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Version  Post-print/accepted manuscript


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Weight Gain and its Correlates among Forensic Inpatients

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**Objective:** We investigated changes in weight, Body Mass Index, and other indices of the metabolic syndrome in forensic inpatients. Weight gain associated with newer antipsychotic medications is well established in the general psychiatric population.

**Methods:** We examined the medical records of 291 men admitted to a forensic hospital at admission and again at discharge or 365 days later if still in hospital. We also recorded diagnosis and smoker status on admission and quantified psychotropic medication treatment and adherence, physical activity, and daytime occupation during the hospitalization.

**Results:** On admission, 33% were obese and 22% of the 106 patients for whom sufficient data were available met criteria for metabolic syndrome. Of patients staying at least 30 days, 60% were weighed again before discharge but repeated blood pressure and waist circumference measures were uncommon, even among those at greatest risk. The 122 forensic inpatients with sufficient information gained an average of 12% of their body weight and 40% increased by at least one Body Mass Index (BMI) category, gaining an average 3.67kg per month. Weight gain was associated with duration of time and was not attributable to being underweight on admission, diagnosis of schizophrenia, atypical antipsychotic treatment, medication adherence, or having been a smoker.

**Conclusions:** Patients gained weight during forensic hospitalization independent of medication use. We recommend further research using consistent measurement and wider sampling of both metabolic syndrome indicators and its individual and systemic causes in forensic populations.

**Clinical Implications**

- Routine monitoring of weight and other metabolic syndrome risk factors among forensic inpatients is needed.

- Behavioural treatment of unhealthy weight gain and other risk factors is advised.
Limitations

- We did not measure dietary intake.
- We measured weight from monthly records, rather than taking measures prospectively, revealing substantial missing data.

KEY WORDS: forensic psychiatry, inpatient, weight gain, Body Mass Index, metabolic syndrome
Mental illness is associated with increased mortality\(^1\) largely due to preventable causes such as cardiovascular disease.\(^3\),\(^6\) The risk of cardiovascular disease is increased by factors including high body weight and abdominal obesity, which are elevated among psychiatric patients.\(^1\),\(^8\) Forensic inpatients’ physical health, however, has received minimal attention from researchers, despite the extensive time they spend in seclusion which limits their physical and social activity.\(^9\) In British studies of forensic patients, most were overweight or obese\(^10\) and they carried substantially greater risk of coronary heart disease than did people in surrounding communities.\(^12\) Forensic patients gained an average of 3kg, and 26% gained over five percent of their body weight, during three months in hospital.\(^10\) We extended this emerging research field by examining adult male forensic patients’ weight on admission and up to one year later, and factors associated with weight gain.

Psychotropic medication is a well established factor in weight gain and related adverse health outcomes among psychiatric patients, particularly atypical antipsychotics.\(^1\),\(^13\) Such medications have been associated with clinically significant weight gain in as few as 10 to 12 weeks.\(^1\),\(^8\),\(^14\)\-\(^21\) Among forensic patients, Haw and Rowell\(^10\) reported that obesity was related to the prescription of one or more antipsychotic medications, particularly valproate. Ojala et al.\(^22\) found that among Finnish forensic patients (89% male, 92% diagnosed with schizophrenia) metabolic syndrome and obesity were more common among those taking regular doses of atypical antipsychotics, controlling for age, gender, and clinical diagnosis, which were not themselves related to Body Mass Index (BMI). In the present study, we examined weight and BMI in male forensic patients and their association with time, psychotropic treatment, medication adherence, and other potential correlates including physical and occupational activity, diagnosis, and having been a smoker. We predicted:
1. Weight and BMI would increase during the hospital stay and be associated with atypical antipsychotic use, medication adherence, and duration of time between admission and the last documented weight within the year.

2. Weight and BMI increase would be associated with physical inactivity, as measured by sleeping or lying down during the day and number of days spent in locked confinement.

3. Weight and BMI increase would be associated with lack of daytime occupation, as measured by attending social and therapeutic activities.

We explored whether weight and BMI change were associated with a diagnosis of schizophrenia, prescribed psychotropic medications, and medication adherence.

**Methods**

**Participants**

We included all 291 men admitted in 2009 or 2010 to a 160-bed maximum security psychiatric hospital in Ontario, Canada providing court-referred assessment and treatment for male patients. We excluded two patients whose medical records were no longer available at followup. Smoking was not permitted anywhere in the hospital. The normal patient diet in 2009-2010 was estimated as providing 2800kcal/day.

**Procedure**

We used existing clinical data by retrieving each patient’s medical record after his first admission during the study period in order to code admission measures. Different personnel retrieved the record again after the end date (365 days later or the date of discharge, whichever was first) to code variables pertaining to the hospital stay, including weight as recorded by clinical staff. The Waypoint Research Ethics Board reviewed and approved the collection of data from medical records without patient consent.
**Measures**

We recorded age, height (cm), and weight (kg) on admission, and weight again at the end date if at least one month later, to calculate Body Mass Index (BMI; Health Canada, 2003) and its change. We also recorded weight month by month where documented in the medical records. We recorded waist circumference (>102cm is considered obese in men) and systolic blood pressure (>130mmHg is considered high) at admission and end date. We coded smoking as 1 if the patient had been a nicotine smoker at admission or 0 if not, and schizophrenia as 1 if the first admission assessment included this diagnosis or 0 if not.

We coded physical inactivity following the Problem Identification Checklist\textsuperscript{25}: “gets no physical exercise, spends a great deal of time sleeping or lying about,” coded on a five-point scale of 1-no problem, 3-moderate problem, and 5-severe problem. Time spent in confinement in total days locked in seclusion was another measure of inactivity. For daytime occupation we coded participation in organized social activities as 2 – regular, consistent attendance, 1–irregular, occasional attendance, or 0 – did not attend. We coded participation in therapeutic activities similarly, summing points for attendance at skill-building therapy, structured groups, structured and unstructured individual psychotherapies.

We measured adherence with psychotropic medication, including those prescribed for psychosis as well as those for mood disorder which have also been associated with weight gain\textsuperscript{20,22} in five categories: 1 – refused, 2 – not offered, 3 – complied inconsistently (complied on some occasions and not others, or complied with some medications but not others), 4 – complied consistently, regardless of clinical change. We also recorded the type of medications prescribed in five categories of antipsychotics (atypical, butyrophenones, phenothiazines, thioxanthenes,
other) and seven categories of other psychotropic medication (benzodiazepines, anxiolytics, antimanic agents, anticholinergic agents, dopamine-related, SSRI-related, other antidepressants).

**Statistical Analysis**

Analyses were conducted using SPSS 19. Following descriptive and inter-item correlational analyses, we tested hypothesis 1 using a repeated measures t-test of admission vs. end date measures of weight and BMI, and with a Pearson correlation test of change in these measures and length of stay. We also examined 95% confidence intervals (CIs), treating any mean falling outside the CI of another as a significant difference. We tested hypotheses 2 and 3 using Pearson correlation tests of weight and BMI change with physical activity and daytime occupation measures, respectively. We also used multiple linear regression analysis to identify the correlates of weight change bearing the strongest independent relationship.

**Results**

Inter-rater reliability in 10 cases for key variables was $\kappa = 1.00$ (diagnosis of schizophrenia, smoker, atypical antipsychotics), ICC $\geq .95$ for weight, height, blood pressure, and days in confinement, except physical inactivity, ICC = .58. Most patients (79%) were discharged within the year. The mean age on admission was 35.1 years ($SD = 12.5$) and primary diagnoses included schizophrenia (47%) followed by other psychotic disorders (20%), personality disorder (12%), mood disorder (8%), substance related disorders (4%), and others (8%); five (2%) received no psychiatric diagnosis. Psychotropic medication adherence data were available for 287 patients, of whom 13% were offered none; 7% refused, 28% complied inconsistently, and 53% complied consistently. Smoker status was available for 275 patients; 67% had been smokers.
Admission Measures

Weight was documented at admission for 274 patients, height for 262, and both for 257. The mean weight was 81.17 kg ($SD = 18.66$), and the mean BMI (range = 13.79 – 63.89) was 26.29 ($SD = 6.45$) with nearly half the patients in the normal range (46%, Table 1). Systolic blood pressure was documented at admission for 225 patients, with a mean of 129.78 mm ($SD = 15.73$). Waist circumference was documented at admission for 116, with a mean of 98.97 cm ($SD = 24.83$). Using the three indexes BMI $\geq 25$, blood pressure over $>130$, and circumference $>102$, 23 patients (22% of the 106 with all data available) met the criteria for metabolic syndrome. Having metabolic syndrome on admission was unrelated to having a subsequent weight, blood pressure, or waist circumference measure.

Physical Activity and Daytime Occupation

Among the 291 patients, physical inactivity was present in 98 (34%) patients and these men had a mean problem score of 2.87 ($SD = 0.86$), close to “moderate.” Confinements occurred for 143 (49%) patients; these men were confined an average of three times and had a mean of 32.45 days ($SD = 59.22$) spent in confinement (on average of 20% of their stay). Participation in social activities was regular for 47 (16%) patients and occasional for 220 (75%). Only 57 (19%) patients participated in at least one therapeutic activity, and the mean activity score was 0.38 ($SD = 0.91$).

Weight and BMI Change

Most patients (214, 73%) stayed at least 30 days. Only eight had a subsequent measure of waist circumference documented in the medical record after the first month; therefore, no further analyses were conducted on this variable. A minority (78, 36%) had their blood pressure documented on admission and after the first month; they had a mean reduction of 8.37mm ($SD =
Most (129, 60%) had their weight documented on admission and after the first month, but seven of these patients did not have a height documented.

The remaining analyses, therefore, are based on 122 patients for whom a BMI could be calculated at both admission and discharge. The mean age of this subsample of 122 patients was 35.71 (SD = 11.90), mean length of stay was 192 days (SD = 135) and 84 (69%) were discharged within the first year. In this subsample we also measured time between admission and the last recorded weight before the end date, mean duration = 145 days (SD = 122). Their mean BMI on admission was nearly identical to the total sample mean, \( M = 26.06 \) (SD = 5.64). Age had positive but nonsignificant correlations with weight \( r(120) = .11, p = .213 \), and BMI \( r(120) = .17, p = .067 \). Most (73%) were prescribed one or more atypical antipsychotics, 39% thiozanthenes, and 18% benzodiazepines. Of other psychotropic prescriptions the most common class was anticholinergic agents (22%). Most patients (54%) complied consistently with these medications.

**Hypothesis 1.** The hypothesized weight and BMI increases were observed (Figure 1). During their inpatient stay, patients gained a mean of 12% of their body weight (SD = 12), 69% gained at least 5%, 38% gained at least 12%, and 40% increased by at least one BMI category (3% went down one category). Table 2 shows that weight gains were seen across all BMI categories and not limited to previously underweight patients, \( F(5, 116) = .487, p = .786 \). We also hypothesized and observed positive correlations between duration until the last recorded weight and weight gain \( r(98) = .31, p = .002 \), and BMI gain \( r(98) = .30, p = .002 \). The mean weight gain per month was 3.67 kg (SD = 4.64), illustrated in Figure 2. Contrary to hypothesis, weight and BMI change were not significantly associated with atypical antipsychotic medication, weight ROC area = .546 (SE = .061), 95% CI = [.426, .666], BMI ROC area = .543 (SE = .061),
95% CI = [.422, .663]. Associations with medication adherence were positive but not significant for weight, \( r(110) = .14, p = .137 \), and BMI, \( r(110) = .15, p = .128 \).

**Hypothesis 2.** We hypothesized that weight and BMI change would be associated with physical inactivity measures. Positive but nonsignificant correlations were found for weight gain and physical inactivity, \( r(86) = .15, p = .166 \), and days in confinement, \( r(120) = .03, p = .787 \); for BMI change, the association with physical inactivity was significant, \( r(86) = .21, p = .049 \), but not with days in confinement, \( r(120) = -.01, p = .787 \).

**Hypothesis 3.** We hypothesized that weight and BMI change would be associated with lack of daytime occupation. A small, nonsignificant association was found for weight gain and attending patient social activities, \( r(120) = .08, p = .376 \), but a positive association between weight gain and participating in therapeutic activities, \( r(120) = .19, p = .039 \). A similar pattern was found for BMI gain, including social activities, \( r(120) = .09, p = .334 \), and therapeutic activities, \( r(120) = .21, p = .022 \). We speculated that therapeutic activity would be more available to patients who stayed longer, and a *post hoc* correlation test confirmed this, \( r(116) = .56, p < .001 \); patients not transferred to a “treatment ward” were rarely offered nonpharmacological therapy.

**Exploratory Analyses.** Weight and BMI change were not significantly associated with diagnosis of schizophrenia, weight ROC area = .550 \((SE = .055)\), 95% CI = [.443, .657], BMI ROC area = .543 \((SE = .055)\), 95% CI = [.436, .651], or having been a smoker on admission, weight ROC area = .583 \((SE = .053)\), 95% CI = [.481, .691], BMI ROC area = .579 \((SE = .054)\), 95% CI = [.474, .685]. Nor were they significantly associated with the number of classes of antipsychotic medications prescribed (which itself was unrelated to length of time between weights), weight \( r(111) = .05, p = .636 \), BMI \( r(111) = .04, p = .682 \). Effects of similar
magnitude but negative valence were observed for the number of classes of other psychotropic medications. In linear multiple regression (with mean replacement) entering variables with the highest bivariate correlation coefficient within each hypothesis, but substituting social activities for therapeutic activities because of collinearity, duration between admission and last weight recorded achieved significance, $\text{Beta} = .285$, $t(112) = 3.20$, $p = .002$, as did physical inactivity, $\text{Beta} = .105$, $t(112) = 2.09$, $p = .039$.

**Discussion**

This is the first study to examine weight change over more than three months and its physical and social correlates among forensic inpatients. One in five men met criteria for metabolic syndrome on admission, although the necessary clinical data were not documented in up to 60% of cases. Although weight gain was substantial, we did not find statistically significant associations between weight change and schizophrenia, major classes of antipsychotic or other psychotropic medication, or medication adherence. This finding might reflect the longer stay in this study compared with previous forensic inpatient research, or a consequence of limited variability in the present sample with respect to atypical antipsychotic use; i.e., most patients received atypical antipsychotic medication.

Blood pressure was clinically monitored in about one third of patients and decreased on average, perhaps due to antipsychotics’ hypotensive effect.\(^{22}\) Waist circumference was rarely documented. Clinicians have been encouraged to monitor weight and other risk factors for metabolic syndrome in all patients prescribed antipsychotic medication.\(^{1,11,15-16,26-27}\) Waist circumference is considered particularly important\(^{28}\) but “difficult to measure accurately in obese subjects, and unsafe to measure in unsettled patients.”\(^{29}\) Patients could take their own waist circumference (with a paper measuring tape if needed for safety) and other measures, as part of
efforts to encourage their participation in healthy living. Electronic recording would enable flagging of clinically important results.

We found some evidence indicating BMI increase was related to physical inactivity. Lifestyle changes are considered the first line of treatment to decrease cardiovascular risks in people with metabolic syndrome, being more effective than pharmacological interventions. Forensic psychiatrists try to treat obesity on a case-by-case basis by imposing limits on junk food but systematic control over diet and behavioural contingencies is quite feasible in psychiatric hospitals. A simple measure already taken in the study hospital is to reduce the regular diet to no more than 2400kcal/day, and therapy for forensic inpatients with metabolic syndrome that supports dietary and activity changes is proposed.

**Limitations**

This was an archival study with a within-subjects design rather than experimental control. We recorded weight from medical records which were missing data on blood pressure and waist circumference for many patients, making more detailed investigation of metabolic syndrome unfeasible. There were also gaps in monthly weights and other measures, which may have limited the power for hypothesis testing, but was an important finding in itself regarding the level of monitoring. We used broad measures of diagnosis and medication use rather than symptoms and specific dosages, which might reduce sensitivity to any medication-related effects. We were unable to measure dietary intake, an important factor in weight change. We recorded days in confinement due to individual seclusions only, whereas patients also spent some daytime hours confined for administrative reasons and were routinely secluded on admission for up to five days; thus we may have underestimated the effect of confinement. We recorded only whether patients attended therapeutic activities occasionally or regularly, rather than the amount of time
spent; however, research suggests psychiatric inpatients spend less than 4% of their time engaged in therapeutic or social activities.\textsuperscript{30} Therapy participation was confounded with length of stay and most patients had little opportunity to participate in psychosocial therapy. While most of our measures were coded with excellent inter-rater reliability, physical inactivity obtained lower agreement, which might limit detection of its association with weight change.

**Conclusion**

As hypothesized, patients gained weight during forensic hospitalization although this was independent of medication use and other expected variables. Among forensic patients in hospital for at least a month and for whom data were available, weight and BMI increases were substantial and most strongly associated with duration of time between the admission and last weight measured within the year. Patients gained an average of 12% of their body weight, not just attributable to those who were underweight on admission. Clinical monitoring of metabolic risk factors was incomplete and unrelated to the presence of metabolic syndrome or its risk on admission. There have been calls for equitable health care for people with serious mental illness\textsuperscript{16} and for correctional inmates,\textsuperscript{43} and we extend this concern to forensic patients and the need for the monitoring, prevention, and treatment of weight gain and metabolic syndrome.

**Acknowledgements**

We would like to thank Terri Newman, Louise Moreau, and Waypoint Provincial Forensic Programs staff for administrative assistance and helpful feedback on this research, and Waypoint Clinical Information Services staff for assistance. We also thank Chelsea Turan, Jenna Rutherford, Shealyn May, Desiree Robitaille, and Sonja Dey for assistance. Michael Seto, Marnie Rice, and Jamie Karagianis provided helpful comments on an earlier draft of this manuscript. No funding was provided for this research.
References


Table 1  Body Mass Index Categories among Adult Male Forensic Inpatients on Admission (N = 257) and Comparing Admission and Discharge (N = 122).

<table>
<thead>
<tr>
<th>Admission BMI Category</th>
<th>Whole Sample</th>
<th>Subsample Admission</th>
<th>Subsample Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Underweight</td>
<td>4</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Normal</td>
<td>46</td>
<td>120</td>
<td>45</td>
</tr>
<tr>
<td>Overweight</td>
<td>27</td>
<td>69</td>
<td>30</td>
</tr>
<tr>
<td>Obese I</td>
<td>14</td>
<td>35</td>
<td>16</td>
</tr>
<tr>
<td>Obese II</td>
<td>7</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Obese III</td>
<td>3</td>
<td>8</td>
<td>3</td>
</tr>
</tbody>
</table>

*Note: BMI (kg/m²): Underweight < 18.5, Normal weight =18.5 - 24.9, Overweight = 25.0 - 29.9, Obese class I = 30.0 - 34.9, Obese class II = 35.0 - 39.9, Obese class III ≥ 40.0 (Health Canada, 2003).*
Table 2  Mean Weight (and Standard Deviation) at Admission and Discharge, and Mean Gain in Body Weight (Percent) among Male Forensic Inpatients as a Function of BMI Category at Admission

<table>
<thead>
<tr>
<th>Admission BMI Category</th>
<th>n</th>
<th>Admission Weight (SD)</th>
<th>Discharge Weight (SD)</th>
<th>Weight Gain (%) (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>4</td>
<td>51.00 8.76</td>
<td>61.00 5.72</td>
<td>22.70 26.48</td>
</tr>
<tr>
<td>Normal</td>
<td>55</td>
<td>67.73 7.83</td>
<td>76.82 9.90</td>
<td>13.56 8.45</td>
</tr>
<tr>
<td>Overweight</td>
<td>37</td>
<td>84.73 8.33</td>
<td>92.24 13.09</td>
<td>9.00 11.88</td>
</tr>
<tr>
<td>Obese I</td>
<td>19</td>
<td>102.16 8.88</td>
<td>112.58 12.67</td>
<td>10.77 14.48</td>
</tr>
<tr>
<td>Obese II</td>
<td>4</td>
<td>120.75 10.34</td>
<td>125.50 12.12</td>
<td>3.88 2.93</td>
</tr>
<tr>
<td>Obese III</td>
<td>3</td>
<td>117.67 18.93</td>
<td>124.33 29.14</td>
<td>5.13 11.69</td>
</tr>
<tr>
<td>Total</td>
<td>122</td>
<td>80.66 18.44</td>
<td>89.31 19.90</td>
<td>11.52 11.66</td>
</tr>
</tbody>
</table>

Note: BMI (kg/m²): Underweight < 18.5, Normal weight =18.5 - 24.9, Overweight = 25.0 - 29.9, Obese class I = 30.0 - 34.9, Obese class II = 35.0 - 39.9, Obese class III ≥ 40.0 (Health Canada, 2003).
Figure 1. Mean Weight (a) and BMI (b) and 95% Confidence Intervals among Male Forensic Inpatients at Admission and Discharge (N=122).

a.

kg

b.

BMI
Figure 2. Mean Weight and 95% Confidence Intervals as a Function of Months since Admission (Indicated by Dashed Line) among Male Forensic Inpatients

Note: Number of cases varies due to discharges and missing data; admission N = 122, 1 month n = 67, 2 months n = 44, 3 months n = 33, 4 months n = 26, 5 months n = 26, 6 months n = 24, 7 months n = 19, 8 months n = 22, 9 months n = 20, 10 months n = 18, 11 months n = 19.