

Early Onset Scoliosis, Late Onset Back Pain; a large database evaluation of demographic factors influencing the development of adult-onset back pain

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INTRODUCTION: Early-onset scoliosis (EOS), defined as spinal curvature ≥ 10 degrees presenting before age 10, is commonly associated with back pain. A recent single center retrospective study of care-giver reported back pain prevalence demonstrated that in a population of 1212 EOS patients, 23% had reported back pain. Despite this, there is a paucity of data regarding the natural history of EOS, and its influence on the development of adult-onset back pain (ABP). This study seeks to elucidate the relationship between EOS and the development of ABP; especially focusing on those who did not have a clinical diagnosis of back pain, and the influence of operative intervention on the development of back pain using a large patient database.

METHODS: A retrospective cohort study was conducted using aggregated data from 101 healthcare organizations (n=141,609,413). Patients with EOS were identified by querying this database (n=96,932). Clinically significant ABP in this population was defined as that which incurred a formal diagnosis of dorsalgia after the age of 18 (n=2,795, ABP group), all others were grouped into a no ABP group (NABP). Demographic data was available for patients who were diagnosed with EOS from 1/1/2005 through 2025 (NABP n=89,729; ABP n=1,720). All available data points were collected for these populations, and subgroups were formed by identifying EOS pts with and without ABP that had a posterior spinal fusion (PSF) prior to adulthood (ABP-OP vs NABP-OP), as well as ABP with and without PSF prior to adulthood (ABP-OP vs ABP-NOP). As a function of this database, only demographic information was collected. Analysis was completed using chi-square, t-tests, and a logistic regression where appropriate with significance set at $p < 0.05$.

RESULTS:

The final cohort consisted of 91,449 patients, of which 55,931 identified as female (61.16%). There was a statically significant difference between the gender composition of the two groups ($P < 0.01$), as 61% (n=54634) of the NABP group and 75% (n=1297) of the ABP group were female. There was also a significant difference at age of EOS diagnosis ($P < 0.01$). The NABP group was diagnosed at a mean age of 7.09 ± 2.99 years, while the ABP group was diagnosed at a mean age of 8.68 ± 1.72 .

There was also a significant difference between the two groups in terms of several race/ethnicity categories, including white ($p < 0.01$), Hispanic & Latino ($p < 0.01$) and Asian ($p < 0.01$). There was not a significant difference in the black population between the two groups ($p = 0.05$). Obesity was also correlated with the ABP group ($P < 0.01$), as well as the presence of a diagnosis of neuromuscular scoliosis ($P < 0.01$). There was not a significant difference in chronic pain syndromes such as fibromyalgia between the two groups ($P = 0.06$).

On subgroup analysis, there were 400 patients in the ABP-OP group and 4270 patients in the NABP-OP group, of which 140 patients in the ABP-OP group and 423 patients in the NABP-OP group were excluded given incomplete demographic data. There was a significant difference ($p < 0.01$) between the ABP-OP and NABP-OP groups in terms of age at EOS diagnosis and gender ($p < 0.01$) and white race ($p < 0.01$); however, there was no difference in Hispanic & Latino ethnicity ($p = 0.69$), black race ($p = 0.72$), or Asian race ($p = 0.85$).

When comparing the ABP-OP group with the ABP-NOP group (n=1460), there was a significant difference between the age at diagnosis ($p < 0.0001$) and "other" race ($p = 0.03$), but no difference between gender ($p = 0.791$), Hispanic & Latino ethnicity ($p = 0.7898$), nor white ($p = 0.3430$), black ($p = 0.7377$), or Asian ($p = 0.3633$) race.

DISCUSSION AND CONCLUSION:

This study highlights a significant association between EOS and ABP, with female gender, older age at EOS diagnosis, obesity, and neuromuscular scoliosis as key risk factors. Operative intervention did not eliminate ABP risk, suggesting that long-term monitoring and preventive strategies are essential for high-risk EOS patients. These findings underscore the need for further research into the multifactorial causes of ABP in this population to improve lifelong spine health outcomes.

By identifying demographic and clinical predictors of ABP in EOS patients, this study provides critical insights for early risk stratification and personalized care. The persistence of ABP despite surgical intervention emphasizes the importance of holistic, long-term management approaches. These results can guide clinicians in counseling patients and families while informing future research on mitigating chronic pain in EOS survivors.

Characteristic	EOS without ABP (n=88,729)	EOS with ABP (n=1,720)	P-Value
Age			
Age at Index (Mean ± SD)	7.09 ± 2.89	8.68 ± 1.72	< 0.01
Sex			
Female	54,634	34,565	< 0.01
Male	34,565	416	< 0.01
Unknown Gender	50	10	0.98
Race & Ethnicity			
Not Hispanic or Latino	54,217	1,284	< 0.01
Hispanic or Latino	13,607	204	< 0.01
Unknown Ethnicity	21,805	232	< 0.01
White	50,716	1,242	< 0.01
Black or African American	8,635	210	0.05
Other Race	8,623	83	< 0.01
Asian	4,218	44	< 0.01
American Indian or Alaska Native	411	10	0.45
Native Hawaiian/Pacific Islander	414	-	0.15
Unknown Race	15,313	140	

Table 1: Demographic Data of EOS with and without ABP

Characteristic	Op EOS w/ ABP (n=260)	Op EOS w/o ABP (n=3,847)	P-Value
Age at Index			
Mean ± SD	8.17 ± 2.12	6.59 ± 3.08	< 0.01
Sex			
Female	199	2,523	< 0.01
Male	61	1,321	< 0.01
Unknown Gender	0	10	0.41
Ethnicity			
Not Hispanic or Latino	209	2,591	0.32
Hispanic or Latino	28	448	0.69
Unknown Ethnicity	23	410	0.36
Race			
White	195	2,485	< 0.01
Black or African American	30	473	0.72
Unknown Race	19	369	0.22
Other Race	12	322	0.93
Asian	10	157	0.85
American Indian/Alaska Native	0	13	0.35
Native Hawaiian/Pacific Isl.	0	28	0.17

Table 2: Demographic Data of EOS with PSF before adulthood, with and without ABP

Characteristic	Non-Op EOS w/ ABP (n=1,460)	Op EOS w/ ABP (n=260)	P-Value
Age			
Age at Index (Mean ± SD)	8.77 ± 1.62	8.17 ± 2.12	< 0.0001
Sex			
Female	1,098	199	0.65
Male	355	61	0.77
Unknown Gender	10	0	0.18
Ethnicity			
Not Hispanic or Latino	1,075	209	0.02
Hispanic or Latino	176	28	0.55
Unknown Ethnicity	209	23	0.92
Race			
White	1,048	195	0.29
Black or African American	180	30	0.72
Other Race	51	12	0.37
Asian	40	10	0.25
American Indian/Alaska Native	10	0	0.18
Native Hawaiian/Pacific Isl.	12	-	0.14
Unknown Race	121	19	

Table 3: Demographic Data of EOS with ABP, with and without PSF before adulthood