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A nested case-control study: Personal, social and environmental correlates of vigorous physical activity in adolescents with asthma*

Running head: **Correlates of physical activity in asthma**

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Abstract

Objective: Physical activity (PA) is associated with health benefits. Children and adolescents with asthma may be limited in their physical activity, particularly at vigorous intensity due to asthma symptoms or poor psychological adjustment to asthma. We aimed to investigate if self-perceived competence, enjoyment, support from others and social-physical environment were associated with vigorous physical activity (VPA) and secondarily to assess if such associations were modified by asthma and asthma **severity**.

Methods: Data from a nested case-control study at 13 years of age within the birth-cohort Environment and Childhood Asthma Study were compiled from 95 participants with and 79 without asthma. The participants completed a questionnaire designed to capture self-perceived competence, enjoyment, support from others and social-physical environment. VPA, defined as ≥6 Metabolic Equivalents, was recorded objectively by SenseWear^{TM} Pro$_2$ Armband. Asthma **severity** was assessed pragmatically by lung function and use of inhaled glucocorticosteroids and β_2-agonists, and incidence of exacerbations in the last 14 days. Data were analysed using linear regression analysis.

Results: No significant differences between adolescents with and without asthma were identified in terms of VPA, competence-enjoyment, support from others and social-physical environment. Peer support (b = 0.29 (0.05, 0.52)) and competence-enjoyment (b = 0.23 (0.01, 0.44)) were significantly and positively associated with VPA, and teacher support (b = -0.26 (-0.50, -0.02)) were inversely associated. The model explained 25% of the variance in VPA.

Conclusions: **Peer support and competence-enjoyment were positively associated with increased VPN in adolescents irrespectively of asthma and asthma severity.**

Introduction

Physical activity (PA) is associated with health benefits, and positively affects psychological functioning, quality of life, morbidity and cardiorespiratory fitness (1, 2). PA is also associated with improved self-esteem, social interaction and fewer depression symptoms (3). Physical exercise is well tolerated and recommended for patients with asthma (2, 4, 5). However, in studies it have been shown that children with asthma and poor disease control have lower levels of objectively recorded vigorous physical activity (VPA) (6). A similar distinction is reported in children with asthma overall by self-reported VPA (7). Objective recording may though be more adequate to capture actual PA (8). However, differences in moderate to vigorous physical activity (MVPA) are not evident in either of the studies (6, 7), which is confirmed in a Norwegian cohort (9), of which this study depends on. Furthermore, van Gent et al (10) did not found lower level of VPA based on both self-reports and objective recordings, and neither did Nystad (11) at any level of exercise frequency or exercise hours a week in asthma based on self-reports. Even though asthma control and severity are associated with level of PA (1, 6, 7), and that increased intensity and exercise load is associated with bronchoconstriction (12), there is also evidence that psychosocial and socio-demographical factors and knowledge/competence are important for level of physical activity in children and adolescents with asthma (1, 13-18). Parents observing shortness of breath in their child may lead them to restrain their children from exertion (14), with subsequent increasing fear of breathlessness followed by personal or parental restrictions (15, 16).

Physical activity in school-children and adolescents in general are determined by a complex mixture of psychological and social factors and differs in form throughout different locations (19). **Competence and enjoyment scales derived from Harter´s competence motivation theory (20) in which these two aspects are regarded as highly related (21), scales on support from significant others which are emanated from Bandura´s social-cognitive**

theory, and social-physical environment scales including opportunity, facility and license to PA are shown to capture such factors(21). Age accounts for a considerable amount of variance while the supportive role from adults diminishes as they get older (19). However, male gender (22), parental support (19, 22, 23), (22) parental social support (24), teacher support (19, 23, 25) and peer support (22, 23) are positively associated with enhanced PA, whereas inverse associations have been observed for parental emotional support for adolescent girls (24) and higher BMI z-score (22). Perceived school environment is reported as associated with PA (25) while environmental factors have been reported to be of limited, no or unclear impact on PA (19, 21-23).

In order to improve motivational strategies for children with asthma to be physically active, we aimed to investigate if self-perceived competence, enjoyment, support from others and social-physical environment were associated with VPA and secondarily to assess if such associations were modified by asthma and asthma severity.

Materials and Methods

Study design

The present nested case-control study includes data from a 13 year follow up (9) between October 2005 and June 2006 of the Environment and Childhood Asthma (ECA) study in Oslo, Norway (26). The study initially enrolled 3754 children from a general urban population. The 1250 children who had their lung function measured at birth (27) and/or attended an investigation in the two-year nested case control study based upon recurrent bronchial obstruction versus no lower respiratory tract disease (n=562) were invited for a 10-year follow-up study, attended by 1019. Further details of study design are given elsewhere (27, 28).

The present study included adolescents who were defined with current asthma at 10 years of age and/or at 13-year inclusion using the following definitions:

Asthma was defined by the presence of at least two of the following three criteria (28): (a) dyspnoea, chest tightness and/or wheezing, (b) doctors diagnosis of asthma and/or (c) use of asthma medication (β_2-agonists, sodium chromoglycate, corticosteroids, leukotriene antagonists and/or aminophylline).

Current Asthma at 10 or 13 years was defined asthma, plus at least one of the following three criteria fulfilled (28): (a) Dyspnoea, chest tightness and/or wheezing in the last 12 months, (b) use of asthma medication (β_2-agonists, sodium chromoglycate, corticosteroids, leukotriene antagonists and/or aminophylline) in the last 12 months and/or (c) a positive exercise-induced asthma test (conducted at 10 years only).

During the 13-year follow-up visit the adolescents attended a 1 day clinical examination and 4 days home monitoring of PA.

The study was approved by the Norwegian Data Inspectorate as well as by the Regional Committee for Medical Research Ethics. Written informed consent to take part was obtained from the participating children and their parents.

Subjects

All 310 adolescents who at the 10-year follow-up investigation of the ECA study had defined current asthma and the child born closest in time without a history of lower respiratory disease were asked to attend the 13-year follow-up investigation (28). Fifty-six per cent (n= 174) agreed to participate, 95 (66 boys) with current asthma at the 10-years or at 13-year inclusion, and 79 (41 boys) without asthma were included in the present study. At 13-year inclusion, 4 adolescents without asthma from 10-year follow-up had current asthma by definition above.

In the present 13-year follow-up there were no difference between attendees and decliners at 10 years of age with respect to socioeconomic factors (income and education), body mass index (BMI), lung function, bronchial hyper responsiveness, use of inhaled corticosteroids or β_2-agonists, prevalence of wheeze and exercise induced bronchoconstriction (28).

Methods

*All p*articipants with asthma used their regular medications, whereas the investigations were postponed whenever appropriate to ensure at least three weeks with no signs or symptoms of any respiratory tract infection.

Study personnel performed a parental structured interview including questions related to airways symptoms and any medication used by the child (28, 29).

Self-perceived personal, social and environmental factors were assessed by a paper-based validated self-report questionnaire (Table 1) (19, 21, 23) completed by the adolescent on the clinical visit. The questionnaire is designed to capture theoretically derived relevant perceived personal, social and environmental factors shown to influence PA in children.

Physical activity levels were recorded using the SenseWear^{TM} Pro$_2$ Armband (BodyMedia Inc. Pittsburgh, PA, USA) and computed at 1-minute intervals, randomly started on a Wednesday or on a Sunday and included three week-days and one weekend-day. Data from the monitor was downloaded and analysed with software developed by the manufacturer of the Armband (Innerview Professional Research Software Version 5.1). Physical activity data were adjusted for the mean hours each day the Armband was worn, to acquire 24hrs units. Days were the Armband was worn less than 19.2hrs (80%) are excluded from analysis.

VPA was defined as PA above 6 Metabolic Equivalents (METs). Moderate physical activity (MPA) was defined as PA with cut of points between 3 and 6 METs.

Body weight was measured with the subject wearing light clothing and without shoes (Seca 709, Germany). Height was measured to the nearest 0.5 cm by using a stadiometer. Body mass index was calculated as body mass (kg) divided by height (m) squared. Overweight were defined according to Cole et al (30). Skin fold thickness was measured with a Harpenden skin fold calliper (Holtain, Dyfed, UK) at the biceps, triceps, subscapular and suprailiac region and given as the sum of the four measurements.

Lung function was measured by maximum forced expiratory flow-volume curves (Masterlab, Erich Jaeger® GmbH & Co KG, Würzburg, Germany) and reported as forced expiratory volume in one second (FEV_1), forced vital capacity (FVC) and forced expiratory flow at 50% of FVC (FEF_{50}). Measurements were conducted according to criteria of European Respiratory Society and American Thoracic Society (31). The predicted values of Zapletal et al. (32) were used for comparisons.

Highest recorded oxygen uptake (VO_{2max}) expressed in ml $kg^{-1}*min^{-1}$ during treadmill running (Woodway Gmbh, Weil am Rhein, Germany) until exhaustion was measured (9). Heart rate was recorded every minute (Polar Vantage, Polar Electro KY, Kempele, Finland). Minute ventilation, respiratory exchange ratio and oxygen uptake were measured and recorded every minute after 4 min of running using an oxygen analyser with mixing chamber (Oxycon Champion, Erich Jaeger® Gmbh &Co KG, Hoechberg, Germany). Calibration was conducted before each test. The main criterion for having reached maximal effort was a subjective assessment by the test leader that the participant had reached his or her maximal effort. The second criterion was a respiratory exchange ratio above 1.00, heart rate above 190 beats * min^{-1} or reporting perceived exertion above 17 using the Borg-RPE-Scale (33).

Asthma **severity** was assessed pragmatically by use of inhaled glucocorticosteroids last 14 days, use of β_2-agonists last 14 days, incidence of exacerbations in the last 14 days and lung function (assessed by FEF_{50}).

Statistical analysis

Continuous data are reported as mean with standard deviation when normally distributed and median with interquartile range elsewhere. Categorical data are reported as numbers and per cent.

Bivariate analysis using independent t-test, Mann-Whitney Wilcoxon tests and Chi-Square-test were performed when comparing adolescents with asthma and controls. Linear regression analysis was used to detect associations between VPA/MPA, and gender, skin fold thickness, asthma, use of inhaled glucocorticosteroids last 14 days, use of β_2-agonists last 14 days, incidence of exacerbations last 14 days, lung function assessed by FEF_{50} and seven relevant personal, social and environmental factors (as presented in Table 1), and interactions between significant variables in the model. Jackknife Residuals and Cook´s d were used to assess the underlying assumptions of the analysis of covariance. First, bivariate regression analysis were conducted with each dependent variable (VPA and MPA). Second, multivariate linear regression analysis were conducted. The independent variables were removed stepwise retaining the most significant independent variables until only significant variables remained.

To test the construct validity for the instrument of PA-influencing factors in the current cohort, exploratory factor analysis with varimax rotation was conducted. In the parental practical support, teacher support and physical-social opportunity scales one item each with poor loading were removed to increase internal reliability. **In the current case, an abbreviated version (enjoyment three items and perceived competence two items) from the enjoyment and competence subscales (21) was used. Exploratory factor analysis**

revealed these five items to load on one factor which was labelled *competence-enjoyment*. Hence, competence and enjoyment were collapsed to represent one scale. Cronbach´s α was used to assess the internal reliability of the personal, social and environmental factors within the study sample. Table 1 presents factors including examples of items in questionnaire, number of items in each factor, response format and Cronbach´s α values. Internal consistency values (α) were in the range of 0.48-0.82. Scores were reversed in case of questions formulated disparate to ensure accordance between increased score and increased positive value of factors.

Statistical significance level was set to 5%. Statistical analyses were performed with Statistical Package for Social Sciences Version 19.0 (SPSS, Chicago, IL, USA).

Results

The characteristics of the attending adolescents are presented by adolescents with and without asthma in Table 2. In Table 3, median score of the seven personal, social and environmental factors are presented by group.

Age, height, weight, MPA, VPA, VO_{2max}, skin fold thickness (Table 2), competence-enjoyment, support from others (4 factors) and perceived environment (2 factors) scores (Table 3) were not significantly different between groups. Neither were there significantly more participants who were overweight in any of the groups (Table 2). Adolescents without asthma had significantly better lung-function (FEV_1 % of predicted values, FEV_1/FVC, FEF_{50} % of predicted values), and there were significantly more boys in the group of adolescents with asthma compared to those without (71% vs. 52%, *p*-value 0.01) (Table 2).

In linear regression analysis peer support and competence-enjoyment were significantly and positively associated with VPA, and female gender, skin fold thickness and teacher support were inversely associated (Table 4). The final model explained 25% of the variance in VPA. Participants reporting one point higher perception of peer support had increased VPA of 0.29 hours each day. Participants reporting one point higher perception of the competence-enjoyment scale perceived their competence-enjoyment as increased and were 0.23 hours more in VPA. Participants reporting one point higher perception of teacher support were 0.26 hours less in VPA. There were no significant association between MPA and either factor included in the model (results not shown).

No significant interactions between asthma or gender and peer support, teacher support, and competence-enjoyment were detected in association with VPA.

Discussion

Peer support and competence-enjoyment were significantly associated with increased time spent in VPA for both adolescents with and without asthma and female gender, skin fold thickness and teacher support were inversely associated. The model explained 25% of the variance. **Asthma and markers of asthma severity did not modify the associated factors of VPA.** Adolescents with and without asthma were not significantly different in time spent in VPA, aerobic fitness, perceived competence-enjoyment and support from others or in perception of their environment.

Similar level of VPA in adolescents with and without asthma as in the present study is presented and discussed previously based on the same cohort (9, 34). Self-perceived competence, enjoyment, support from others and social-physical environmental factors related to PA are general and not asthma-specific. Nevertheless, such personal, social and environmental factors that may contribute to higher levels of PA in the general population may be even more important in asthma.

As previously shown in the ECA study, aerobic fitness is shown to be associated with VPA in adolescents with asthma **which confirms the importance of VPA to improve fitness.** (34). Research support that exercise intensity above 80% of maximal heart rate improves aerobic fitness to a greater extent than moderate exercise intensity (35). Factors contributing to more time spent in VPA may thereby be essential for adolescents with asthma to avoid a decreasing fitness which may increase physiological barriers of PA and subsequent fear of breathlessness and personal and parental restrictions of PA (15, 16).

We have not found any studies published who have evaluated perceived personal, social and environmental factors shown to influence VPA in adolescents with asthma. While adolescents with and without asthma did not differ significantly by time spent in VPA or by competence-

enjoyment, support from others and perception of their physical-social environment, it is appropriate to consider the results compared with school children in general (a population without asthma). Peer support (19, 23), self-efficacy (23), parental support (19) and teacher support (19, 25) are associated with increased PA. Peterson et al (24) reported that parental social support is associated with increased PA in both girls and boys, but for boys indirectly through self-efficacy while parental emotional support is negatively associated with PA for adolescent girls (24). Perceived personal, social and environmental factors associated with VPA (contrary to moderate to vigorous PA) in adolescents are less studied than level of PA in general, but Allison et al (36) found self-efficacy to be predictive of self-reported VPA in high school students and Corder et al (22) found peer support to be associated with VPA in weekdays and family logistic support in weekend-days.

In the present study the association between VPA and the one factor solution of competence-enjoyment may reflect a sense of mastery and enjoyment as being two sides of the same coin in young people; both important prerequisites for enhanced VPA. Our finding would be in accordance with competence motivation theory (20) and knowledge on predictors of PA in general (16, 23, 24, 36). Competence-enjoyment which theoretically resembles an intrinsically motivational orientation may represent a resource to overcome possible physiological barriers of VPA. Indeed, perceived competence and enjoyment of PA have been shown to associate positively with enhanced PA(19, 23). In a previous study on children and adolescents in general where social and functional outcome expectations also were measured, these dimensions were inter-correlated with competence and enjoyment (21). Accounting for adolescents with asthma´s possible fear of breathlessness or asthma symptoms during PA (15, 16), or their possible poor psychological adjustment (1), one could expect a distinct association with VPA for adolescents with asthma compared with adolescents without. Contrary, as long as activity

level of adolescents with and without asthma are similar, one could assume that competence-enjoyment is an important factor of VPA for adolescents in general. Irrespective of whether low level of competence-enjoyment and thereby lower level of PA is explained by barriers related to asthma symptoms, or barriers related to cardiorespiratory exhaustion in general, competence-enjoyment may be an independent factor determining level of PA. Lack of significant interaction between group and competence-enjoyment in the present study support this interpretation.

As far as peer support is concerned, the factor's association with VPA is sensible compared with previous research (14, 16, 19, 21-24). Children and adolescents with asthma endeavour to be "normal" amongst peers (37) which may contribute to the **perception** of peer support by those with high level of PA and that boys participate in 0.55 hours more VPA each day than girls in the present study. Gender differences in PA are well known in several studies (7, 22, 24, 38)., We found, however, no interaction between peer support and gender in association with VPA and may interpret peer support as a contributor of VPA irrespectively of gender. **We would, nevertheless, be careful about conclusions of whether peer support is casual to VPA or concurrent. The association may appear as those who are physically active and engage in sports with peers also perceive peer support to a greater extent. Theoretical derivation of the concept, and previous validation of the scales however, support that peer support is a contributor of PA** (19, 21).

The lack of associations between VPA and parental support and a negative association with teacher support are not in accordance with previous studies (19, 22-25). Differences in findings could be related to age of participants as we may assume that teacher support is less important for a 13 years old than a 10 years old (25). One may also assume that those individuals who participate in less VPA receive more articulated support from teachers who want them to be more in PA. Skin-fold thickness were a confounder of teacher support in the

analysis, which may support an interpretation that adolescents who are less active and have larger skin-fold thickness receive inefficient support from their teachers. The negative association may then be interpreted as concurrent rather than a casual relation. Lack of association between VPA and parental practical and emotional support as in the present study may also be explained by age of subjects. Studies showing a positive association between PA and different parental support are all based on participants who are younger (9-11 years)(21-23, 25) than the subjects in the present study, or studies with a larger range of age in subjects (19). Older subjects seems less sensible of parental support (19). Concerning parental restrictions to PA by fear of breathlessness in children and adolescents with asthma (15, 16), one may also expect the association to be negative. Lack of negative significant association of parental support may thereby be interpreted as satisfactory.

As far as safe environment and physical-social opportunity is concerned we are not surprised by the lack of association with VPA since evidence in former research is not concurrent (13, 19, 21-23, 25). Environment may change through seasonal variations and differences between weekdays and weekend days may influence the role of the environment. Further exploration and validation of the measurement of perception of environment is also needed (21). Environment may also be less important for 13 years old than younger children. Questions were stated with `neighbourhood´ or `nearby home´ and one could expect increased physical range and more independent management of insecure environment in older children.

We have not found any studies where personal, social and environmental factors determining level of PA are evaluated in adolescents with and without asthma, but several factors have been described in different terms in both qualitative and quantitative studies in patients with asthma at different ages. Knowledge, perception of symptoms, disease and treatment (14), exercise tolerance (17), winter season (cold air/air-pollution)(13, 16), time constraint, lack of motivation, less self-efficacy, and perceived asthma severity (16) are associated with low

level of PA or inactivity. Social support are identified as an important facilitator of PA (16). Summer season, larger home, younger mothers, mothers who do not work or attend school, and being a boy are all correlated with increased PA in a cohort of urban 4-year old children in New York (13). These factors may all be related to aspects of competence-enjoyment, support from others and environmental factors.

The main strengths of the present study are the objective recording of PA which gives reliable and valid measurements (8), and the nested case-control design in a population based birth-cohort (9, 26-28). The standardized instrument used to measure perceived personal, social and environmental influences on PA also strengthen the study. Previous research shows that indexes of the questionnaire are valid (19, 21, 23), and internal consistency of the present significant factors (α: 0.82, 0.73, 0.60) are satisfactory. However, environmental factors (safe environment/physical-social opportunity) are divided differently in the present study and low internal consistency of these latter factor (α: 0.48) is a methodological limitation to be considered. The present findings regarding parental support in the study may also be biased due to a non-ideal consistency of the measurement of the factors (α: 0.59, 0.68) and may fail to capture the intricate and contradictory association between VPA and parental practical support and parental emotional support as reported by Petersen et al (24). When conducting exploratory factor analysis we found competence and enjoyment to load on one dimension. Whereas competence and enjoyment with PA may be regarded conceptually different (19), children may nevertheless perceive them as integrated. Good fit indices obtained in a confirmatory factor analysis of an enjoyment-competence dimension in a previous study (21) support the view that competence and enjoyment could be considered two sides of the same coin.

Findings in the present study should be considered when developing interventions to increase level of PA in adolescents with asthma or in the general population. If interventions are

designed to increase enjoyment, underpin competence and are carried out in an environment of supportiveness including peer participation, we may assume that VPA will increase(19). **Enjoyable activities accommodated to adolescents´ abilities may support perceptions of competence and enjoyment, and reinforce an intrinsic motivational orientation towards PA.** We cannot; however, rule out the importance of parental or teacher support, or the physical-social environment as important factors (19, 21-25) to consider when designing interventions to increase PA. Psychosocial factors associated with PA may be complex (19, 21, 24) and we consider statistical explained variance of 25% as satisfying to point out the importance of competence-enjoyment and peer-support. Nevertheless, we suggest that peer support and competence-enjoyment should be central elements of PA interventions for adolescents with or without asthma. Considering similar level of VPA in girls and boys as an objective, we suggest females may have exceptional focus in certain interventions.

Conclusion

In conclusion peer support and competence-enjoyment are positively associated with level of PA in adolescents irrespectively of asthma and asthma severity. These may be perceived as resources in adolescents´ own premises to enable VPA in adolescents with asthma. Interventions to increase PA ought to be designed to maximize peer support, competence and enjoyment to succeed.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing the paper. The present study was supported by grants from the South-Eastern Norway Regional Health Authority.

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Table 1. Self-perceived personal, social and environmental factors with cronbachs α, and example of items from questionnaire measured by scales.

	N of items	α
Parental practical support (response format 1-4[a])	2	0.59
How often does your mother or father take you to exercise or play sports?		
Parental emotional support (response format 1-4[a])	2	0.68
How often does your mother or father encourage you to play, exercise or do sports?		
Peer support (response format 1-4[a])	3	0.82
How often do your friends exercise or play sports with you?		
Teacher support (response format 1-4[a])	2	0.60
How often does your teacher talk about exercise in lessons?		
Competence-enjoyment (response format 1-5[b])	5	0.73
I wish I could play more games and sports than I get chance to.		
Safe environment (response format 1-5[b]**)**	4	0.75
It is safe to walk or play alone in my neighbourhood during the day.		
Physical-social opportunity (response format 1-5[b])	2	0.48
There are other children nearby home to go out and play with.		

[a]Response format 1-4; 1= never or hardly ever, 2=once or twice a week, 3= almost every day, 4=every day
[b]Response format 1-5; 1= does not suit for me, 5= suits for me

Table 2. Descriptive data of participants presented by adolescents with and without asthma. Data are given as mean and standard deviation (SD) in parentheses unless otherwise stated[a].

	Adolescents with asthma (n=95) Mean (SD)	**Adolescents without asthma** (n=79) Mean (SD)	***P*-value[b]**
Age (yrs); *Mean (Min-Max)*[a, c]	13.6 (12.8-14.3)	13.6 (12.6-14.3)	0.64
Height (cm)	164 (9)	162 (7)	0.16
Weight (kg)	53 (11)	50 (10)	0.09
FEV_1 (% of predicted) [c]	100 (13)	104 (13)	**0.04**
FEV_1/FVC [c]	85 (7)	87 (6)	**0.01**
FEF_{50} (% of predicted) [c]	86 (21)	98 (22)	**<0.001**
Skin fold thickness (mm)	37.3 (13.1)	36.1 (12.8)	0.55
VO_{2max} (ml $kg^{-1} * min^{-1}$)	53.5 (7.7)	53.4 (9.2)	0.95
Vigorous PA (hours · day^{-1}); median (IQR) [a, c]	1.21 (1.33)	1.31 (1.26)	0.94
Moderate PA (hours · day^{-1}); median (IQR) [a, c]	3.59 (2.06)	3.46 (1.78)	0.27
Boys; n(%)[a]	67 (71)	41 (52)	**0.01**
Overweight; n(%)[a]	15 (16)	8 (11)	0.29
Use of ICS last 14 days; n(%)[a, c]	30 (32)	NA	-
Use of β_2-agonists last 14 days; n(%)[a]	35 (37)	NA	-
Asthma exacerbations last 14 days; n(%)[a]	11 (12)	NA	-
Self-reported exercise induced asthma exacerbations; n(%)[a]	34 (36)	NA	-

Activity limitations due to asthma; n(%)[a]	21 (22)	NA	-

[b] *P*-values for any differences between groups. Statistic significant differences between groups are given in bold

[c] Abbreviations: Min, minimum; Max, maximum; $FEV_{1,}$ forced expiratory volume in 1 s; FVC, forced vital capacity; FEF_{50} forced expiratory flow at 50% of FVC; PA, physical activity; IQR, interquartile range; ICS, inhaled corticosteroids; NA, non-applicable.

Table 3. Median score of perceived personal, social and environmental factors presented by adolescents with and without asthma. Data are given as median with Interquartile Range (IQR) in parentheses.

	Adolescents with asthma (n=82) Median (IQR)	**Adolescents without asthma** (n=65) Median (IQR)	***P*-value**[a]
Parental practical support	1.75 (1.38)	1.50 (1.00)	0.66
Parental emotional support	2.50 (1.50)	2.00 (1.00)	0.86
Peer support	2.33 (1.00)	2.33 (0.67)	0.10
Teacher support	1.50 (1.00)	1.50 (1.00)	0.93
Competence-enjoyment	3.80 (1.20)	3.90 (1.05)	0.97
Safe environment	5.00 (0.75)	5.00 (0.31)	0.14
Physical-social opportunity	4.50 (1.00)	4.50 (1.50)	0.44

[a] *P*-values for any differences between groups.

Table 4. Regression coefficients for associated factors of objectively measured VPA in a linear regression model. Statistically significant coefficients are given in bold.

	Bivariate analysis		**Multivariate analysis**	
	Coefficient with 95% Confidence Interval	***P*-value**	**Coefficient with 95% Confidence Interval**	***P*-value**
Girls[a]	**-0.61 (-0.93, -0.29)**	**<0.001**	**-0.55 (-0.86, -0.25)**	**<0.001**
Skin fold thickness (mm)	**-0.02 (-0.03, -0.01)**	**0.001**	**-0.02 (-0.03, -0.01)**	**0.003**
Asthma[b]	-0.02 (-0.35, 0.30)	0.89	-0.18 (-0.47, 0.12)	0.24
FEF_{50} (% of predicted)	-0.004 (-0.01, 0.003)	0.28	-	-
Use of ICS last 14 days[c]	-0.01 (-0.44, 0.42)	0.96	-	-
Use of β_2-agonists last 14 days[c]	-0.06 (-0.46, 0.34)	0.77	-	-
Asthma exacerbations last 14 days[c]	0.00 (-0.63, 0.64)	0.99	-	-
Parental practical support	0.17 (-0.08, 0.41)	0.19	-	-
Parental emotional support	0.08 (-0.11, 0.28)	0.39	-	-
Peer support	**0.42 (0.18, 0.66)**	**0.001**	**0.29 (0.05, 0.52)**	**0.02**
Teacher support	-0.13 (-0.40, 0.13)	0.33	**-0.26 (-0.50, -0.02)**	**0.04**
Competence-enjoyment	**0.41 (0.20, 0.62)**	**<0.001**	**0.23 (0.01, 0.44)**	**0.04**
Safe environment	0.08 (-0.13, 0.30)	0.44	-	-
Physical-social opportunity	0.17 (-0.07, 0.36)	0.06	-	-

[a]Girls with reference to boys
[b]Asthma with reference to non-asthma
[c]Yes with reference to No