The Prevalence of Obesity in Atlantic Canadians with Arthritis

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Background:

Arthritis is a condition that affects joints and the surrounding tissues, causing chronic pain, limiting mobility and contributing to disability. There are both non-modifiable risk factors such as age, sex, and genetics as well as modifiable risk factors including physical activity, diet, and obesity that impact the risk of developing arthritis. In addition to reducing risk, maintaining a healthy body weight or body mass index (BMI) may also prevent disease progression, reduce pain, and improve movement [1].

Not only do the Atlantic provinces have some of the highest rates of arthritis in Canada (up to 25% of the population) [2], but the percent of individuals in Atlantic Canada that are obese (24-30%) is also well above the national average (20%) [3].

BMI is one of the most common measures of obesity, but it does not account for body composition or fat mass distribution. Waist circumference, waist-to-hip ratio and percent body fat/fat mass are also commonly associated with the metabolic complications of obesity [4-6]. BMI at 18 years of age has been shown to be a strong predictor of obesity in adulthood and a gain in BMI units has been associated with increased risk of disease [7]. Few studies have

attempted to include more than one measure of adiposity, [8-11] and there is a lack of research directly comparing the different measures of adiposity in individuals with arthritis.

Therefore, the **purpose** of this study was to examine the association between prevalence of arthritis and obesity in Atlantic Canadians using both current and past (age 18) anthropometric data.

Methods:

The prevalence of arthritis was estimated using questionnaire data from the Atlantic PATH cohort. In the current study, 30549 participants provided data on whether they had ever been diagnosed with arthritis. Recruitment and data collection have been previously described [12]. As part of the questionnaire, participants were asked to provide anthropometric data including height, weight, and waist and hip circumference measurements. Additionally, body composition (i.e., fat mass and fat-free mass) was assessed by bioelectrical impedance, using a Tanita Segmental Body Composition Analyzer, and standard anthropometric indexes (height, weight, hip and waist circumference) were collected by research nurses. Both self-reported and measured height, weight, waist and hip circumference were used for calculating BMI and waist-to-hip ratios. BMI values were used to quantify the percent of Atlantic PATH participants who were underweight, normal weight, overweight or obese as defined by having a BMI of <18.5, 18.5-24.9, 25.0-29.9 or >30.0, respectively. The waist-to-hip ratio was set at >0.90 for men and >0.85 for women [13]. Abdominal obesity was defined as having a waist circumference ≥102 cm for men and ≥88cm for women [12, 13]. The fat mass index and fat-free mass index were calculated by dividing fat mass and fat-free mass by height in meters squared, respectively [14].

Data analyses were performed with SPSS (version 22) and statistical significance was defined as $P \leq 0.05$. Differences in anthropometric measures between participants with and without arthritis were determined by independent t-test. Pearson partial correlation coefficients were calculated between BMI, waist to hip ratio, percent body fat, BMI at 18 years and change in BMI from 18 years and adjusted for age and sex.

Results:

Overall, more than 70% of the population in the Atlantic PATH cohort had a BMI that is classified as overweight (25-29.9) or obese (>30), whereas 62% had a waist-to-hip ratio above recommendations and 52% had abdominal obesity (Table 1). Arthritis was reported in 26% of the total Atlantic PATH cohort (Table 1).

Of those that reported being diagnosed with arthritis, 25% had a BMI in the normal range, 36% were overweight and 38% were obese compared to 29%, 38%, and 33% respectively, in participants without arthritis (Table 1). The data showed that 50% of participants without arthritis had abdominal obesity and 62% had a waist-to-hip ratio above recommendations whereas 58% of participants with arthritis had abdominal obesity and 64% had a waist-to-hip ratio above recommendations (Table 1). The high levels of adiposity in participants with arthritis were reflected by significantly higher body weight, waist circumference, hip circumference, BMI, fat mass index and change in BMI from 18 years of age compared to participants without arthritis (Table 2).

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Arthritis significantly correlated with height, weight, waist circumference, hip circumference, BMI, waist-to-hip ratio, percent body fat, fat mass index, and change in BMI from 18 years of age (Table 3). After adjusting for age and sex, a significant correlation was still observed between arthritis and weight, waist circumference, hip circumference, BMI, waist-to-hip ratio, percent body fat, fat mass index, and change in BMI from 18 years of age (Table 3).

Table 1: Prevalence[a] of arthritis and adiposity in the Atlantic PATH cohort

		Total	No Arthritis	Arthritis
Arthritis		30549	22452 (73.50)	8097 (26.48)
Waist-to-hip ratio[b]		16591 (62.24)	1184 (61.54)	4443 (64.25)
Abdominal obesity[c]		13830 (51.77)	9586 (49.67)	3978 (57.51)
BMI categories[d]	Underweight	206 (0.82)	152 (0.84)	53 (0.82)
	Normal Weight	6973 (27.86)	5258 (29.09)	1632 (25.14)
	Overweight	9318 (37.23)	6777 (37.50)	2350 (36.20)
	Obese	8533 (34.09)	5890 (32.58)	2457 (37.85)

[a] Data are presented as n (%).

[b] Waist to hip ratio >0.90 for men and >0.85 for women.

[c] Waist circumference ≥102 cm for men and ≥88 cm for women.

[d] Underweight, normal weight, overweight or obese have a BMI of <18.5, 18.5-24.9, 25.0-29.9 or >30.0, respectively.

Table 2: Anthropometric measures[a] of participants with and without arthritis

	Total	No Arthritis	Arthritis
Height, cm	162.21 (20.51)	162.59 (20.44)	161.37 (20.38)
Weight, km	78.88 (18.19)	76.50 (17.89)	79.77 (18.88)*
Waist, cm	93.49 (16.00)	93.02 (15.74)	94.82 (16.66)*
Hips, cm	105.26 (13.29)	104.83 (13.02)	106.46 (13.96)*
Body mass index (BMI), kg/m^2	28.34 (5.96)	28.11 (5.82)	28.92 (6.27)*
Waist-to-hip ratio	0.89 (0.11)	0.89 (0.10)	0.89 (0.11)
Percentage fat mass, %	33.53 (9.19)	33.14 (9.14)	34.45 (9.22)
Fat mass index, kg/m2	9.57 (5.99)	9.37 (4.62)	10.03 (8.62)*
Fat free mass index, kg/m^2	17.86 (4.46)	17.88 (4.55)	17.75 (4.23)
BMI at 18 years	21.86 (4.34)	21.89 (4.32)	21.77 (4.36)
Change in BMI from 18 years	5.70 (5.65)	5.41 (5.47)	6.55 (6.06)*

[a] Data are presented as means (standard deviation).

* Significant difference from "No Arthritis" group, $P \leq 0.05$.

Table 3: Correlation between arthritis and body adiposity measurements

	Pearson correlation coefficients			
Correlation	r	P	r^a	P^a
Height, cm	-0.026	<0.001	-0.016	0.065
Weight, km	0.031	<0.001	0.067	<0.001
Waist, cm	0.050	<0.001	0.065	<0.001
Hips, cm	0.054	<0.001	0.064	<0.001
Body mass index (BMI), kg/m^2	0.060	<0.001	0.087	<0.001
Waist-to-hip ratio	0.014	0.019	0.027	0.002
Percentage fat mass, %	0.063	<0.001	0.061	<0.001
Fat mass index, kg/m2	0.050	<0.001	0.084	<0.001
Fat free mass index, kg/m2	-0.013	0.070	0.028	0.002
BMI at 18 years	-0.008	0.269	0.035	<0.001
Change in BMI from 18 years	0.059	<0.001	0.021	0.016

[a] Adjusted for age and sex.

Discussion:

This study focuses exclusively on people in Atlantic Canada, an area of the country with particularly high rates of both arthritis and obesity. The results of this study show a strong relationship between different measures of adiposity and an interesting link with arthritis. The current BMI data in those with arthritis are not surprising. Several others have reported a higher incidence of arthritis in those with increasing BMI [15-18]. Previous studies have reported only 24% of individuals with arthritis have a BMI ≥30.0, [19] whereas in the current study we observed a higher prevalence (>37%) with a BMI in the obese range. Although, with the ever increasing obese population [3] and increased incidence of arthritis in those over the age of 45-55 years [20], the results of the current study may not be all that surprising.

In an aging population, there are predictable (or expected or anticipated) changes in weight, height, and fat-free mass [21, 22]. In recent years, several projects have reported not only BMI data in arthritis patients but body composition data as well. Similar to our results, a significant

correlation has been reported between arthritis and BMI, waist-to-hip ratio, percent fat mass, and fat mass index [9]. Likewise, percent body fat and fat mass index were reported to be significantly higher in patients with arthritis compared to those without [23]. Adiposity measurements in relation to specific locations of arthritic joints may be considered in future research as previous studies suggest that BMI and percent fat are associated with osteoarthritis of the hand, knee, and hip [9-11], whereas hand osteoarthritis is additionally associated with the waist-to-hip-ratio [9]. We observe a significant association in arthritis and the waist-to-hip ratio, however, in the current study we did not differentiate between the location of arthritis.

In summary, the current study describes the overall prevalence of obesity and arthritis in the Atlantic PATH cohort. It demonstrates a good correlation between the various type of adiposity measures and reveals an increase in adiposity measures in participants with arthritis as compared to participants that had not been diagnosed with arthritis. There is currently no cure for arthritis and more research is needed to better understand the pathophysiology of the disease. Thus, future research should focus on the complex mechanisms linking obesity and arthritis.

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