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Original article

Differences in body mass index among individuals with PsA, psoriasis, RA and the general population

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Abstract

Objectives. To compare obesity among individuals with PsA, psoriasis (PsO), RA and the general population (*n*), and identify correlates of obesity among individuals with PsO and PsA.

Methods. We compared the BMI of patients with PsA ($n = 644$), PsO ($n = 448$), RA ($n = 350$) and the general population using age- and sex-adjusted linear and logistic regression analyses. We conducted multivariate analyses limited to PsO and PsA to determine correlates of BMI and obesity.

Results. The mean BMI (kilogram per square metre) for individuals with PsA, PsO, RA and the general population were 29.6, 27.9, 27.3 and 26.1, respectively. The proportion with obesity was 37, 29, 27 and 18% for individuals with PsA, PsO, RA and the general population, respectively. The differences in BMI were significant between all categories ($P < 0.05$) except between PsO and RA. Age- and sex-adjusted linear and logistic regression confirmed that these differences were significant. In multivariate logistic regression analyses adjusted for age, sex, smoking, PsO duration, psoriasis area severity index score, use of DMARDs, glucocorticoids and biologics, the odds of obesity were 61% higher for PsA patients than PsO patients (95% CI 1.10, 2.37). When we additionally adjusted for the physical component summary of the short form-36, the association was attenuated and became insignificant.

Conclusions. Individuals with PsA have a higher mean BMI than those with PsO, RA or the general population. The BMI difference between PsA and PsO correlates with physical health.

Key words: psoriasis, psoriatic arthritis, rheumatoid arthritis, body mass index, obesity.

CLINICAL SCIENCE

Introduction

Psoriasis (PsO) is a chronic, inflammatory, autoimmune disease of the skin that affects 2–3% of the population [1]. Up to 40% of individuals with PsO develop PsA [2], which adds substantially to the disease burden for PsO patients, with frequent joint destruction associated with cartilage erosions, bone damage and joint fusion. Of several purported risk factors, obesity has been linked with an increased risk of PsO (inflammatory skin condition) [3] and RA (inflammatory arthritis) [4]. The underlying hypothesis is that the increased inflammation [5] associated with obesity could contribute to the risk and severity of these inflammatory conditions. If this hypothesis holds true, one could expect the link with PsA to be even stronger, as the condition has inflammatory components of both the skin and joints. A recent study reported that PsA was associated with BMI at the age of 18 years, but not with current BMI [6]. To further address this hypothesis, we compared obesity among individuals with PsA, PsO, RA and the general population (*n*), and identified the correlates of obesity among individuals with PsO and PsA.

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Methods

Study population

Four hundred and forty-eight PsO and 644 PsA patients were selected from the Toronto and Vancouver sites of the International Psoriasis and Arthritis Research Team (IPART) database. All diagnoses were made by dermatologists and rheumatologists. PsA diagnoses were further confirmed by the ClASsification of Psoriatic ARthritis (CASPAR) criteria [7]. RA data were collected from 350 physician-diagnosed patients enrolled in a longitudinal survey of RA care, identified from administrative health databases of all residents of British Columbia, Canada. Comparison data for the general population were obtained from the 2005 Canadian Community Health Survey (CCHS), Cycle 3.1. The CCHS represents a cyclic, telephone-administered survey conducted by Statistics Canada every 2 years [8]. Analyses were limited to respondents who were $\geqslant$18 years of age. Ethical approval for this study was obtained from the University of British Columbia Behavioural Research Ethics Board.

Assessment of variables

BMI was calculated as the subject's weight in kilograms divided by height in metres, squared. BMI was further dichotomized into non-obese ($<$30 kg/m^2) and obese ($\geqslant$30 kg/m^2) categories [9]. Data on age, sex and other variables were obtained from the respective databases.

Statistical analysis

We compared BMI among the four groups (PsA, PsO, RA and *n*) using analysis of variance (ANOVA) and performed all pairwise comparisons using Tukey's test. We performed age- and sex-adjusted linear regression analyses using BMI as a continuous outcome, and logistic regression analyses using obesity as a dichotomous outcome. We conducted multivariate linear as well as logistic regression analyses limited to PsO and PsA groups adjusting for age, sex, smoking, PsO duration, psoriasis area severity index (PASI) score and use of DMARDs, glucocorticoids and biologics to determine the independent correlates of increased obesity in these patients. To further investigate factors mediating differences in BMI, we evaluated the impact of adding the mental component summary (MCS) and physical component summary (PCS) of the short form-36 (SF-36) questionnaire, a health-related quality of life measure, into our final model. The MCS is comprised of four psychological components, including vitality, social functioning, emotional role and mental health, whereas the PCS is comprised of four physical health components, including physical functioning, physical role, bodily pain and general health. Higher MCS and PCS values suggest better mental and physical health, respectively. For all point estimates, we calculated 95% CIs. All *P*-values are two sided. Statistical analyses were conducted using SAS software, version 9.2 (SAS Institute, Cary, NC, USA).

Results

The mean BMIs (kilogram per square metre) for individuals with PsA, PsO, RA and the general population were 29.6, 27.9, 27.3 and 26.1, respectively. The demographics and BMI of the study population according to group are shown in Table 1. The differences in BMI were significant between all categories (ANOVA, $P < 0.0001$, Tukey's test $P < 0.05$) except between PsO and RA. Table 2 shows the age- and sex-adjusted differences in BMI and obesity in the PsO, PsA and RA groups compared with the general population. All three groups had significantly higher BMIs and odds of obesity than the general population. Table 3 displays the results of the multivariate logistic regression analysis limited to PsO and PsA patients with complete data. After adjustments for listed co-variables (Model 1), the odds of obesity were 61% higher in PsA than in PsO (95% CI 1.10, 2.37). We further evaluated correlations of the MCS and PCS of the SF-36 questionnaire with BMI in our models. The addition of MCS into our multivariate logistic regression model (Model 2), did not impact the

Table 1 Demographics and BMI of the study population

Characteristics	PsA (*n* = 644)	PsO (*n* = 448)	RA (*n* = 350)	General population (*n* = 115787)
Age, mean (S.D.), years	50 (13)	47 (13)	65 (13)	50 (19)
Sex: female, %	41	42	68	53
BMI, mean (S.D.), kg/m^2	29.6 (7.3)	27.9 (5.7)	27.3 (6.0)	26.1 (5.0)
Obese (BMI $\geqslant$30 kg/m^2), %	37	29	27	18
Smoking (ever), %	44	48	60	–
Arthritis duration, mean (S.D.), years	13.0 (10.0)	–	17.1 (12.8)	–
PsO duration, mean (S.D.)	21.7 (13.5)	16.8 (15.0)	–	–
PASI, mean, median (interquartile range)	5.2, 2.7 (0.9–5.4)	5.9, 4.1 (2.4–6.6)	–	–
PCS, mean (S.D.)	39.1 (12.1)	49.7 (9.6)	–	–
MCS, mean (S.D.)	45.6 (12.1)	47.2 (10.1)	–	–
Biologics, %	19	3	–	–
DMARD use, %	60	12	–	–
Steroid use, %	5	1	–	–

risk of obesity associated with PsA (OR = 1.60, 95% CI 1.09, 2.36). However, when we added PCS to our model (Model 3), the excess risk of obesity associated with PsA was lost [odds ratio (OR) = 1.13, 95% CI 0.74, 1.72] indicating that the PCS was associated with obesity risk (OR = 0.96, 95% CI 0.95, 0.98). Only age and sex remained as significant predictors of obesity. Similar results were obtained with multivariate linear regression analyses.

When we conducted additional analyses using the four individual components of the PCS (physical functioning, role physical, bodily pain and general health) in Model 3 instead of the PCS, our results did not change materially. Similarly, the results did not change in separate models using the four MCS scales (vitality, social functioning, emotional role and mental health) instead of the MCS in Model 3.

Table 2 Age- and sex-adjusted differences in BMI/obesity in people with RA, PsO and PsA in comparison with the general population

	Age- and sex-adjusted differences (β coefficient) in BMI by linear regression (95% CI)	Age- and sex-adjusted OR of obesity by logistic regression (95% CI)
General population	0 (Referent)	1.00 (Referent)
RA	1.03 (0.51, 1.55)	1.62 (1.28, 2.05)
PsO	1.80 (1.34, 2.26)	1.84 (1.50, 2.26)
PsA	3.39 (3.00, 3.77)	2.71 (2.31, 3.18)

Discussion

We observed that individuals with PsO, PsA and RA were at greater risk of obesity than the general population, and that individuals with PsA were at markedly increased risk in particular. Individuals with PsA have higher BMIs than those with PsO after adjusting for age, sex, smoking, PsO duration, PASI score, DMARDs, glucocorticoids, biologics and the MCS of the SF-36 health-related quality of life questionnaire. Further adjustment for the PCS of the SF-36 revealed that the PCS correlated with the increased obesity in PsA. Considering the substantially increased risk of cardiovascular disease (CVD) in PsA, obesity and physical activity represent potentially important modifiable risk factors.

In this study, the mean BMI for individuals with PsA was 1.80 kg/m^2 (95% CI 0.61, 2.99 kg/m^2) higher than that for those with PsO, and the odds of obesity were increased by 61% among individuals with PsA compared with PsO (95% CI 1.10, 2.37) after adjustments for co-variables. Previous evidence from cross-sectional [10], case–control [11] and cohort studies [3] suggests that obesity is a significant risk factor for PsO. Recently, a large PsO cohort

Table 3 Multivariate logistic regression analyses of correlates of obesity in people with PsO and PsA

	Multivariate[a] OR of obesity (95% CI)	Multivariate[b] OR of obesity (95% CI)	Multivariate[c] OR of obesity (95% CI)
Diagnosis			
PsO	1.00 (Referent)	1.00 (Referent)	1.00 (Referent)
PsA	1.61 (1.10, 2.37)	1.60 (1.09, 2.39)	1.13 (0.74, 1.72)
Sex			
Female	1.00 (Referent)	1.00 (Referent)	1.00 (Referent)
Male	0.63 (0.45, 0.88)	0.63 (0.45, 0.89)	0.70 (0.50, 0.99)
Age	1.02 (1.01, 1.04)	1.02 (1.01, 1.04)	1.02 (1.00, 1.03)
Smoking			
No	1.00 (Referent)	1.00 (Referent)	1.00 (Referent)
Yes	1.44 (1.04, 2.01)	1.42 (1.02, 1.98)	1.26 (0.89, 1.78)
PsO duration	0.99 (0.98, 1.00)	0.99 (0.97, 1.00)	0.99 (0.98, 1.00)
PASI score	1.03 (1.01, 1.05)	1.03 (1.01, 1.05)	1.02 (0.99, 1.05)
DMARD use			
No	1.00 (Referent)	1.00 (Referent)	1.00 (Referent)
Yes	0.99 (0.67, 1.45)	0.98 (0.67, 1.44)	0.92 (0.62, 1.36)
Glucocorticoid use			
No	1.00 (Referent)	1.00 (Referent)	1.00 (Referent)
Yes	1.26 (0.51, 3.11)	1.21 (0.49, 3.00)	0.99 (0.39, 2.51)
Biologics use			
No	1.00 (Referent)	1.00 (Referent)	1.00 (Referent)
Yes	1.14 (0.69, 1.89)	1.13 (0.68, 1.87)	1.11 (0.66, 1.86)
MCS		0.99 (0.98, 1.01)	0.99 (0.98, 1.02)
PCS			0.96 (0.95, 0.98)

[a]Adjusted for diagnosis, age, sex, smoking, PsO duration, PASI score, DMARD use, glucocorticoid use and biologics use. [b]Adjusted for MCS in addition to all of the above. [c]Adjusted for PCS in addition to all of the above.

study [6] indicated that obesity increases the risk of PsA as well. Our results support these observations. Obesity may increase the risk for PsA by modulating inflammation or may increase the risk of joint damage and subsequent inflammation due to increased joint loading. Alternatively, pain and inflammation can lead to reduced physical activity in arthritis patients [12], which in turn may increase the risk of obesity. Whether PsA specifically promotes obesity through decreased physical functioning or whether obesity promotes PsA (as suggested by prior cohort studies) needs further prospective investigations.

BMI increases with age in adulthood, until the age of 60–75 years, and the prevalence of obesity or extreme obesity is the highest in women below the age of 60 [13]. Our study was consistent with these findings as increasing age and female gender were observed risk factors for obesity in PsO and PsA patients.

Our study did not confirm previous reports of rheumatoid cachexia, or low body mass among RA patients [14], potentially due to improved treatment regimens in RA. Patients with PsA had higher rates of obesity than patients with RA, possibly pointing out metabolic differences between these diseases. The present finding that the mean BMI in PsA is 2.3 kg/m^2 higher than in a comparative RA population (29.6 *vs* 27.3 kg/m^2) is consistent with findings from a large US registry (32.1 *vs* 29.8 kg/m^2, $P < 0.001$) [15].

Chronic inflammation, such as that noted in psoriatic conditions, has been recognized as a risk factor for CVD [16, 17]. For example, extent of skin disease (as determined by skin score) in patients with PsA correlates with cardiovascular risk [18]. Furthermore, obesity has also been associated with chronic inflammation and cardiovascular risk [5, 19, 20]. Given the substantially increased risk of CVD in PsA, obesity and physical activity represent potentially impactful modifiable risk factors.

The diagnostic accuracy and uniformity in data capture for the large sample of patients with PsO and PsA are unique strengths of this study. Physician-diagnosed RA cases were identified using diagnostic codes from province-wide administrative billing databases, and the definition was made further specific by including only those with two RA codes at least 2 months apart, to remove those with transient inflammatory arthritis [21]. The height and weight of PsO and PsA patients were ascertained objectively, avoiding recall bias. In lieu of raw physical or psychiatric assessment data, we have used PCS and MCS to measure physical and mental dimensions of health, respectively. With regard to disease-specific comparisons (RA *vs* PsA), we cannot rule out the possibility of selection bias, as the individuals with RA were identified from a different cohort than the PsA and PsO patients. Such a potential selection bias would not affect the comparisons between PsA and PsO.

In conclusion, the present study demonstrates that BMI is higher in PsA (skin and joint disease) than that in PsO (skin disease), RA (joint disease) or the general population. Furthermore, our results suggest that the BMI difference between PsA and PsO is independent of other risk factors of obesity but correlates with the PCS of the SF-36. These findings highlight for clinicians the need to control obesity in PsA patients through regular non-weight-bearing physical exercises. Studies of the impact of physical activity on BMI and CVD among these populations are urgently needed.

Rheumatology key messages

- PsA patients have higher BMIs than those with PsO, RA or the general population.
- The BMI difference between PsA and PsO correlates with physical health.
- PsA patients should be urged to control obesity through regular non-weight-bearing physical exercises.

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