Research Square

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Disability and Risk of Asthma in young adults : A Nationwide Population-Based Cohort Study

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Abstract

Background

Asthma is a common chronic airway disease influenced by various factors, including emerging evidence suggesting the role of disability. However, the association between disability and asthma risk remains understudied in young adults.

Methods

We conducted a retrospective cohort study using data from the Korean National Health Information Database, including 5,369,424 adults aged 20 to 39 years who underwent health screening between 2009 and 2012. Incident asthma was identified using diagnostic codes, and multivariable Cox proportional hazards models were employed to assess its association with disability after adjusting for key demographic and clinical factors.

Results

Among 5,369,424 participants, 1.5% had a registered disability. During a median follow-up of 11.5 years, individuals with disabilities had modestly increased risk of developing asthma compared to those without disabilities (adjusted hazard ratio, 1.14; 95% confidence interval, 1.11–1.16). Stratified analyses showed elevated asthma risk in those with epilepsy, mental disorders, physical disabilities, and visual impairment, while autism spectrum disorder was associated with reduced risk.

Conclusion

Disability in young adults is associated with a modest increase in risk of incident asthma, with risk varying by disability type. These findings highlight the importance of inclusive health surveillance and further research into the underlying mechanisms.

Trial registration

Not applicable.

Introduction

Asthma is a common chronic inflammatory airway disease that can develop at any age and is a major contributor to global morbidity and healthcare burden [1]. Although it is well recognized as a childhood-onset condition, increasing attention has been directed toward its high and rising incidence in young adults—a life stage generally considered to be characterized by good health and peak social productivity [2]. This growing concern highlights the importance of identifying and addressing modifiable risk factors specific to this population.

While the pathogenesis of asthma is highly complex and heterogeneous, involving genetic, environmental, and immunological factors [3], increasing evidence suggests a role for social determinants of health, including disability status, that may influence both the development and progression of asthma [4]. In particular, young adults with disabilities may represent a uniquely vulnerable group due to disproportionately high rates of underlying health conditions such as obesity, difficulties with medication adherence without assistance, and overall younger age at diagnosis when compared to non-disabled populations [5]. Notably, several studies have demonstrated that children with disabilities, such as developmental delays, learning disabilities, or hearing and speech impairments, are at greater risk of developing asthma compared to their peers without disabilities [4, 6]. Multiple mechanisms have been proposed to explain this relationship. For instance, systemic hypoxia related to hearing loss has been suggested as a potential contributor to asthma pathophysiology [7]. In children with attention-deficit/hyperactivity disorder, chronic inflammation and elevated stress responses may increase susceptibility to asthma [8]. In addition, acute nonischemic hypoxia during asthma exacerbations has been postulated as a possible biological link between asthma and motor disabilities, such as seizure or cerebral palsy [9, 10]. However, most existing studies were limited by small sample sizes, cross-sectional designs, or a narrow focus on specific subgroups, making it difficult to draw generalizable conclusions regarding asthma risk in adults with disabilities [4, 6]. Moreover, little is known about this relationship in young adults with disabilities, who represent a growing and often underserved population.

In this retrospective cohort study using nationwide health insurance claims and disability registration data, we aimed to investigate the association between disability and the risk of incident asthma in a large population of Korean adults aged 20 to 39 years. Furthermore, we performed stratified analyses to explore whether specific disability types are differentially associated with asthma development.

Methods

Data source

This retrospective cohort study utilized the Korean National Health Information database, which covers nearly 97% of the Korean population [11]. Administered by the National Health Insurance Service (NHIS), the country's sole national health insurer, the dataset includes disease diagnoses categorized according to the 10th revision of the International Classification of Diseases (ICD-10), demographic variables, economic factors, healthcare utilization (outpatient department visits, emergency room visits, hospitalization, and intensive care unit admission), health screening results (smoking status, alcohol consumption, and daily physical activity), medical treatments and procedures, and mortality data provided by Statistics Korea, an initiative of the Korean Ministry of Strategy and Finance.

Study population

From the NHIS database, a total of 6,891,401 individuals aged 20 to 39 years who underwent health screening between 2009 and 2012 were initially identified. After excluding 563,314 individuals with missing screening data and 2,409 individuals who died within one year of follow-up, 911,974 individuals

with at least one healthcare utilization record for asthma (ICD-10: J45–J46) were also excluded. Among the remaining 5,413,704 individuals, an additional 44,280 were excluded based on a one-year of lag period. The final cohort comprised 5,369,424 individuals (**Supplementary Figure 1**). This study was approved by the Institutional Review Board of Samsung Medical Center (IRB No. 2025-05-130). Informed consent was waived as we used a deidentified dataset. This study was conducted in accordance with the principles of the Declaration of Helsinki.

Exposure: Disability

The Korea National Disability Registration System (KNDRS), established in 1989, had registered approximately 2.645 million individuals as of 2021, accounting for about 5.1% of the total population [12]. The system legally defines 15 distinct types of disabilities, broadly categorized into physical and mental disabilities. Physical disabilities include impairments of external or internal bodily functions, while mental disabilities encompass developmental and psychiatric impairments. The 15 current disability types include impairments of the extremities, vision, hearing, speech and language, as well as disabilities due to brain injury, facial deformity, renal failure, heart disease, liver disease, respiratory disorders, ostomy, epilepsy, intellectual disability, autism, and mental disorders. In this study, disability types and severity were extracted from the KNDRS database for analysis.

Outcome: Newly diagnosed Asthma

The outcome was incident asthma, defined as three or more outpatient department visits with the corresponding diagnosis of asthma, coded under ICD-10 J45–J46 during the follow-up period [13-15].

Covariates

Data on basic demographic characteristics (age and sex), health-related behaviors (smoking status and alcohol consumption), and comorbidities were obtained from the study dataset. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). Alcohol consumption was categorized as none, mild (daily alcohol intake >0 and <30 g for men, >0 and <20 g for women), or moderate (daily alcohol intake ≥30 g for men and ≥20 g for women).

Comorbidities were defined based on clinical measurements, medication use, and diagnostic codes, as follows: Diabetes mellitus was defined as a fasting plasma glucose level ≥126 mg/dL or use of antidiabetic medications, along with ICD-10 codes E10–E14. Hypertension was defined as a systolic blood pressure ≥140 mmHg, diastolic blood pressure ≥90 mmHg, or current use of antihypertensive medications in conjunction with relevant ICD-10 codes (I10–I13, I15). Dyslipidemia was defined as a total cholesterol level ≥240 mg/dL or use of lipid-lowering agents with ICD code E78. Atopy was defined as having ICD-10 code L20 with three or more outpatient visits or at least one hospitalization within one year. Allergic rhinitis was defined using ICD-10 codes J30.1–J30.4 with three or more outpatient visits or at least one hospitalization during the same period.

Statistical analysis

Descriptive statistics are presented as number (percentage) for categorical variables and as mean ± standard deviation for continuous variables. Group comparisons between individuals with and without disability were performed using the χ^2 test for categorical variables and the t-test for continuous variables. Multivariable Cox proportional hazards regression models were employed to investigate the association between disability and the incidence of asthma. Covariates adjusted for in the models included age, sex, BMI, household income level, smoking status, alcohol use, regular physical activity, atopy, and allergic rhinitis, considering the potential association of those factors with asthma [16, 17]. Subgroup analyses were further performed based on disability type. All statistical analyses were conducted using SAS software (SAS Institute Inc., Cary, NC, USA).

Results

Baseline characteristics

Baseline demographic and health-related characteristics are presented in **Table 1**. The study included 5,369,424 individuals, of whom 80,466 (1.5%) reported having a disability. Overall, the mean age was approximately 31 years, and over 60% were male. Compared to those without disability, individuals with disability were slightly older (32.25 vs. 30.73 years, $P < .0001$), more likely to be male (81.5% vs. 61.3%, $P < .0001$), and had a higher mean BMI (23.89 vs. 23.01 kg/m², $P < .0001$). The disability group had a higher rate of current smoking with ≥10 pack-years (19.8% vs. 13.5%) and a higher proportion of non-drinkers (43.4% vs. 36.7%), while mild alcohol consumption was more common among those without disability (53.2% vs. 45.2%) ($P < .0001$ for both). Comorbidities including diabetes mellitus (3.9% vs. 1.9%), hypertension (13.1% vs. 7.6%), and dyslipidemia (9.3% vs. 6.8%) were significantly more prevalent in the disability group ($P < .0001$ for all). Additionally, atopy (0.43% vs. 0.37%, $P = .0075$) and allergic rhinitis (3.8% vs. 3.4%, $P < .0001$) were also more frequent in the disability group.

Disability and Asthma development

The association between disability and the incidence of asthma is detailed in **Table 2**. During a median follow-up period of 11.5 years (interquartile range, 10.1–12.2 years), approximately 10.28% of individuals with disabilities developed asthma, similar to the incidence observed among those without disabilities (10.35%). The unadjusted hazard ratio (HR) for asthma in individuals with disability was 1.00 (95% confidence interval [CI], 0.98–1.02), whereas the adjusted HR was 1.14 (95% CI, 1.11–1.16), after controlling for age, sex, BMI, household income level, smoking status, alcohol use, regular physical activity, atopy, and allergic rhinitis. When stratified by disability severity, individuals with mild disability (n = 52,003) showed an adjusted HR of 1.17 (95% CI, 1.14–1.20), while those with severe disability (n = 28,463) had an adjusted HR of 1.07 (95% CI, 1.03–1.11), indicating a modest but statistically significant increased risk of asthma in both groups compared with individuals without disability. These findings are further illustrated by the Kaplan–Meier survival curves shown in **Figure 1**, which demonstrate a consistent pattern.

Disability subtypes and Asthma development

Table 3 presents a stratified analysis based on disability subtypes. Of the 15 subtypes examined, four showed a significantly higher risk of asthma compared to those without disabilities. Notably, individuals with epilepsy had a significantly increased adjusted HR of 1.38 (95% CI, 1.06–1.80) and mental disorders (HR, 1.19; 95% CI, 1.05–1.35) also showed elevated risks. Individuals with physical impairment had an adjusted HR of 1.18 (95% CI, 1.15–1.22) and those with visual impairment had an adjusted HR of 1.09 (95% CI, 1.03–1.16). In contrast, autism spectrum disorder was associated with a reduced risk of asthma (adjusted HR, 0.49; 95% CI, 0.31–0.77). Other subtypes, including brain injury disability, hearing and speech impairment, intellectual disability, renal or cardiac disorder, hepatic disorder, facial disability, and enterostomy or urostomy, did not show statistically significant associations. Individuals with respiratory disorder exhibited the highest incidence rate (22.11 per 1,000 pack year) and an elevated unadjusted HR (2.55; 95% CI, 1.11–5.88), though the adjusted HR did not reach statistical significance (2.36; 95% CI, 0.98–5.68), likely due to the small sample size (n = 23).

Discussion

In this large, nationwide cohort of Korean young adults, approximately 1.5% were identified as having a registered disability, and 10.3% of these individuals developed asthma over a median follow-up of 11.5 years. After adjusting for demographic, behavioral, and clinical factors, disability status was associated with increased risk of incident asthma; both mild and severe disabilities contributed to this risk, with a greater increase observed in the mild disability group. Subgroup analyses revealed that several specific types of disability, including epilepsy, mental disorders, physical impairments, and visual impairments were associated with higher asthma risk, whereas autism spectrum disorder was associated with reduced risk.

Prior studies have reported the concurrent prevalence of asthma with various developmental disabilities and delays among children and adolescents [6, 18, 19]. Recent research in United States pediatric populations indicates that asthma risk is nearly three times higher in children with disabilities and twice as high in those with developmental delays compared to typically growing children [4]. Despite the limited large-scale evidence in adult populations, especially in early adulthood, our findings build on pediatric research by highlighting similar patterns in young adults, a group often overlooked in disability-related asthma studies.

Patients with epilepsy also exhibited increased risk of developing asthma in our study, with an adjusted HR of 1.38. This finding is consistent with previous findings indicating that individuals diagnosed with epilepsy at ages 0–10 and 31–40 are at elevated risk for subsequent asthma [20]. Additionally, prior research reported that individuals with a history of seizures had an adjusted odds ratio of 2.43 (95% CI, 1.52–3.89) for developing asthma [4]. Chronic respiratory problems are also well-documented among children with neurological impairments [10]. One potential shared mechanism linking epilepsy and asthma is chronic inflammation, which has also been implicated in the bidirectional relationship between mental disorders and asthma. Elevated levels of cytokines have been associated with both chronic neuroinflammation and neuronal damage in epilepsy [21], and these inflammatory mediators are

overexpressed in the asthmatic bronchial epithelium [22]. This suggests that cytokine-driven inflammatory pathways may represent a crucial common mechanism underlying both conditions.

In the present study, individuals with mental disorders demonstrated increased risk of developing asthma with an adjusted HR of 1.19. This finding aligns with previous evidence suggesting a bidirectional relationship between asthma and mental health conditions [23]. A prior diagnosis of mental illness has been associated with elevated hazard ratios for developing asthma ranging from 1.06 (95% CI, 1.00–1.12) for developmental disorders to 2.33 (95% CI, 2.28–2.39) for substance use disorders [23]. Although the underlying mechanisms are not yet fully understood, several shared pathophysiological pathways have been proposed. Both asthma and mental disorders are linked to chronic inflammation, with elevated levels of cytokines and increased expression of cytokine-related receptors in the peripheral blood and cerebrospinal fluid [24]. They also share common environmental exposures, including air pollution and smoking, as well as genetic susceptibilities [25]. Moreover, increasing evidence suggests that psychosocial factors play a role in asthma pathophysiology. Studies have shown that negative affect and acute stress may exacerbate airway inflammation, as reflected by increased levels of fractional exhaled nitric oxide, and are associated with declines in lung function among adults with asthma [26]. In addition, autonomic nervous system dysregulation, which is commonly observed in depression, has been implicated in asthma, with the parasympathetic branch contributing to bronchoconstriction and autonomic nervous system abnormalities linked to bronchodilator resistance and airway hyperresponsiveness [27].

In our study, young adults with physical impairments showed 1.18-fold increased risk of asthma compared to those without disabilities. In the KNDRS database, physical impairments comprise disabilities of the extremities, including conditions such as limb dysfunction and spinal disorders [12]. According to previous studies in pediatric populations, spine and thoracic cage deformities, such as scoliosis, have been linked to a high prevalence of ventilatory defects. More than half of children with these deformities exhibit obstructive, restrictive, or mixed ventilatory patterns, with obstructive lung disease reported in approximately 30% and asthma diagnosed in about one-third of those with reduced FEV_1/FVC ratios or decreased FEV_1 [28, 29]. The mechanisms underlying airway obstruction may include compression of a mainstem bronchus by distorted spinal and mediastinal structures, resulting in reduced expiratory flow and increased airway resistance [30, 31]. Additional contributing factors include chronic airway inflammation caused by impaired clearance of secretions [32], and pulmonary hypoplasia due to thoracic deformities during periods of rapid lung growth, as reflected by reduced alveolar development and decreased number of pulmonary vessels [33, 34].

Also, individuals with visual impairments exhibited 1.09-fold higher risk of developing asthma compared to those without disabilities. In a previous study conducted in a United States pediatric population, children with blindness had a significantly higher likelihood of asthma, with an adjusted odds ratio of 1.61 (95% confidence interval, 1.06 to 2.45) [4]. In contrast, studies in adult populations have reported increased risk of visual impairment among individuals with asthma [35, 36], but research examining the risk of asthma among individuals with preexisting visual impairments remains limited. Moreover, the

biological mechanisms underlying the increased risk of asthma in this population remain poorly understood and will require further investigation.

Our findings have important public health implications, suggesting that young adults with disabilities may be at increased risk for developing asthma. The importance of identifying asthma across all age groups has been increasingly recognized. In particular, early diagnosis in childhood is critical, as children with asthma frequently experience an accelerated decline in lung function during early adulthood [37]. Early recognition and intervention have been associated with improved quality of life, enhanced daily functioning, and a reduction in acute exacerbations and overall health care utilization [38, 39]. Furthermore, a recent study demonstrated that identifying adults in the community who exhibit respiratory symptoms without a formal asthma diagnosis and providing them with timely specialist-directed care can result in a significant reduction in subsequent healthcare usage for respiratory conditions [40]. These findings support the integration of routine surveillance for respiratory symptoms and early diagnostic assessments, including pulmonary function testing, into standard clinical care. Such strategies may be particularly valuable for young adults with disabilities, who appear to represent a population at elevated risk.

This study has several strengths, including the use of a large and nationally representative dataset that covers nearly the entire Korean population, comprehensive classification of disability type and severity, and an extended duration of follow-up (over ten years). However, certain limitations should be acknowledged. First, asthma diagnoses were based on claims data, which may not accurately reflect disease severity or level of symptom control. Second, unmeasured confounders, such as environmental factors, genetic predisposition, or variability in treatment adherence, may have influenced the observed associations. Third, because this dataset is derived from a single country's healthcare infrastructure, the findings may have limited generalizability to other populations.

Disability in young adults is associated with increased risk of incident asthma, with variation by disability type. These findings underscore the need for inclusive health monitoring and targeted research to elucidate the mechanisms linking disability and respiratory health in different age groups.

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Samsung Medical Center (IRB No. 2025-05-130). The requirement for informed consent was waived by the Institutional Review Board of Samsung Medical Center because this study used deidentified nationwide claims data.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from the Korean National Health Insurance Service, but restrictions apply to the availability of these data.

Competing interests

The authors declare that they have no competing interests.

Funding

None.

Trial registration

Not applicable.

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Tables

Table 1. Baseline characteristics of the study population

	Total	Disability		
	(N = 5,369,424)	No	Yes	P value
		(n = 5,288,958)	(n = 80,466)	
Age, years	30.75 ± 4.98	30.73 ± 4.97	32.25 ± 4.98	<.0001
20-29	2,316,311 (43.14)	2,292,889 (43.35)	23,422 (29.11)	<.0001
30-39	3,053,113 (56.86)	2,996,069 (56.65)	57,044 (70.89)	
Sex, Male	3,306,895 (61.59)	3,241,285 (61.28)	65,610 (81.54)	<.0001
Body mass index, kg/m^2	23.02 ± 3.6	23.01 ± 3.59	23.89 ± 3.91	<.0001
<18.5	400,760 (7.46)	395,863 (7.48)	4,897 (6.09)	
<23	2,495,458 (46.48)	2,465,568 (46.62)	29,890 (37.15)	
<25	1,041,130 (19.39)	1,024,402 (19.37)	16,728 (20.79)	
≥25	1,432,076 (26.67)	1,403,125 (26.53)	28,951 (35.98)	
Smoking status				<.0001
Never smoker	2,861,111 (53.29)	2,823,738 (53.39)	37,373 (46.45)	
Ex smoker, <10 pack years	429,818 (8)	423,274 (8)	6,544 (8.13)	
Ex smoker, ≥10 pack years	126,265 (2.35)	123,286 (2.33)	2,979 (3.7)	
Current smoker, <10 pack years	1,224,167 (22.8)	1,206,553 (22.81)	17,614 (21.89)	
Current smoker, ≥10 pack years	728,063 (13.56)	712,107 (13.46)	15,956 (19.83)	
Alcohol consumption				<.0001
None	1,973,340 (36.75)	1,938,430 (36.65)	34,910 (43.38)	
Mild	2,850,904 (53.1)	2,814,534 (53.22)	36,370 (45.2)	
Moderate	545,180 (10.15)	535,994 (10.13)	9,186 (11.42)	
Income, the lowest 25%	1,136,638 (21.17)	1,108,727 (20.96)	27,911 (34.69)	<.0001
Regular exercise*	694,235 (12.93)	681,598 (12.98)	12,637 (15.7)	<.0001
Comorbidities				
Diabetes mellitus	104,034 (1.94)	100,920 (1.91)	3,114 (3.87)	<.0001
Hypertension	410,424 (7.64)	399,879 (7.56)	10,545 (13.1)	<.0001
Dyslipidemia	365,652 (6.81)	358,158 (6.77)	7,494 (9.31)	<.0001
Atopy	20,086 (0.37)	19,739 (0.37)	347 (0.43)	0.0075

Allergic rhinitis	180,632 (3.36)	177,577 (3.36)	3,055 (3.8)	<.0001

*Regular exercise, mid-term exercise ≥ 5 days or vigorous exercise ≥ 3 days in a week.

Table 2. The association between disability and risk of asthma development

	Number of subjects	Number with asthma	IR per 1,000 PY	Unadjusted HR (95% CI)	Adjusted HR* (95% CI)
Without disability	5,288,958	547,525	9.65	1 (Reference)	1 (Reference)
With disability	80,466	8,271	9.67	1 (0.98–1.02)	1.14 (1.11–1.16)
Mild	52,003	5,375	9.62	1 (0.97–1.03)	1.17 (1.14–1.20)
Severe	28,463	2,896	9.76	1 (0.96–1.04)	1.07 (1.03–1.11)

*Adjusted for age, sex, body mass index, household income level, smoking status, alcohol use, regular physical activity, atopy, and allergic rhinitis

Abbreviations: IR = incidence rate, PY = person-years, HR = hazard ratio, CI = confidence interval.

Table 3. Incidence rates and hazard ratios for asthma according to disability status and subtype

	Number of subjects	Number with asthma	IR per 1,000 PY	Unadjusted HR (95% CI)	Adjusted HR* (95% CI)
Without disability	5,288,958	547,525	9.65	1 (Reference)	1 (Reference)
Disability subtypes					
Physical impairment	45,707	4,745	9.66	1.01 (0.98–1.03)	1.18 (1.15–1.22)
Brain injury disability	2,661	269	9.69	1.00 (0.88–1.12)	1.09 (0.97–1.23)
Visual impairment	10,060	997	9.24	0.96 (0.90–1.02)	1.09 (1.03–1.16)
Hearing impairment	5,873	629	9.93	1.03 (0.96–1.12)	1.07 (0.99–1.16)
Speech impairment	905	92	9.45	0.99 (0.80–1.21)	1.12 (0.91–1.37)
Intellectual disability	10,391	1,046	9.85	1.00 (0.94–1.07)	1.06 (0.99–1.12)
Autism spectrum disorder	413	18	4.18	0.44 (0.28–0.69)	0.49 (0.31–0.77)
Mental disorder	2,104	239	11.44	1.16 (1.02–1.32)	1.19 (1.05–1.35)
Renal disorder	1,145	105	8.78	0.90 (0.75–1.09)	0.93 (0.77–1.13)
Cardiac disorder	184	20	10.46	1.08 (0.70–1.67)	1.14 (0.73–1.76)
Respiratory disorder	23	5	22.11	2.55 (1.11–5.88)	2.36 (0.98–5.68)
Hepatic disorder	79	10	12.57	1.30 (0.70–2.41)	1.43 (0.77–2.66)
Facial disability	278	29	9.86	1.02 (0.71–1.46)	1.12 (0.78–1.62)
Enterostomy or urostomy	204	13	6.31	0.64 (0.37–1.10)	0.73 (0.43–1.26)
Epilepsy	439	54	12.38	1.27 (0.98–1.66)	1.38 (1.06–1.80)

*Adjusted for age, sex, body mass index, household income level, smoking status, alcohol use, regular physical activity, atopy, and allergic rhinitis

Abbreviations: IR = incidence rate, PY = person-years, HR = hazard ratio, CI = confidence interval.

Figures

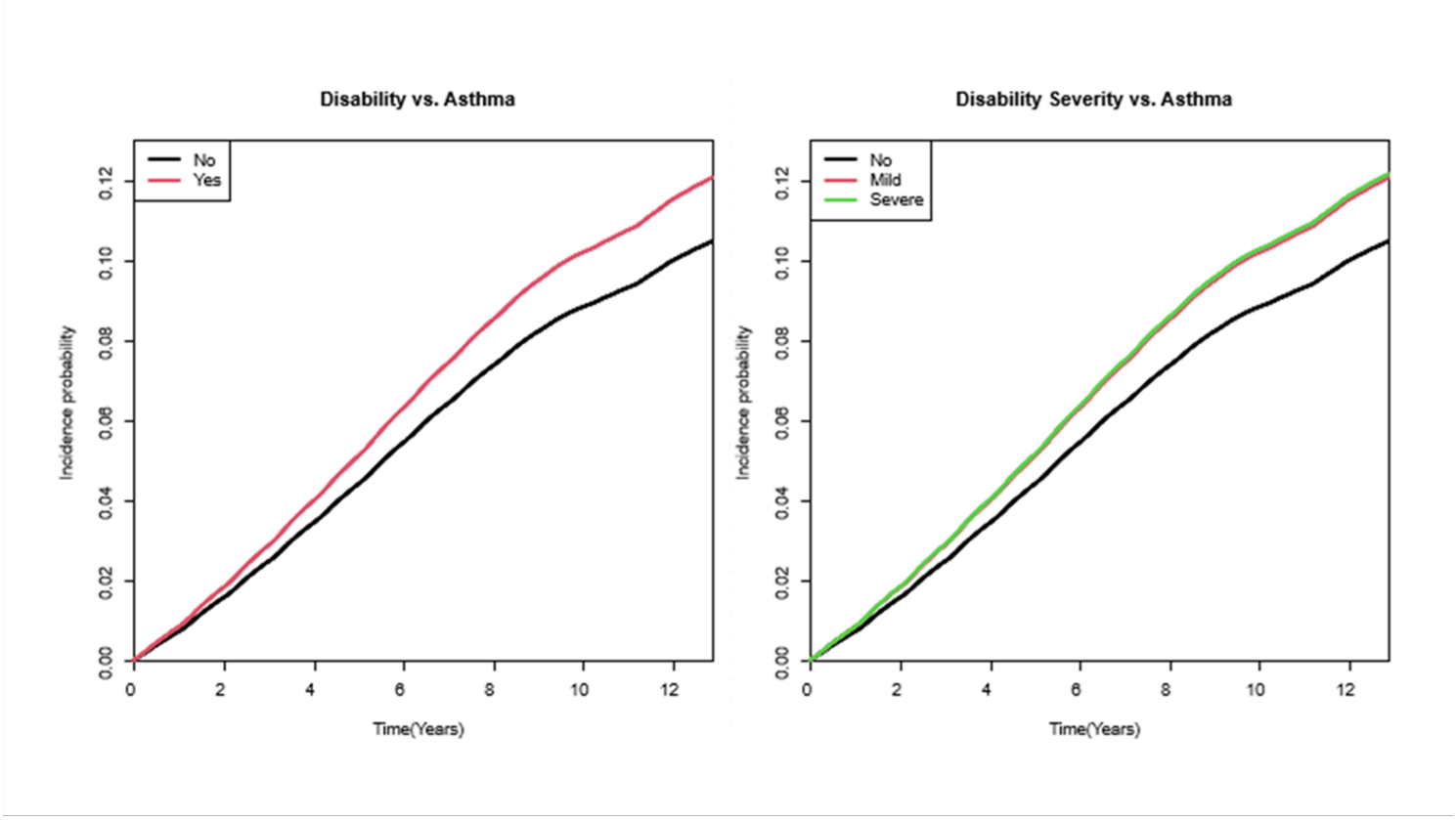


Figure 1

Kaplan-Meier curves for the asthma development according to the presence or absence of disability in young adults

Supplementary Files

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- SupplementaryFigure.docx