

Canadian federal penitentiaries as obesogenic environments: a retrospective cohort study

Claire Johnson RD, Jean-Philippe Chaput PhD, Maikol Diasparra PhD, Catherine Richard RD, Lise Dubois PhD

Abstract

Background: Very little is known about how incarceration influences a person's weight in Canada. We sought to determine how inmates' weights change during their incarceration in Canadian federal penitentiaries.

Methods: We performed a retrospective, longitudinal cohort study to examine weight change in Canadian federal penitentiaries. To participate, inmates had to have been incarcerated for at least 6 months at the time of the study. Current anthropometric data were measured or taken from medical records, then compared with anthropometric data from the beginning of incarceration (mean follow-up of 5.0 ± 8.3 yr). We examined 3 outcomes: change in weight (kg), change in body mass index (BMI) and rate of weight change (kg/yr) during incarceration.

Results: A total of 1420 inmates participated in this study. Almost three-quarters (73.0%, $n = 1037$) of participants gained weight during incarceration. Inmates gained a median of 6.2 (95% confidence interval [CI] 5.6–6.9) kg, and BMI increased by 2.0 (95% CI 1.8–2.2). Obesity rates increased by 71%, from 26.6% of participants ($n = 378$) on admission to 45.4% of participants at follow-up ($n = 645$). The proportion of inmates with a BMI in the normal range (18.5–24.9) decreased by 52%. Weight gain was found to be associated with older age, region (Ontario v. Atlantic), ethnicity (Aboriginal inmates showed the highest weight gain), longer incarceration, and longer total sentence. However, weight gain was not associated with sex, feeding system or spoken language.

Interpretation: The Canadian correctional environment can be considered obesogenic, with most inmates experiencing undesirable and rapid weight gain during their incarceration. Rates of obesity increased dramatically during incarceration, and could put inmates at increased risk of obesity-related health problems.

It is well-established that obesity increases the risk of developing noncommunicable diseases such as type 2 diabetes mellitus, cardiovascular disease and certain types of cancer, as well as all-cause mortality.¹ Marginalized groups, such as inmates, carry a disproportionately high burden of obesity, because they are often from vulnerable segments of the population with low socioeconomic status.^{2–4} In 2015, a Canadian study found that 64.5% of inmates were overweight or obese at the beginning of their sentence.⁵ This prevalence is higher than 61.3% for the general Canadian adult population, as measured by the Canadian Community Health Survey in 2015.⁶ Research done in other countries has identified correctional institutions as obesogenic environments, with most inmates gaining weight during incarceration.⁷ However, very little is known on weight changes among Canadian inmates. This is an important knowledge gap, because there are more than 40 000 adults in custody across Canada.⁸ Many correctional physicians anecdotally report weight gain as a substantial problem for inmates, but lack the data to support these claims.⁹ Physicians across Canada are called upon to care for this unique population, because inmates get transferred to community hospitals when their medical condition warrants

it. In the event that an inmate gains weight excessively while incarcerated, the burden of care and associated costs will be increased and assumed by Correctional Service Canada. Once released, after less than 5 years for most inmates,¹⁰ the care and associated costs are covered through provincial health care budgets.¹¹

Obesogenic environments are defined as “the sum of influences that the surroundings, opportunities or conditions of life have on promoting obesity in individuals or populations.”^{12,13} There is increasing recognition that the environment plays an important role in shaping health behaviours, such as eating habits and physical activities.¹⁴ For inmates,

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Correspondence to: Claire Johnson, cjohn127@uottawa.ca

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everything about the prison environment is controlled, including their opportunities to eat and to exercise.⁴ The prison food environment is more controlled than most food environments because inmates eat from the same food service within the penitentiary. In many cases, the kitchen provides a standardized menu to all inmates. The controlled nature of prison provides a unique opportunity to examine weight changes in a homogeneous environment.

The objective of this study was to examine how incarceration influences inmates' weight in Canadian correctional institutions. We hypothesized that inmates would gain weight during incarceration in federal penitentiaries.

Methods

Study design and study population

We performed a retrospective, longitudinal cohort study to investigate whether correctional institutions are obesogenic environments. In 2016 and 2017, we collected data from 1420 inmates who volunteered and who had been incarcerated, for at least 6 months, in institutions in Atlantic Canada and Ontario. We used a convenience sample and offered information sessions with the inmate committee in each of the institutions where we were collecting data to encourage volunteers. In addition, we advertised the study on the prisons' telecommunication services. Inmates were asked to submit their names to a designated staff member in each penitentiary.

We initially drew a random list of inmates who we called down to the office to ask whether they wanted to participate. We had a very low response rate with this approach, because inmates found it stressful to be called to the office without knowing why. Most of the inmates contacted in this way refused to participate. We were more successful when we asked for volunteers. In addition, asking inmates to submit their names to a staff member increased their confidence in the study. We did not keep track of who volunteered and who did not. For ethical reasons, we could not gather data on inmates who did not volunteer to participate because we did not have their consent to access their administrative files. We collected data from 88% of the eligible inmates. Participants were recruited from 5 federal penitentiaries (4 male institutions and 1 female institution) near Kingston,¹⁵ chosen for reasons of geographical feasibility, and from all 5 federal penitentiaries (4 male institutions and 1 female institution) in New Brunswick and Nova Scotia.¹⁵ We excluded provincial institutions from our data collection because they are part of a different governance system and only house inmates for short-term sentences (< 2 yr). Inmates with critical illnesses who were admitted to the prison hospital and inmates who were pregnant were excluded from the study.

We used a standardized protocol to collect anthropometric measurements at follow-up for half of our data. The protocol was performed by trained research assistants as part of a face-to-face interview and was guided by a report from the World Health Organization.¹⁶ Participants' heights were measured while they were standing against a wall, and weights were measured on a scale. Two measurements were taken; a third

was taken if the first 2 measurements showed a significant difference (≥ 0.5 cm for height and > 0.5 kg for weight). The final recorded measurement was the mean of the 2 nearest values.¹⁶ The rest of the anthropometric measurements (at follow-up and at admission) were objectively measured by a health care professional (i.e., a nurse or dietitian) using a similar protocol. Historical data, such as weight and height on admission to the penitentiary, were drawn from participants' electronic medical records. Sociodemographic data (i.e., sex, age, region, language, ethnicity), information about the institution (i.e., feeding system, security level) and details of the inmates' sentences (i.e., length of incarceration, length of total sentence) were drawn from the electronic Offender Management System.

The 3 main outcomes of the study were change in weight (difference between weight at admission and at follow-up), change in body mass index (BMI; difference between BMI at admission and at follow-up), and annual change in weight during incarceration (kg/yr; weight change during incarceration divided by the number of years of incarceration at the time of study). In addition, data on weight and BMI were compared with similar data from Statistics Canada's Canadian Community Health Survey of the general Canadian adult population in 2015⁶ to contextualize our findings.

Statistical analysis

We performed χ^2 and nonparametric median comparison tests (Wilcoxon and Kruskal-Wallis) to detect significant changes in anthropometric data. We used these tests because the data did not have a normal distribution. Statistical analyses were performed using SAS version 9.4, with significance set at $p < 0.05$ for all analyses.

Ethics approval

Our study was approved by the Research Ethics Board at the University of Ottawa and the research branch at Correctional Service Canada. Inmates volunteered to participate and provided their consent. Because many inmates hesitate to sign documents or forms owing to low literacy or fear of reprisal, participants were able to provide verbal consent if they so preferred.¹⁷ All personal data collected were coded to ensure confidentiality.

Results

Table 1 describes our participants, and Table 2 presents the proportion of inmates in each BMI category at admission and at follow-up. On admission to the penitentiary, the combined prevalence of overweight (39.4%) and obesity (26.6%) was 66.0%. During incarceration, the combined prevalence of overweight (38.8%) and obesity (45.4%) increased to 84.2% (a 27.6% increase from admission). The increase in prevalence was mainly due to the 71% increase in inmates who became obese (BMI ≥ 30.0) during incarceration (26.6% obesity on admission v. 45.4% obesity at the time of study). The proportion of inmates with a normal weight (BMI 18.5–24.9) was reduced by about one-half, whereas the proportion of

inmates who were overweight (BMI 25.0–29.9) remained stable.

Table 3 presents data on median weight change, median BMI change, and median annual weight change by sociodemographic factors. The changes are based on the time elapsed between admission and follow-up (mean duration 5.0 $\pm$ 8.3 yr). Overall, inmates gained a median of 6.2 kg. The median BMI increase was 2.0. The annual rate of weight gain was 1.5 kg per year. No significant differences were seen between men and women, or between Francophones and Anglophones. Inmates between 45 and 64 years of age gained more weight (median 7.6 kg) than inmates in other age groups. However, younger inmates, between 18 and 24 years of age, gained weight more rapidly (median 3.5 kg/yr). Regional differences were seen; in Atlantic institutions, although inmates had higher mean BMI on admission compared with those from Ontario (28.2 v. 27.3), they gained less weight (median 5.1 v. 7.1 kg) once incarcerated. Aboriginal inmates were more likely to gain weight (median 7.7 kg) than inmates of other ethnicities.

Table 4 presents data on median weight change, median BMI change and median annual weight change by institutional factors, such as feeding system, length of incarceration, security level and total duration of sentence. Inmates in medium security institutions had a significantly higher increase in weight (median 7.0 kg) than those in minimum or maximum (median 5.6 kg for both) security penitentiaries. However, this difference was not related to the feeding system. Inmates incarcerated for shorter periods (< 18 mo) underwent more rapid weight gain (6.4 kg/yr) compared with inmates incarcerated for more than 5 years (0.64 kg/yr). Inmates with longer sentences (> 25 yr) tended to gain more weight (median 7.7 kg) than inmates with shorter sentences.

The combined prevalence for overweight (34.6%) and obesity (26.7%) for the general Canadian population was 61.3% in 2015 (Appendix 1, available at www.cmajopen.ca/content/6/3/E347/suppl/DC1).⁶ For inmates, the combined prevalence for overweight (39.4%) and obesity (26.6%) was 66.0% on admission to the penitentiary. This discrepancy is due to the higher rates of overweight in inmates on admission. However, during incarceration, the proportion of inmates with obesity became much higher than that seen in the general population (Appendix 1).

Interpretation

Almost three-quarters (73%) of the 1420 participants in our study gained weight during their incarceration. Median weight gain was 6.2 kg, with a median annual weight gain of 1.5 kg per year. In addition, we saw a 71% increase in the proportion of inmates with obesity during incarceration (from 26.6% at admission to 45.4% at follow-up). This excessive weight gain is concerning and could lead to obesity-related health problems for these individuals.

Penitentiaries in Japan have been shown to be less obesogenic than the general community. Most Japanese inmates lost weight, and BMI scores decreased during incarceration.

Table 1: Sociodemographic factors for all participants

Factor	No. (%) <i>n</i> = 1420
Sex	
Male	1276 (89.9)
Female	144 (10.1)
Age, yr	
18 to $\leq$ 24	104 (7.3)
$\geq$ 25 to $\leq$ 34	389 (27.4)
$\geq$ 35 to $\leq$ 44	315 (22.2)
$\geq$ 45 to $\leq$ 64	504 (35.5)
$\geq$ 65	108 (7.6)
Region	
Atlantic	520 (36.6)
Ontario	900 (63.4)
First language	
English	1265 (89.1)
French	155 (10.9)
Ethnicity	
White	904 (63.7)
Black	203 (14.3)
Aboriginal	214 (15.1)
Other	99 (7.0)
Feeding system	
Tray (menu)	393 (27.7)
Cafeteria (menu)	522 (36.8)
Kitchenette (no menu)	505 (35.6)
Security level	
Maximum	348 (24.5)
Medium	781 (55.0)
Minimum	291 (20.5)
Length of incarceration at follow-up	
$\leq$ 18 mo	553 (38.9)
> 18 mo to $\leq$ 5 yr	458 (32.3)
> 5 yr	409 (28.8)
Length of sentence, yr	
2 to $\leq$ 3	285 (20.1)
> 3 to $\leq$ 5	286 (20.1)
> 5 to $\leq$ 25	365 (25.7)
> 25	484 (34.1)

Unlike Canadian inmates, Japanese inmates follow strict low-calorie diets and are obliged to work and exercise daily.^{18,19} However, Japanese inmates were the only outliers in a recent systematic review that examined weight changes during

Table 2: Categories of body mass index for Canadian inmates on admission and at follow-up

Category	BMI range	Admission, no. (%) <i>n</i> = 1420	Follow-up, no. (%) <i>n</i> = 1420	<i>p</i> value
Underweight	< 18.5	17 (1.2)	F	< 0.0001*
Normal	18.5–24.9	466 (32.8)	222 (15.6)	
Overweight	25.0–29.9	559 (39.4)	551 (38.8)	
Obese	≥ 30.0	378 (26.6)	645 (45.4)	
Overweight and obese	≥ 25	937 (66.0)	1196 (84.2)	
Obesity class I	30.0–34.9	236 (16.6)	405 (28.5)	
Obesity class II	35.0–39.9	92 (6.5)	146 (10.3)	
Extreme obesity class III	≥ 40.0	50 (3.5)	94 (6.6)	

Note: BMI = body mass index, F = proportion too low to report and could threaten confidentiality.
* χ^2 test; *p* < 0.05 considered significant.

Table 3: Median change in weight and body mass index, and annual rate of change, between admission and follow-up by sociodemographic characteristic

Characteristic	Median weight change, kg (95% CI)	<i>p</i> value*	Median BMI change (95% CI)	<i>p</i> value*	Median annual rate of change, kg/yr (95% CI)	<i>p</i> value*
Overall	+6.20 (5.55–6.85)		+2.00 (1.79–2.21)		+1.52 (1.24–1.81)	
Sex						
Male	+6.50 (5.82–7.18)	0.3	+2.00 (1.78–2.22)	0.7	+1.46 (1.18–1.75)	0.2
Female	+5.80 (3.60–8.00)		+2.00 (1.19–2.81)		+2.69 (0.99–4.39)	
Age, yr						
18 to ≤ 24	+4.70 (2.99–6.41)	0.05	+1.60 (1.04–2.16)	0.04	+3.51 (2.08–4.93)	< 0.0001
≥ 25 to ≤ 34	+5.70 (4.62–6.78)		+1.80 (1.45–2.15)		+2.30 (1.63–2.98)	
≥ 35 to ≤ 44	+6.30 (4.99–7.70)		+2.00 (1.55–2.45)		+2.13 (1.35–2.92)	
≥ 45 to ≤ 64	+7.60 (6.35–8.85)		+2.50 (2.09–2.91)		+1.03 (0.68–1.39)	
≥ 65	+5.30 (3.87–9.46)		+1.75 (1.28–3.10)		+0.51 (0.16–0.85)	
Region						
Atlantic	+5.05 (4.00–6.10)	0.0004	+1.70 (1.35–2.05)	0.002	+1.42 (0.91–1.92)	0.1
Ontario	+7.10 (6.28–7.92)		+2.30 (2.04–2.56)		+1.57 (1.22–1.92)	
First language						
English	+6.30 (5.61–6.99)	0.3	+2.00 (1.78–2.22)	0.4	+1.50 (1.20–1.80)	0.9
French	+6.00 (4.08–7.92)		+1.90 (1.28–2.52)		+1.75 (0.78–2.72)	
Ethnicity						
White	+6.30 (5.47–7.13)	0.004	+2.00 (1.73–2.27)	0.005	+1.42 (1.07–1.78)	0.06
Black	+7.00 (5.54–8.46)		+2.20 (1.75–2.65)		+2.06 (1.22–2.90)	
Aboriginal	+7.70 (6.92–10.52)		+2.40 (1.83–2.97)		+1.72 (0.89–2.54)	
Other	+3.30 (1.61–4.99)		+1.00 (0.77–1.86)		+1.14 (0.49–1.78)	

Note: BMI = body mass index, CI = confidence interval.
*Wilcoxon test was used in analyses with two categories (sex, region, language), a Kruskal–Wallis test was used in analyses with three or more categories (age and ethnicity); *p* < 0.05 was considered significant.

incarceration.⁷ The findings from 16 different studies showed that 50%–80% of inmates gained weight during incarceration in the United States and United Kingdom.^{3,7,9,20–23} The

amount and pace of weight gained varied by study, and ranged from a modest mean gain of 0.96 kg over 2 years³ to a substantial 0.5-kg gain per week.⁹ The latter study involved female

Table 4: Median change in weight and body mass index, and annual rate of change, between admission and follow-up by institutional characteristic

Characteristic	Median weight change in kg (95% CI)	p value*	Median BMI change (95% CI)	p value*	Median annual weight change in kg/yr (95% CI)	p value*
Overall	+6.20 (5.55–6.85)		+2.00 (1.79–2.21)		+1.52 (1.24–1.81)	
Feeding system						
Tray (menu)	+6.00 (4.83–7.17)	0.97	+1.90 (1.52–2.28)	0.97	+1.48 (0.98–1.97)	0.97
Cafeteria (menu)	+6.85 (5.75–7.95)		+2.20 (1.86–2.54)		+1.63 (1.18–2.08)	
Kitchenette (no menu)	+6.50 (5.41–7.59)		+2.10 (1.74–2.46)		+1.50 (0.93–2.07)	
Security level						
Maximum	+5.55 (4.32–6.78)	0.05	+1.80 (1.42–2.18)	0.04	+1.45 (0.94–1.95)	0.1
Medium	+7.00 (6.10–7.90)		+2.30 (2.01–2.59)		+1.79 (1.39–2.19)	
Minimum	+5.55 (4.07–6.93)		+1.80 (1.34–2.26)		+1.02 (0.24–1.81)	
Length of incarceration at follow-up						
≤ 18 mo	+5.60 (4.70–6.50)	0.001	+1.90 (1.60–2.20)	0.001	+6.40 (5.33–7.47)	< 0.001
> 18 mo to ≤ 5 yr	+5.75 (4.65–6.85)		+1.80 (1.45–2.15)		+2.09 (1.67–2.51)	
> 5 yr	+8.40 (6.92–9.88)		+2.70 (2.23–3.17)		+0.64 (0.54–0.74)	
Length of total sentence, yr						
2 to ≤ 3	+6.00 (4.63–7.37)	0.006	+2.00 (1.55–2.45)	0.007	+6.21 (4.76–7.66)	< 0.001
> 3 to ≤ 5	+6.25 (4.99–7.51)		+2.00 (1.60–2.40)		+3.74 (2.78–4.70)	
> 5 to ≤ 25	+5.50 (4.35–6.65)		+1.70 (1.33–2.07)		+1.95 (1.44–2.46)	
> 25	+7.70 (6.36–9.04)		+2.50 (2.06–2.94)		+0.69 (0.56–0.81)	

Note: BMI = body mass index, CI = confidence interval.

*Kruskal–Wallis test; $p < 0.05$ was considered significant. The mean ($\pm$ standard deviation) length of time between admission and follow-up was 5.0 ($\pm$ 8.3) years.

inmates in the US and was based on weight gained during the first 2 weeks of incarceration.^{7,9}

Our findings suggest that weight gain was more rapid in the first months of incarceration. A median weight gain of 6.4 kg/yr was noted among inmates incarcerated for less than 18 months, compared with 0.64 kg/yr among inmates incarcerated for more than 5 years at the time of study. Rapid weight gain in the beginning of incarceration could be the result of withdrawal from alcohol, drugs and tobacco.⁹ It is well-established that inmates have higher rates of smoking and substance dependence than are seen in the general population.^{24,25} In support of this hypothesis, studies performed in penitentiaries where inmates were allowed to smoke tobacco reported modest weight gain.^{2,3,23,26} Tobacco withdrawal could explain the variation in gains between studies. In Canada, tobacco became prohibited in federal penitentiaries in 2008.²⁷ This prohibition may contribute to weight gain for some inmates, because people who smoke tend to have lower BMIs than those who do not,²⁸ and smoking cessation typically leads to weight gain.²⁹

On admission to the penitentiary, inmates had rates of obesity similar to those of the general Canadian adult population (~27% for both groups). However, during incarceration, the prevalence of obesity among inmates increased to 45.4%. The proportion of inmates with weight in the normal range also changed during incarceration. On admission, 32.8% of inmates

had a normal BMI; that proportion had decreased to 15.6% at follow-up. On admission, the proportion of inmates with a normal BMI (32.8%) was similar to the proportion seen in the general Canadian adult population (36.1%).⁶ Thus, there is little difference in proportions of people in each BMI category between inmates on admission to a penitentiary and the general population. However, during incarceration, the proportion of inmates in the normal and obese ranges changes substantially.

The rate at which Canadian inmates gain weight (median 1.5 kg/yr; mean 4.3 kg/yr) is higher than the rate of weight gain in nonincarcerated Canadian adults (0.37 kg/yr for men, 0.29 kg/yr for women), and our findings suggest that inmates tend to gain more weight during the beginning of their incarceration. Thus, inmates gain excessive weight throughout their incarceration, but the rate at which they gain weight decreases over time. Moreover, only 45% of the Canadian adults gained weight in 2006, compared with 73% of inmates.³⁰ In the community, men tend to gain weight more rapidly than women.³⁰ However, the opposite is seen in the correctional setting, where many studies have shown weight gain to be more severe for women than for men.^{2,21,31} Because we did not see a significant difference between men and women in terms of weight outcomes in our study, we can conclude that sex did not influence weight gain, suggesting that Canadian correctional institutions are equally obesogenic for men and women.

Some Canadian penitentiaries have a central feeding system that uses a standardized menu,³² whereas other institutions have a feeding system in which inmates purchase and prepare their own foods.¹⁵ We found no significant difference in weight gain based on these different feeding systems.

Limitations

The observational nature of the data precludes inferences about causality. Residual confounding by unmeasured variables is always possible in observational studies. It was not possible to create a cohort of nonincarcerated adults to match our sample, which would have provided a better comparison group. We used the best data available from Statistics Canada,⁶ which allowed us to compare our results with the broader context of obesity in Canada.

Conclusion

Our study provides evidence that correctional institutions in Canada are obesogenic environments. Inmates come into prison with higher BMIs compared with the general adult population, and most inmates gain weight during incarceration. Prison could be an opportunity to address the health needs of inmates, many of whom come from marginalized or vulnerable populations. This opportunity may be missed if the environment is so obesogenic that the most important change to inmates' physical health status is weight gain. Releasing inmates in poorer health than when they were admitted into the penitentiaries is a likely scenario. Further research should identify strategies to make the correctional environment less obesogenic.

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Affiliations: Interdisciplinary School of Health (Johnson), University of Ottawa; Healthy Active Living and Obesity Research Group (Chaput); Children's Hospital of Eastern Ontario Research Institute; School of Epidemiology and Public Health (Diasparra, Richard, Dubois), University of Ottawa, Ottawa, Ont.

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