia, and more than 25% meet criteria for marked frailty.[74,75] LTC staff levels and skill sets have not kept pace with increasing resident frailty, increased prevalence of dementia and other chronic conditions, or rising dependency.[76,77]

As a result, LTC staff report increased workloads and decreased quality of work life.[78,79] Care models in PAC and LTC differ in important ways. Most PAC centres embody family-integrated care, with a family member active in the child's care – with positive effects on quality of care, communication between healthcare workers and families, and parental satisfaction.[80,81] Staffing models also differ substantially. Most direct care in acute care settings (including PAC[82]) is provided by RNs or LPNs (average 11.5 nursing hours per patient day).[83] In LTC, at least 80% of direct care is provided by care aides (average slightly over 2 care aide hours per resident day) for a complex and vulnerable population.[84]

Limitations

To compare our data to Canadian normative population-based data, we had to standardize our SF-8 data for age and sex to the same population (Statistics Canada, 1999[50]) to which we compared our data.[26] Our data were collected in 2009–2011, so the population data we used were outdated. Statistics Canada data indicate that the 2011 population[85] was older than in 1999 (31% age 45 years vs. 44%) but otherwise comparable. Using 2011 population data for standardization might slightly alter our results but would prevent comparing our results with the only available normative Canadian population health data. Our analyses are descriptive and our study is cross-sectional, therefore our results show statistical associations but no causality. While we adjusted our analyses for age and sex by standardizing data sets, we did not use statistical models allowing concurrent control for multiple covariates. Future studies must assess predictors and consequences of poor physical/mental health using more advanced statistical methods.

Conclusions

We found important health differences among healthcare worker groups within LTC and PAC. Physicians and managers had better health than front-line care staff (RNs, LPN, care aides). Health is especially poor among front-line staff in LTC, who care for a highly vulnerable and medically, functionally, and socially complex population of older adults (most with dementia).[70,86-88] Mental health of healthcare workers in LTC is notably worse than the general population, and LTC RNs have lower physical and mental health than RNs in PAC. Although most research focuses on patient health or the general population, we cannot neglect healthcare workers in highly complex and stressful environments. Their health affects quality of

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care. Health measures are largely influenced by individual characteristics, but features of work

environments such as available resources, communication, and leadership may also contribute.[69,89] These

contextual work environment characteristics are modifiable and provide starting points for interventions

to improve workplace health and well-being.

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Table 1: Health domains measured by the SF-8, definitions and response options

Health domain	Definition	Response options	Assigned SF-36 score*	SF-8 US norm scores[†]
General health	Overall rating of health in past week	Very poor	22.8	49.4
		Poor	32.6	
		Fair	38.4	
		Good	46.4	
		Very good	52.8	
		Excellent	59.5	
Physical functioning	Extent of physical health problems limiting usual physical activities (e.g., walking, climbing stairs) in past week	Could not do physical activities	21.5	48.3
		Quite a lot	30.3	
		Somewhat	40.1	
		Very little	48.3	
		Not at all	54.1	
Role – physical	Extent of difficulties in past week doing daily work (at home and away from home) because of physical health	Could not do daily work	23.0	48.59
		Quite a lot	28.3	
		Somewhat	38.7	
		Very little	46.9	
		Not at all	54.0	
Bodily pain	Extent of bodily pain in past week	Very severe	25.5	50.0
		Severe	31.5	
		Moderate	40.1	
		Mild	47.7	
		Very mild	53.4	
		None	60.8	
Vitality	Extent of energy in past week	None	28.1	50.1
		A little	35.8	
		Some	45.2	
		Quite a lot	55.6	
		Very much	61.8	
Social functioning	Extent of physical health or emotional problems limiting usual social activities with family or friends in past week	Could not do social activities	23.4	48.5
		Quite a lot	29.5	
		Somewhat	40.4	
		Very little	49.5	
		Not at all	55.3	
Role – emotional	Extent of personal or emotional problems in past week limiting ability to do usual work, school or other daily activities	Could not do daily activities	21.7	47.0
		Quite a lot	29.3	
		Somewhat	38.1	
		Very little	45.7	
		Not at all	52.4	
Mental health	Extent of having been bothered by emotional problems (e.g., feeling anxious, depressed, irritable) in past week	Extremely	21.4	49.0
		Quite a lot	31.6	
		Somewhat	41.5	
		Very little	49.6	
		Not at all	58.8	

*The SF-36 measures each health domain, using 2–10 Likert-scaled items. Health domains in the SF-36 are scored by transforming the score of each item (minimum 1, maximum 2–6, depending on the item) into a 0–100 scale, and averaging scores of each health domain. Therefore, SF-36 health domain scores have a possible range of 0–100, wile SF-8 health domain scores have smaller possible ranges.

[†]Health domain scores above and below the respective normative health domain score indicate above or below average health, respectively, as compared to the US normative population.

Table 2: Sample characteristics by care provider group and study setting

	Physicians (PAC*)	RNs[†] (LTC[‡])	RNs[†] (PAC*)	LPNs[§] (LTC[‡])	Care aides (LTC[‡])	Allied[ǁ] (LTC[‡])	Allied[ǁ] (PAC*)	Educators (PAC*)	Managers (LTC[‡])	Managers (PAC*)
Sample size	N=63	N=169	N=747	N=139	N=1,506	N=145	N=155	N=49	N=69	N=22
Age (years), N (%)										
<25	—	6 (3.6%)	61 (8.2%)	3 (2.2%)	83 (5.5%)	11 (7.6%)	3 (1.9%)	—	—	—
25-34	15 (23.8%)	13 (7.7%)	323 (43.2%)	23 (16.5%)	251 (16.7%)	31 (21.4%)	62 (40%)	14 (28.6%)	5 (7.2%)	3 (13.6%)
35-44	20 (31.7%)	40 (23.7%)	145 (19.4%)	43 (30.9%)	409 (27.2%)	35 (24.1%)	49 (31.6%)	17 (34.7%)	20 (29%)	7 (1.8%)
45-54	14 (22.2%)	47 (27.8%)	156 (20.9%)	42 (30.2%)	471 (31.3%)	46 (31.7%)	32 (20.6%)	15 (30.6%)	20 (29%)	9 (40.9%)
55-65	12 (19%)	48 (28.4%)	58 (7.8%)	26 (18.7%)	270 (17.9%)	20 (13.8%)	9 (5.8%)	3 (6.1%)	24 (34.8%)	3 (13.6%)
>65	2 (3.2%)	15 (8.9%)	3 (0.4%)	—	21 (1.4%)	2 (1.4%)	—	—	—	—
Missing	—	—	*1 (0.1%)*	*2 (1.4%)*	*1 (0.1%)*	—	—	—	—	—
$p_{(LTC\ vs\ PAC)}$[¶]	—	—	**<0.0001**	—	—	—	**0.001**	—	—	0.163
Sex, N (%)										
Male	30 (47.6%)	14 (8.3%)	43 (5.8%)	11 (7.9%)	105 (7%)	17 (11.7%)	21 (13.5%)	5 (10.2%)	5 (7.2%)	1 (4.5%)
Female	33 (52.4%)	152 (89.9%)	703 (94.1%)	126 (90.6%)	1399 (92.9%)	118 (81.4%)	134 (86.5%)	43 (87.8%)	62 (89.9%)	21 (95.5%)
Missing	—	3 (1.8%)	*1 (0.1%)*	2 (1.4%)	2 (0.1%)	10 (6.9%)	—	*1 (2.0%)*	2 (2.9%)	—
$p_{(LTC\ vs\ PAC)}$[¶]	—	—	0.199	—	—	—	0.810	—	—	0.636
Highest education, N (%)										
High school degree or less	—	—	—	—	244 (16.2%)	7 (4.8%)	—	—	—	—
HCA certificate	—	—	—	—	1259 (83.6%)	—	—	—	—	—
Diploma/certificate	—	111 (65.7%)	223 (29.9%)	126 (90.6%)	—	55 (37.9%)	28 (18.1%)	3 (6.1%)	29 (42.0%)	4 (18.2%)
Bachelor's degree or higher	63 (100.0%)	58 (34.3%)	522 (69.9%)	12 (8.6%)	—	83 (57.2%)	127 (81.9%)	46 (93.9%)	40 (58.0%)	18 (81.8%)
Missing	—	—	*2 (0.3%)*	*1 (0.7%)*	*3 (0.2%)*	—	—	—	—	—
$p_{(LTC\ vs\ PAC)}$[¶]	—	—	**<0.0001**	—	—	—	**<0.0001**	—	—	0.128
Job experience, M (SD)										
Years worked on unit/in facility	13.7 (10.9)	6.0 (6.3)	13.4 (10.1)	4.6 (4.7)	5.5 (6.3)	6.3 (7)	12.1 (8.0)	15.3 (9.9)	7.8 (7.8)	17.7 (10.8)
$p_{(LTC\ vs\ PAC)}$**	—	—	**<0.0001**	—	—	—	**<0.0001**	—	—	**0.001**
Years worked in current role	19.4 (12.1)	11.7 (10.8)	14.1 (10.9)	11.7 (11.1)	10.9 (8.9)	8.0 (7.6)	16.9 (9.8)	20.0 (12.4)	7.1 (7.6)	8.7 (6.1)
$p_{(LTC\ vs\ PAC)}$**	—	—	0.012	—	—	—	**<0.0001**	—	—	0.358
Clinical specialty, N (%)										
Critical care	22 (34.9%)	—	319 (42.7%)	—	—	—	80 (51.6%)	21 (42.9%)	—	12 (54.5%)
Medical	17 (27.0%)	—	283 (37.9%)	—	—	—	40 (25.8%)	16 (32.7%)	—	6 (27.3%)
Surgical	24 (38.1%)	—	145 (19.4%)	—	—	—	35 (22.6%)	12 (24.5%)	—	4 (18.2%)
Province										
Saskatchewan	—	53 (31.4%)	—	18 (12.9%)	333 (22.1%)	14 (9.7%)	—	—	12 (17.4%)	—
Alberta	8 (12.7%)	72 (42.6%)	69 (9.2%)	71 (51.1%)	837 (55.6%)	93 (64.1%)	9 (5.8%)	—	26 (37.7%)	5 (22.7%)
Manitoba	16 (25.4%)	44 (26.0%)	80 (10.7%)	50 (36.0%)	336 (22.3%)	38 (26.2%)	20 (12.9%)	5 (10.2%)	31 (44.9%)	2 (9.1%)
British Columbia	10 (15.9%)	—	129 (17.3%)	—	—	—	46 (29.7%)	8 (16.3%)	—	4 (18.2%)
Nova Scotia	17 (27.0%)	—	107 (14.3%)	—	—	—	38 (24.5%)	12 (24.5%)	—	5 (22.7%)
Ontario	3 (4.8%)	—	217 (29.0%)	—	—	—	24 (15.5%)	13 (26.5%)	—	2 (9.1%)
Quebec	9 (14.3%)	—	145 (19.4%)	—	—	—	18 (11.6%)	11 (22.4%)	—	4 (18.2%)

Note: N = number of individuals, % = percent of individuals, M = mean, SD = standard deviation

*PAC = pediatric acute care

[†]RNs = registered nurses

[‡]LTC = long term care

[§]LPNs = licensed practical nurses

[‖]Allied = allied healthcare providers

[¶]Based on a two-tailed Fisher's exact test

**Based on a two-tailed t-test for independent samples

Table 3: Age- and sex-adjusted SF-8 sub-scores by care provider group and study setting

	Physicians (PAC*)	RNs[†] (LTC[‡])	RNs[†] (PAC*)	LPNs[§] (LTC[‡])	Care aides (LTC[‡])	Allied[‖] (LTC[‡])	Allied[‖] (PAC*)	Educators (PAC*)	Managers (LTC[‡])	Managers (PAC*)
General health	N=62	N=168	N=745	N=139	N=1,502	N=144	N=155	N=49	N=69	N=22
M (SD)	54.6 (5.4)	48.0 (6.7)	50.1 (7.4)	51 (6.4)	50.2 (7.5)	51.8 (7.5)	48.8 (8.6)	51 (5.7)	50.3 (5.8)	55.5 (5.1)
95% CI	53.8; 55.4	47.0; 49.0	49.5; 50.7	49.8; 52.2	49.8; 50.6	50.7; 53.0	47.6; 50.0	48.9; 53.1	48.2; 52.3	52.0; 59.1
% ceiling	29.0%	15.5%	13.2%	20.1%	16.0%	18.1%	18.1%	16.3%	27.5%	36.4%
Physical functioning	N=62	N=168	N=745	N=139	N=1,503	N=145	N=155	N=49	N=69	N=22
M (SD)	52.8 (3.4)	49.4 (5.7)	49.3 (6.3)	49.5 (5.4)	49.0 (7.1)	50.9 (5.1)	49.9 (5.7)	49.5 (5.3)	50.5 (5.5)	52.9 (3.0)
95% CI	52.3; 53.3	48.6; 50.2	48.9; 49.8	48.6; 50.5	48.6; 49.4	50.2; 51.7	49.1; 50.7	47.6; 51.4	48.5; 52.5	50.8; 55.0
% ceiling	79.0%	53.6%	50.1%	53.2%	47.3%	53.8%	52.9%	49.0%	65.2%	77.3%
Role – physical	N=62	N=168	N=744	N=139	N=1,502	N=142	N=155	N=49	N=68	N=22
M (SD)	52.1 (4.8)	49.1 (6.0)	50.1 (6.1)	48.5 (6.2)	48.4 (7.7)	50.9 (5.8)	48.2 (7)	50.0 (4.8)	50.7 (5.7)	53.8 (1.1)
95% CI	51.3; 52.8	48.3; 50.0	49.7; 50.6	47.4; 49.6	48.0; 48.8	50.0; 51.7	47.2; 49.2	48.3; 51.8	48.6; 52.7	53.0; 54.6
% ceiling	74.2%	57.7%	55.2%	57.6%	50.3%	58.5%	58.1%	59.2%	66.2%	95.5%
Bodily pain	N=62	N=164	N=745	N=138	N=1,503	N=141	N=155	N=49	N=69	N=22
M (SD)	55.9 (5.4)	47.6 (7.7)	50.7 (7.1)	49.7 (5.7)	50.2 (8.2)	53.4 (7.9)	52.4 (6.9)	50.9 (6.5)	53.2 (6.4)	51.6 (7.3)
95% CI	55.1; 56.7	46.5; 48.7	50.2; 51.3	48.6; 50.7	49.8; 50.62	52.2; 54.6	51.4; 53.3	48.5; 53.2	50.9; 55.5	46.5; 56.6
% ceiling	45.2%	22.0%	19.9%	16.7%	22.4%	24.8%	22.6%	20.4%	30.4%	31.8%
Vitality	N=62	N=169	N=745	N=139	N=1,502	N=143	N=155	N=49	N=68	N=22
M (SD)	54.1 (5.5)	50.8 (7.3)	52.3 (7.1)	50.3 (7.6)	53.8 (7.5)	53.2 (6.3)	48.4 (9.1)	51 (6.3)	55.5 (6.5)	53.5 (5.6)
95% CI	53.2; 54.9	49.8; 51.8	51.7; 52.9	48.9; 51.7	53.4; 54.2	52.2; 54.1	47.1; 49.6	48.7; 53.3	53.2; 57.9	49.6; 57.5
% ceiling	12.9%	17.8%	7.4%	16.5%	27.8%	10.5%	7.7%	4.1%	11.8%	13.6%
Social functioning	N=62	N=166	N=744	N=137	N=1,502	N=142	N=155	N=49	N=69	N=22
M (SD)	52.3 (5.2)	47.2 (6.9)	48.1 (6.9)	46.3 (7.0)	47.3 (8.8)	49.6 (6.9)	48.5 (5.2)	50.0 (5.1)	49.8 (7.3)	51.9 (6.5)
95% CI	51.5; 53.0	46.2; 48.2	47.6; 48.7	45.0; 47.6	46.9; 47.8	48.5; 50.6	47.7; 49.2	48.2; 51.9	47.2; 52.5	47.3; 56.4
% ceiling	46.8%	39.2%	27.6%	35.8%	37.1%	33.1%	34.2%	30.6%	42.0%	59.1%
Role – emotional	N=62	N=169	N=744	N=135	N=1,505	N=141	N=155	N=49	N=69	N=22
M (SD)	50.2 (3.7)	46.5 (6.1)	47.4 (5.8)	47.3 (4.8)	47.2 (6.8)	46.6 (5.5)	46.5 (6.4)	44.7 (6.0)	49.0 (5.1)	50.8 (3.8)
95% CI	49.6; 50.8	45.7; 47.4	47.0; 47.9	46.4; 48.2	49.7; 50.6	45.8; 47.4	45.6; 47.4	42.1; 46.9	47.2; 50.9	48.1; 53.5
% ceiling	59.7%	56.8%	45.2%	51.9%	51.8%	48.9%	52.3%	42.9%	68.1%	72.7%
Mental health	N=62	N=168	N=745	N=138	N=1,504	N=143	N=155	N=49	N=69	N=22
M (SD)	52.9 (4.7)	47.5 (8.1)	49.5 (7.2)	47.4 (7.2)	50.1 (8.3)	47.8 (7.3)	50.6 (6.2)	47.9 (6.3)	50.0 (6.0)	49.8 (8.9)
95% CI	52.2; 53.6	46.1; 48.6	48.9; 50.1	46.0; 48.7	46.8; 47.5	46.7; 48.9	49.7; 51.5	45.6; 50.1	47.8; 52.1	43.6; 56.0
% ceiling	32.3%	35.1%	28.5%	34.8%	41.3%	30.8%	29.0%	28.6%	42.0%	31.8%

Note: N = number of individuals (may differ from sample size reported in table 2 due to missing data), M = mean, SD = standard deviation, 95% CI = 95% confidence interval; % ceiling = percent of participants who selected the response category representing the best possible health status

*PAC = pediatric acute care
[†]RNs = registered nurses
[‡]LTC = long term care
[§]LPNs = licensed practical nurses
[‖]Allied = allied healthcare providers

Table 4: Comparison of age- and sex-adjusted SF-8 sub-scores among care provider groups working in long term care and pediatric acute care settings

	Registered Nurses		Allied Health Providers		Managers	
	MD [95% CI]	*P**	MD [95% CI]	*P**	MD [95% CI]	*P**
General health	-2.1 [-3.7; -0.5]	**0.004**	3.0 [0.8; 5.1]	**0.002**	-5.2 [-9.6; -0.8]	**0.016**
Physical functioning	0.1 [-1.2; 1.4]	1.000	1.0 [-0.7; 2.7]	0.463	-2.4 [-5.8; 1.0]	0.287
Role – physical	-1.0 [-2.3; 0.3]	0.212	2.7 [0.9; 4.5]	**0.001**	-3.1 [-6.6; 0.4]	0.125
Bodily pain	-3.1 [-4.7; -1.5]	**<0.0001**	1.0 [-1.1; 3.1]	0.649	1.6 [-2.5; 5.7]	0.774
Vitality	-1.5 [-3.1; 0.1]	0.066	4.8 [2.7; 6.9]	**<0.0001**	2.0 [-2.1; 6.1]	0.618
Social functioning	-0.9 [-2.4; 0.6]	0.407	1.1 [-0.9; 3.1]	0.496	-2.1 [-5.9; 1.7]	0.513
Role – emotional	-0.9 [-2.2; 0.4]	0.260	0.1 [-1.6; 1.8]	1.000	-1.8 [-5.1; 1.5]	0.521
Mental health	-2.0 [-3.6; -0.4]	**0.006**	-2.8 [-4.9; -0.7]	**0.004**	0.2 [-3.9; 4.3]	1.000

Note: MD = mean difference (mean for long term care minus mean for pediatric acute care); 95% CI = 95% confidence Interval

*Based on analyses of variance (ANOVA), including Dunnett-adjusted post-hoc comparisons of each care provider group with normative data

Table 5: Age- and sex-adjusted SF-8 physical and mental component summary scores by care provider group and care setting, compared to age and sex adjusted SF-36 normative data

				Physical Component Summary Score				Mental Component Summary Score			
	N	M	SD	95% CI	MD [95% CI]	P*	M	SD	95% CI	MD [95% CI]*	P*
Normative data	9,367	50.5	9.0	50.3; 50.7	—	—	51.7	9.1	51.5; 51.9	—	—
Physicians (PAC†)	62	54.9	5.3	54.1; 55.7	**4.4 [1.3; 7.5]**	**0.001**	53.6	5.5	52.7; 54.4	1.9 [-1.3; 5.1]	0.646
RNs‡ (LTC§)	159	49.1	7.3	48.0; 50.2	-1.4 [-3.3; 0.5]	0.363	47.1	9.4	45.7; 48.5	**-4.6 [-6.6; -2.6]**	**<0.0001**
RNs‡ (PAC†)	740	50.9	7.2	50.3; 51.4	0.4 [-0.5; 1.3]	0.925	49.7	8.5	49.0; 50.4	**-2.0 [-3.0; -1.0]**	**<0.0001**
LPNs‖ (LTC§)	131	50.5	6.4	49.3; 51.8	0.0 [2.1; -2.1]	1.000	47.3	8.5	45.7; 48.9	**-4.4 [-6.6; -2.2]**	**<0.0001**
Care aides (LTC§)	1,490	49.7	8.2	49.3; 50.2	**-0.8 [-1.5; -0.1]**	**0.010**	50.6	9.3	50.1; 51.1	**-1.1 [-1.8; -0.4]**	**<0.001**
Allied¶ (LTC§)	131	53.7	7.4	52.5; 54.8	**3.2 [1.1; 5.3]**	**<0.001**	48.5	8.3	47.2; 49.8	**-3.2 [-5.4; -1.0]**	**<0.001**
Allied¶ (PAC†)	155	49.7	8.2	48.5; 50.8	-0.8 [-2.8; 1.2]	0.948	49.3	7.6	48.2; 50.4	-2.4 [-4.4; 0.4]	0.010
Educators (PAC†)	49	51.4	5.6	49.4; 53.4	0.9 [-2.6; 4.4]	0.998	47.6	7.7	44.8; 55.4	-4.1 [-7.7; 0.5]	0.015
Managers (LTC§)	68	52.7	7.0	50.1; 55.2	2.2 [-0.8; 5.2]	0.319	51.5	7.2	48.9; 54.1	-0.2 [-3.3; 2.9]	1.000
Managers (PAC†)	22	55.4	4.0	52.6; 58.2	4.9 [-0.3; 10.1]	0.080	51.1	9.0	44.9; 57.4	-0.6 [-6.0; 4.8]	1.000

Note: N = number of individuals (may differ from sample size reported in table 2 due to missing data), M = mean, SD = standard deviation, 95% CI = 95% confidence interval, MD = mean difference (mean for healthcare worker group minus mean of normative data)

*Based on analyses of variance (ANOVA), including Dunnett-adjusted post-hoc comparisons of each care provider group with normative data
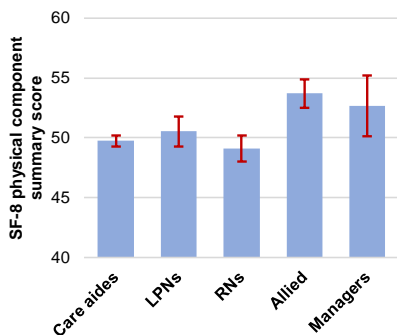
†PAC = pediatric acute care

‡RNs = registered nurses

§LTC = long term care

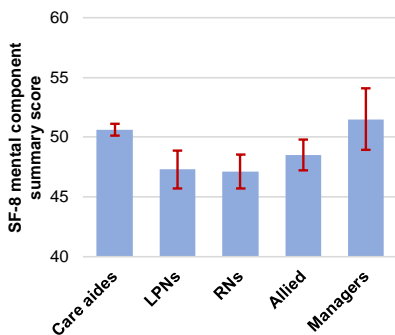‖LPNs = licensed practical nurses

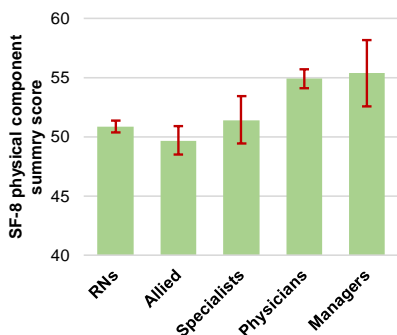¶Allied = allied healthcare providers

A. Physical health LTC

SF-8 physical component summary score — bar chart for Care aides, LPNs, RNs, Allied, Managers

Reference	Comparison	MD [95% CI]	P*
Allied	Care aides	4.0 [2.0; 6.0]	**<0.0001**
	LPNs	3.2 [0.5; 5.9]	**0.010**
	RNs	4.6 [2.0; 7.1]	**<0.0001**
Managers	Care aides	3.0 [0.3; 5.7]	**0.020**
	RNs	3.6 [0.5; 6.7]	**0.015**

B. Mental health LTC

SF-8 mental component summary score — bar chart for Care aides, LPNs, RNs, Allied, Managers

Reference	Comparison	MD [95% CI]	P*
Care aides	LPNs	3.3 [1.0; 5.6]	**0.001**
	RNs	3.5 [1.4; 5.6]	**<0.0001**
Managers	LPNs	4.2 [0.5; 7.9]	**0.018**
	RNs	4.4 [0.8; 8.0]	**0.008**

C. Physical health PAC

SF-8 physical component summary score — bar chart for RNs, Allied, Specialists, Physicians, Managers

Reference	Comparison	MD [95% CI]	P*
Physicians	RNs	4.0 [1.4; 6.6]	**<0.001**
	Allied	5.2 [2.3; 8.1]	**<0.0001**
Managers	RNs	4.5 [0.3; 8.7]	**0.030**
	Allied	5.7 [1.3; 10.1]	**0.004**

D. Mental health PAC

SF-8 mental component summary score — bar chart for RNs, Allied, Specialists, Physicians, Managers
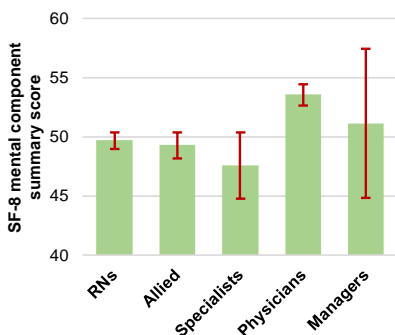
Reference	Comparison	MD [95% CI]	P*
Physicians	RNs	5.7 [2.7; 8.7]	**<0.0001**
	Allied	4.3 [0.9; 7.7]	**0.005**
	Educators	6.0 [1.7; 10.3]	**0.001**

A. Physical health

SF-8 physical component summary score

■ Long Term Care ■ Pediatric Acute Care
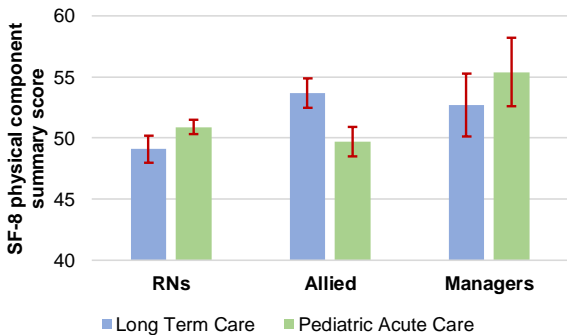
Group	MD [95% CI]	P
RNs	-1.8 [-3.3; -0.3]	**0.012**
Allied	4.0 [1.9; 6.1]	**<0.0001**
Managers	-2.7 [-6.7; 1.3]	0.259

B. Mental health

SF-8 mental component summary score

■ Long Term Care ■ Pediatric Acute Care
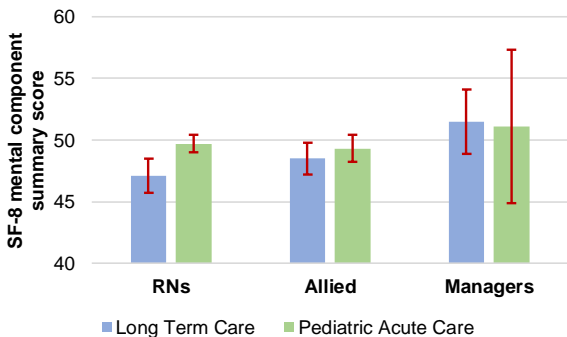
Group	MD [95% CI]	P
RNs	-2.6 [-4.4; -0.8]	**0.002**
Allied	-0.8 [-3.0; 1.4]	0.663
Managers	0.1 [-5.0; 5.2]	1.000

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	✓ (p. 1)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	✓ (p. 2)
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	✓ (p. 3-4)
Objectives	3	State specific objectives, including any prespecified hypotheses	✓ (p. 3-4)
Methods			
Study design	4	Present key elements of study design early in the paper	✓ (p. 4)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	✓ (p. 4)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	✓ (p. 4)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	✓ (p. 4-5)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	✓ (p. 4-5)
Bias	9	Describe any efforts to address potential sources of bias	✓ (p. 4-5)
Study size	10	Explain how the study size was arrived at	✓ (p. 4-5)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	✓ (p. 5-6)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	✓ (p. 5-6)
		(*b*) Describe any methods used to examine subgroups and interactions	✓ (p. 5-6)
		(*c*) Explain how missing data were addressed	✓ (p. 5-6)
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	✓ (p. 6)
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	✓ (p. 6)

		(b) Indicate number of participants with missing data for each variable of interest	✓ (p. 6-7)
Outcome data	15*	Report numbers of outcome events or summary measures	✓ (p. 6-8)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	✓ (p. 6-8)
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	✓ (p. 8)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	✓ (p. 10)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	✓ (p. 8-10)
Generalisability	21	Discuss the generalisability (external validity) of the study results	✓ (p. 8-10)
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	✓ (p. 1)

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.