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ORIGINAL RESEARCH

Physical Activity and Sedentary Time Correlate with Body Composition in Patients with Asthma; a Multicenter Observational Study

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Background: Increasing physical activity is recommended as a non-pharmacological approach for improving the symptoms, quality of life, and overall health in patients with asthma. However, the systemic effect of physical activity, especially sedentary behavior, in patients with asthma remains unclear.

Objective: The aim of this study was to investigate the association of objectively measured physical activity, including sedentary time, with body composition data and clinical characteristics in patients with asthma.

Methods: The study included 85 patients with asthma and 38 healthy controls. Physical activity indices were assessed for 2 weeks using accelerometers. We investigated the relationship between physical activity levels and clinical characteristics, along with its association with body composition data assessed using dual-energy X-ray absorptiometry and computed tomography in patients with asthma.

Results: In patients with asthma, high blood eosinophil counts and poor asthma control, as assessed by the Asthma Control Questionnaire score, were associated with prolonged sedentary time and reduced step count. Moreover, reduced step count was independently associated with an elevated fat mass index, whereas a prolonged sedentary time and high oral corticosteroid doses were independently associated with a low lean mass index in patients with asthma. Prolonged sedentary time demonstrated a negative correlation with erector spinae muscle area after adjusting for background factors.

Conclusion: Sedentary behavior and physical inactivity are associated with body composition in patients with asthma, suggesting the need for interventions targeting these behaviors to improve health outcomes.

Keywords: asthma, physical activity, sedentary time, dual-energy X-ray absorptiometry, fat mass index, lean mass index

Introduction

Asthma is a chronic airway inflammatory disease characterized by variable symptoms that impact long-term quality of life (QOL). The importance of non-pharmacological interventions has been recognized and increasing physical activity is recommended to improve the symptoms, QOL, and overall health of patients with asthma.[1,2] In the general population, physical activity and sedentary behavior have been demonstrated to influence the risk of various diseases and overall mortality.[3,4] Furthermore, sedentary behavior is associated with an increased risk of cardiovascular disease, diabetes, cancer, and poor survival, independent of physical activity levels.[5–7] However, the association between physical activity, especially sedentary behavior, and systemic effects in patients with asthma remains unclear.

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Deterioration in body composition as assessed by dual-energy X-ray absorptiometry (DEXA) and computed tomography (CT) is linked to an increased risk of various diseases and poor prognosis.[8–13] Increased fat mass and reduced lean mass, as assessed by DEXA, are associated with increased mortality and risk of cardiovascular and metabolic diseases.[8,9] In patients with asthma, increased fat mass is linked to greater asthma severity and a decline in lung function.[10] Moreover, the National Health and Nutrition Examination Survey prospective cohort study revealed that both increased fat mass and reduced fat-free mass were associated with poor survival in patients with asthma.[11] Additionally, reduced erector spinae muscle cross-sectional area (ESM_{CSA}) assessed using CT scans was demonstrated to be related to poor prognostic factors in patients with chronic obstructive pulmonary disease (COPD) and pneumonia.[12,13] These observations suggest that body composition indices determined using DEXA and CT could serve as potential indicators for evaluating systemic effects related to long-term health outcomes. However, the relationship between reduced physical activity, particularly sedentary behavior, and adverse changes in body composition in patients with asthma remains uncertain.

The aim of this study was to investigate the association of objectively measured physical activity, including sedentary time, with body composition data and clinical characteristics in patients with asthma. In the present study, we first compared steps, sedentary time, and background factors between patients with asthma and healthy controls. We then examined the association between physical activity and body composition, measured by DEXA and CT, as well as clinical characteristics in patients with asthma.

Materials and Methods

This study was part of a multicenter observational study, examining physical activity and its associated factors in patients with asthma (Physical Activity in Bronchial Asthma; PACTAS study). The study protocol was approved by the institutional review boards of all participating institutions and was implemented in compliance with the Declaration of Helsinki. All participants provided written informed consent before participation. The details of these methods are described in our previous report.[14] We recruited adult patients with asthma and healthy controls from six hospitals and one health check-up center in Japan between March 2019 and December 2020. All patients with asthma exhibited significant airway reversibility or airway hyperresponsiveness. The exclusion criteria comprised patients who had experienced asthma exacerbation within the past 6 weeks, had a respiratory disease other than asthma or COPD, and had comorbidities that prevented the assessment of physical activity. Patients with concomitant COPD who had more than 10 pack-years of smoking history and a forced expiratory volume in 1 second/forced vital capacity ratio of less than 70% after bronchodilator inhalation were also excluded from the analysis.

The control group was recruited through advertisements posted in health checkup centers and respiratory clinics. Participants were required to be at least aged ≥20 years and have no history of respiratory diseases or conditions affecting physical activity. Additionally, only individuals with normal chest radiographic findings and pulmonary function were included. A total of 159 patients with asthma and 46 healthy controls were initially recruited. However, physical activity was not measured in six patients with asthma and four healthy controls (Supplementary Figure 1). Subsequently, 55 participants with incomplete data or less than 10 h of valid activity measurement time were excluded. An additional 17 patients with concomitant COPD were also excluded. Consequently, only 85 patients with asthma and 38 healthy controls were included in this study.

Assessment of Physical Activity

Participants wore accelerometers (Active Style Pro HJA-750C; Omron Colin Co. Ltd, Kyoto, Japan) for 2 weeks, except during showers and baths, and maintained a diary recording the weather conditions and their activities. Steps per day and sedentary time were calculated for 3 days with no special activity, except during rainy weather. Moreover, sedentary time was defined as the total duration spent in activities with a metabolic equivalent of task value of 1.5 or less.[15] The data were considered valid if recordings were made for more than 3 days, with each day having more than 10 h of recorded data. Step count and sedentary time were compared between patients with asthma and those in healthy controls.

Respiratory Function, Asthma Control, and Health Status

Spirometry was performed on all participants before bronchodilator administration; for patients with asthma, post-bronchodilator spirometry was performed 15 min after inhaling salbutamol. Asthma control was assessed using the Asthma Control Questionnaire (ACQ)-6 score. Additionally, dyspnea symptoms were evaluated using the modified Medical Research Council (mMRC) dyspnea scale. To determine exercise tolerance, the 6-min walk test was conducted according to current guidelines,[16] and the 6-min walk distance (6 MWD) was calculated. The respiratory function, 6 MWD, and blood tests were performed at the time of participant recruitment.

Body Composition

Fat and lean masses for the whole body were determined using DEXA following established guidelines in 46 patients with asthma.[17] The fat mass index (FMI) and lean mass index (LMI) were calculated as fat mass/height² and lean mass/height², respectively.[18]

ESM_{CSA} at the level of the lower part of the 12th thoracic vertebra was evaluated by CT using a SYNAPSE volume analyzer in 59 patients with asthma, as previously described.[12,19] Briefly, the left and right ESM_{CSA} were identified and manually outlined. The cross-sectional areas of both ESM_{CSA} were calculated, and the ESM_{CSA} was presented as the sum of the right and left muscles. Body composition was measured at the time of recruitment.

Statistical Analyses

Comparisons between groups were made using the X^2, Fisher exact, or Mann–Whitney *U*-tests. Associations between step count, sedentary time, and clinical variables in patients with asthma were analyzed using Spearman's rank correlations. Univariate and multivariate linear regression analyses were performed to examine the associations between FMI and steps, LMI, and sedentary time, adjusting for age, sex, pack-years, and oral corticosteroid use. The cut-off values for step count and sedentary time were set at 7000 steps and 6 hours, respectively, based on previous reports, to compare body composition between groups.[20–22] Because there was a trend of negative correlation between sedentary time and ESM_{CSA} in Spearman correlation analysis, we also performed linear regression analyses. All data analyses were performed using the EZR software (Saitama Medical Center, Jichi Medical University, Saitama, Japan).[23] The significance level was set at $p<0.05$.

Results

Participants Characteristics

Table 1 lists the background characteristics of the patients. No significant differences were noted in age, sex, body mass index (BMI), smoking status, pack-years, living status, pet ownership, or employment status between patients with asthma and healthy controls. In patients with asthma, the step count was significantly lower than that in healthy controls. Moreover, no significant difference was observed in the sedentary time between patients with asthma and healthy controls.

Table 1 Background Characteristics of Study Participants

	Asthma (n=85)	Healthy Controls (n=38)	*p*-value
Age (y)	61.0±14.1	60.0±14.5	0.954
No. of males/females	25/60	14/24	0.412
BMI (kg/m^2)	23.1±4.2	22.4±3.0	0.324
Smoking status current|Ex (%)	4.7|29.4	2.6|23.7	0.719
Pack-year	7.0±16.3	4.9±12.2	0.341

(*Continued*)

Table 1 (Continued).

	Asthma (n=85)	Healthy Controls (n=38)	*p*-value
Living with family, n (%)	79 (92.9)	36 (94.7)	1.000
Holding pets, n (%)	30 (35.3)	9 (23.7)	0.296
Employment, n (%)	59 (69.4)	28 (73.7)	0.674
Onset age (y)	50.0±20.0	NA	
Disease duration (y)	8.0±13.9	NA	
Childhood asthma, n (%)	19 (22.3)	NA	
OSAS, n (%)	7 (8.2)	3 (7.8)	1.000
Allergic rhinitis, n (%)	24 (28.2)	8 (21.0)	0.506
Sinusitis, n (%)	28 (32.9)	0 (0)	<0.001**
GINA 1/2/3/4/5 (%)	0/8.2/32.9/32.9/25.9	NA	
Oral corticosteroids, n (%)	3 (3.5)	NA	
Oral corticosteroid dose (mg), in patients treated with oral corticosteroids	5.0±3.6	NA	
Biologic therapy, n (%)	17 (20.0)	NA	
Blood Eosinophils (/μL)	104.3±108.7	NA	
IgE (IU/mL)	212.5±2178.0	NA	
FeNO (ppb)	26.5±29.1	NA	
Pre-BD %FEV_1 (%)	94.3±18.0	NA	
Pre-BD FEV_1/FVC (%)	74.1±10.8	NA	
Post-BD %FEV_1 (%)	97.6±1.5	NA	
Post-BD FEV_1/FVC (%)	75.5±8.5	NA	
6MWD (m)	430.0±55.0	NA	
Steps	5138.0±3180.5	7776.6±3655.6	0.002**
Sedentary time (min)	370.3±139.8	362.0±116.1	0.782
Fat mass index †	7.0±2.4	NA	
Lean mass index ‡	16.7±2.1	NA	
ESM_{CSA}, cm^2 ├	44.6±5.1	NA	

Notes: Data are presented as mean ± standard deviation unless otherwise stated. **p<0.01 by Mann–Whitney *U*-test. †n = 48, ‡n = 48, ├n = 59.

Abbreviations: *6MWD*, 6-minute walking distance; *BMI*, body mass index; *OSAS*, obstructive sleep apnea syndrome; ESM_{CSA}, cross-sectional area of the erector spinae muscles; FEV_1, forced expiratory volume in 1 second; *FeNO*, fractional exhaled nitric oxide; *FVC*, forced vital capacity; *GINA*, Global Initiative for Asthma; *NA*, not applicable or not assessed; *pre-BD*, prebronchodilator; *post-BD*, postbronchodilator.

Associations of Sedentary Time and Step Count with Background Factors as Well as Clinical Outcomes in Patients with Asthma

Among background factors, employment status was associated with higher step counts in patients with asthma. However, other factors, including sex, living status, pet ownership, a history of childhood asthma, and comorbidities, demonstrated no significant associations with step counts or sedentary time (Table 2).

Regarding clinical characteristics, both high ACQ scores and elevated blood eosinophil levels were significantly associated with prolonged sedentary time and reduced step count. A high mMRC score was correlated with a low number of steps taken (Table 3).

In patients with asthma, a reduced step count was associated with a high FMI (Table 4). Prolonged sedentary time was linked to a low LMI and exhibited a trend toward reduced ESM_{CSA} (Tables 5 and 6). In the multivariate analysis, significant inverse correlations were noted between steps and FMI as well as between sedentary time and LMI, independent of background factors including age, sex, pack-years, smoking status, and oral corticosteroid use (Tables 4 and 5). However, no significant correlations were found between sedentary time and FMI or between steps

Table 2 Results of Bivariate Analyses

	Steps				Sedentary Time			
	Asthma		Healthy Controls		Asthma		Healthy Controls	
Variables	**Mean±SD**	***p*-value**	**Mean±SD**	***p*-value**	**Mean±SD**	***p*-value**	**Mean±SD**	***p*-value**
Sex		0.761		0.482		0.509		0.152
Male Female	5138.0±3552.1 5124.3±3036.3		6958.2±4094.2 8522.0±3413.8		375.0±189.2 368.7±113.8		315.7±96.8 375.5±122.3	
Living with family		0.857		0.410		0.520		0.597
Yes No	5107.6±3249.8 5148.0±2644.9		7776.6±3466.9 11,559.8±6429.3		370.3±141.9 322.3±105.5		285.3±219.4 315.4±24.7	
Holding pets		0.454		0.802		0.284		0.008**
Yes No	5125.8±2310.1 5138.0±3553.9		8155.6±1991.6 7353.0±4084.6		359.7±162.6 377.0±126.5		294.0±48.7 399.0±124.1	
Employment		0.022*		0.194		0.388		0.019*
Yes No	5936.0±3125.4 4351.5±3200.6		8522.0±3727.2 6475.8±3006.3		359.7±154.7 393.0±100.9		381.2±117.9 294.8±81.6	
Childhood asthma		0.329		-		0.066		-
Yes No	4966.0±2526.2 5141.0±3343.5		- -		395.7±136.2 359.7±138.7		- -	
OSAS		0.829		0.112		0.366		0.464
Yes No	5122.8±3226.2 5260.0±2835.0		10,544.0±3120.4 7531.6±3700.1		393.0±250.1 369.6±124.9		284.3±100.7 365.6±117.6	
Allergic rhinitis		0.911		0.022*		1.000		0.522
Yes No	5151.0±3413.7 4962.6±3087.4		10,298.8±2484.1 7287.8±3838.5		376.5±142.5 368.6±144.3		362.0±172.7 359.8±97.5	
Sinusitis		0.705		-		0.978		-
Yes No	5158.0±3434.4 5107.6±3168.8		- 7776.6±3655.6		378.0±113.5 369.0±156.1		- 362.0±116.1	

Notes: Data are presented as mean ± standard deviation unless otherwise stated. *p<0.05; **p<0.01 by Mann–Whitney *U*-test.

Table 3 Correlation Coefficients (Rs) of Daily Steps and Sedentary Time with Background Characteristics in Patients with Asthma

Variables	**Steps**		**Sedentary Time**	
	r_s	***p*-value**	r_s	***p*-value**
Age	−0.147	0.174	0.066	0.546
BMI	−0.149	0.168	0.007	0.952
Onset age	−0.159	0.143	0.194	0.105
Disease duration	0.030	0.783	−0.192	0.079
Severe exacerbation past 12 mo	0.080	0.461	−0.104	0.343
Blood eosinophils number	−0.283	0.009**	0.222	0.043*
Blood eosinophils percentage	−0.279	0.010*	0.220	0.045*
Post-BD %FEV_1	−0.056	0.613	−0.032	0.780
Post-BD FEV_1%	−0.020	0.857	0.046	0.686
FeNO	0.051	0.643	−0.0002	0.998
6MWD	−0.012	0.928	0.125	0.351
mMRC	−0.213	0.048*	0.167	0.126
ACQ score	−0.216	0.045*	0.230	0.034*
ESM_{CSA}, cm^2	0.092	0.487	−0.253	0.057
Lean mass index	0.085	0.567	−0.309	0.037*
Fat mass index	−0.392	0.006**	0.005	0.971

Notes: *p<0.05; **p<0.01 by Spearman's rank correlation coefficient.
Abbreviations: *6MWD*, 6-minute walking distance; *ACQ*, Asthma Control Questionnaire; *BMI*, body mass index; *ESM_{CSA}*, cross-sectional area of the erector spinae muscles; *FEV_1*, forced expiratory volume in 1 second; *FeNO*, fractional exhaled nitric oxide; *mMRC*, modified Medical Research Council; *post-BD*, postbronchodilator; r_s, Spearman correlation coefficient.

Table 4 Results of Univariate and Multivariate Analysis of Factors Affecting Fat Mass Index in Patients with Asthma

Covariates	**Univariate Model**		**Multivariate Model**	
	Beta Coefficient (95% CI)	***p*-value**	**Beta Coefficient (95% CI)**	***p*-value**
Age	0.017 (−0.033, 0.068)	0.494	0.0271 (−0.021, 0.075)	0.265
Sex (male)	−2.379 (−3.739, −1.020)	<0.001**	−2.780 (−4.234, −1.326)	<0.001**
Pack-year	−0.007 (−0.051, 0.036)	0.737	0.0182 (−0.023, 0.060)	0.382
Smoking status (current)	0.700 (−2.708, 4.168)	0.686	−0.424 (−3.681, 2.831)	0.793
Oral corticosteroids	−0.5713 (−1.394, 0.252)	0.169	−0.280 (−1.002, 0.440)	0.436
Steps	−0.0002 (−0.0004, −0.00005)	0.012*	−0.0002 (−0.0003, −0.00001)	0.036*

Notes: *p<0.05; **p<0.01.

Table 5 Results of Univariate and Multivariate Analysis of Factors Affecting Lean Mass Index in Patients with Asthma

Covariates	Univariate Model		Multivariate Model	
	Beta Coefficient (95% CI)	*p*-value	Beta Coefficient (95% CI)	*p*-value
Age	0.028 (−0.017, 0.073)	0.219	0.020 (−0.024, 0.064)	0.370
Sex (male)	1.939 (0.676, 3.201)	0.003**	1.864 (0.533, 3.195)	0.007**
Pack-year	0.014 (−0.024, 0.053)	0.458	−0.022 (−0.061, 0.016)	0.247
Smoking status (current)	−1.136 (−4.262, 1.989)	0.468	−0.221 (−3.133, 2.691)	0.878
Oral corticosteroids	−0.720 (−1.449, 0.008)	0.052	−0.661 (−1.312, −0.010)	0.046*
Sedentary time	−0.006 (−0.012, −0.001)	0.013*	−0.006 (−0.012, −0.001)	0.013*

Notes: *p<0.05; **p<0.01.

Table 6 Results of Univariate and Multivariate Analysis of Factors Affecting ESM_{CSA} in Patients with Asthma

Covariates	Univariate Model		Multivariate Model	
	Beta Coefficient (95% CI)	*p*-value	Beta Coefficient (95% CI)	*p*-value
Age	−6.748 (−120.655, 7.158)	0.335	−8.691 (−19.405, 2.023)	0.109
Sex (male)	868.619 (549.805, 1187.733)	<0.001**	909.023 (592.343, 1225.703)	<0.001**
Pack-year	7.696 (−4.722, 20.116)	0.219	−13.118 (−24.631, −1.606)	0.026*
Smoking status (current)	667.069 (314.316, 1019.823)	<0.001**	542.803 (176.712, 908.894)	0.004*
Oral corticosteroids	−110.024 (−354.105, 134.658)	0.370	−143.143 (−316.968, 30.682)	0.104
Sedentary time	−0.805 (−2.305, 0.695)	0.286	−1.071 (−2.139, −0.002)	0.049*

Notes: *p<0.05; **p<0.01.

and LMI in the univariate and multivariate analyses (Supplementary Tables 1 and 2). The use of corticosteroids was associated with a low LMI but showed no significant relationship with FMI (Tables 4 and 5). Patients with asthma with step counts of less than 7000 steps exhibited higher FMI, while those with sedentary time of less than 6 hours exhibited higher LMI (Figure 1). Prolonged sedentary time was negatively correlated with ESM_{CSA} after adjusting for background factors (Table 6).

Discussion

This cross-sectional study investigated the link between physical activity, sedentary behavior, and body composition in patients with asthma using objective measures. Prolonged sedentary time was independently associated with reduced LMI and ESM_{CSA}, whereas a low number of steps was correlated with increased FMI after adjusting for background factors such as oral corticosteroid use. These findings indicate that sedentary behavior and reduced physical activity contribute to reduced LMI and ESM_{CSA} and increased FMI in patients with asthma. Therefore, interventions designed to mitigate these behaviors may be essential for improving health outcomes in this population.

First, this study revealed that a prolonged sedentary time, along with oral corticosteroid use, was associated with low LMI, independent of background risk factors in patients with asthma. A negative correlation was also observed between prolonged sedentary time and ESM_{CSA} after adjusting for background factors. This is consistent with the association between sedentary behavior and reduced muscle mass in patients with asthma. Low LMI and ESM_{CSA} could serve as

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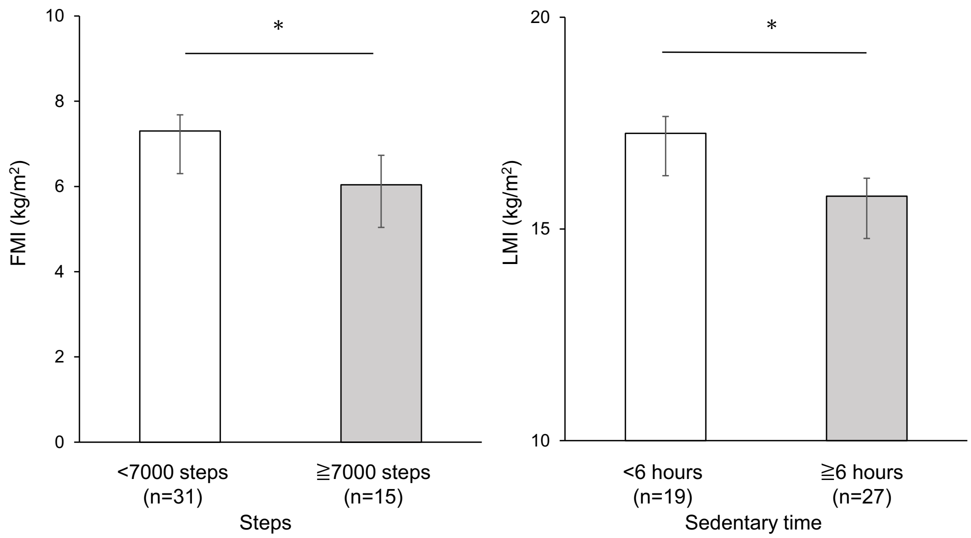

Figure 1 Relationship between steps and FMI, and between sedentary time and LMI. Data are presented as mean ± standard error of the mean. *: $p < 0.05$.

potential indicators of sarcopenia and as independent poor prognostic factors for cardiovascular and respiratory diseases.[8,9,24,25] The present results indicate that a prolonged sedentary time may result in low muscle mass, potentially affecting the health status of patients with asthma. Additionally, the use of systemic glucocorticoids can cause myopathy through direct catabolic effects on skeletal muscle, resulting in proximal muscle weakness and atrophy.[26,27] A recent report revealed that in patients with asthma, the long-term use of oral corticosteroids was associated with decreased lean mass, as estimated by bioelectrical impedance analysis.[28] Our findings enhance the current understanding by demonstrating that a prolonged sedentary time is independently associated with reduced muscle mass, even when accounting for background factors such as oral corticosteroid use in patients with asthma.

This study also demonstrated that a low step count was independently associated with high FMI in patients with asthma. In a previous study, we examined the association between asthma phenotypes and physical activity levels. We found decreased physical activity in patients with an obese non-eosinophilic asthma phenotype.[14] An elevated FMI, independent of BMI classification, could serve as a distinct risk factor for cardiovascular disease and insulin resistance.[29,30] In patients with asthma, increased fat mass is correlated with greater asthma severity, potentially due to inflammatory responses and dysregulated adipocytokine secretion from adipose tissue.[31,32] Therefore, the results of the current study suggest that reduced physical activity may increase metabolic and cardiovascular health risks through increased fat mass, and influence asthma severity.

This study revealed that poor symptom control was linked to prolonged sedentary time and few steps taken by patients with asthma. A previous study on severe asthma demonstrated that, while poor symptom control was associated with prolonged sedentary time, no significant difference was observed in sedentary time between patients with asthma and control participants.[33] These results are consistent with the outcomes of the current study. Moreover, the present results highlight a link between elevated eosinophil levels and prolonged sedentary time in patients with asthma. In patients with asthma, elevated blood eosinophil counts are associated with decreased respiratory function, poor symptom control, exacerbations, and exercise-induced bronchoconstriction.[34–37] In this study, 28 patients had allergic rhinitis, 6 had allergic dermatitis, and 6 had food allergies. However, allergic diseases other than asthma were not associated with elevated blood eosinophil counts or prolonged sedentary time. In patients with diabetes, hyperglycemia and insulin resistance have been reported to be associated with sedentary time, and prolonged sedentary time correlates with body composition deterioration.[38–40] In patients with asthma, the present study identified that factors related to the disease itself, including poor symptom control and blood eosinophil count, were associated with objectively measured sedentary time. This suggests that sedentary time in patients with asthma is associated with the disease pathophysiology. The motivation of patients with asthma to improve their physical activity can be hampered by variable asthma symptoms and airway hyperresponsiveness caused by airway inflammation.[41] Therefore, appropriate pharmacological management, along with guidance to promote physical activity, is important for enhancing physical activity levels in patients with asthma.

Allergic rhinitis and sinusitis have been associated with airway inflammation, asthma severity, and reduced QOL.[42–44] However, no significant associations were observed in this study between these comorbidities and step count or sedentary time. One possible explanation is that the patients included in this study were also receiving treatment for comorbidities. Additionally, the small sample size may have limited the ability to detect significant differences among patients with these comorbidities. Further large-scale investigations are required.

Limitation

This study has several limitations. First, the study was performed in a relatively small cohort. Second, we excluded patients with recent exacerbations, resulting in an underestimation of the association between exacerbations, step count, and sedentary time. Third, a longer measurement period for physical activity could have improved the generalizability of the findings. Fourth, the body composition of healthy controls was not evaluated in this study. Fifth, this study was a cross-sectional analysis; therefore, the causal relationship between step count, sedentary time, and clinical outcomes remains unclear. Future longitudinal studies and clinical trials are needed to clarify the causal relationship between physical activity and body composition and future health outcomes. Finally, the study period partially overlapped with the coronavirus disease 2019 (COVID-19) pandemic. Participants were instructed to record in a diary any days when they refrained from going outside or engaging in physical activity due to the COVID-19 prevention measures. Two patients reported days when they were unable to go outside or engage in physical activity for this reason, and data from those days were excluded from the analysis. However, the potential impact of COVID-19 on study results cannot be entirely ruled out.

Conclusion

The results of this cross-sectional study indicate that sedentary behavior and physical inactivity are associated with body composition in patients with asthma. Elevated blood eosinophil count and poor symptom control have been linked to increased sedentary time and a reduced step count in patients with asthma. Our findings suggest that sedentary behavior and physical inactivity could serve as modifiable risk factors in the management of asthma, although further research is required to establish causality. Further research is required to determine whether a comprehensive approach involving both pharmacological treatments and non-pharmacological interventions to increase physical activity can improve body composition and health outcomes in patients with asthma.

Abbreviations

QOL, quality of life; DEXA, dual-energy X-ray absorptiometry; CT, computed tomography; ESM, erector spinae muscles; ESM_{CSA}, ESM on cross-sectional area; COPD, chronic obstructive pulmonary disease; ACQ, Asthma Control Questionnaire; mMRC, modified Medical Research Council; 6MWD, 6-minute walk distance; FMI, fat mass index; LMI, lean mass index; BMI, body mass index; OSAS, obstructive sleep apnea syndrome; COVID-19, coronavirus disease 2019.

Data Sharing Statement

All data relevant to this analysis are included in this article.

Ethics Approval and Consent to Participate

This study was performed in accordance with the Declaration of Helsinki and approved by the institutional review board of all participating institutions, Ethical Review Board of Kochi Medical School, Ethical Committee for Epidemiology of Hiroshima University, Research Ethics Committee of Yamaguchi Medical University, and Medical Research Ethics Committee, Shimane University Faculty of Medicine. This study was registered on the UMIN Clinical Trials Registry (UMIN000035988).

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

H.I. has speakers fee from AstraZeneca, Glaxo SmithKline, Novartis Pharma, Boehringer Ingelheim Sanofi, and Kyorin Pharmaceutical.

N.H. has speakers fee from Sanofi.

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A.Y. has AstraZeneca, Glaxo SmithKline, Novartis pharma, Kyorin Pharmaceutical, and Boehringer Ingelheim.

K.K., T.O., K.M., A.F-C., Y.A., and Mayuka Yamane have nothing to declare.

The authors report no other conflicts of interest in this work.

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