

# BMI increases after ACL-reconstruction in Adolescents

Regina Hanstein<sup>1</sup>, Noah Kirschner<sup>2</sup>, Christine Moloney<sup>1</sup>, Eric D. Fornari<sup>1</sup>

<sup>1</sup> Division of Pediatric Orthopaedics, Children's Hospital at Montefiore Medical Center, Bronx, NY

<sup>2</sup> Albert Einstein College of Medicine, Bronx, NY



## BACKGROUND

The incidence of ACL injuries in the pediatric and adolescent patient population has increased over the last 20 years. ACL reconstruction is recommended to avoid osteoarthritis later in life. However, a 6-12 months rehabilitation with no or limited sports activity after surgery is required to protect the graft and graft fixation.

## AIMS

Determine, if the period of inactivity after ACL-reconstruction surgery affects the BMI in an adolescent patient population and affects patient self-reported outcomes.

## METHODS

**Study Design:** retrospective review

**Study Population:** Patients 1-21 years of age, who underwent ACL reconstruction surgery by one of two pediatric orthopaedic surgeons between 2013 and July 2018 and had height and weight recorded pre-operatively and during the post-operative period.

**Of 131 Subjects with a min. follow-up of 6 months after ACL-reconstruction, 96 met inclusion criteria.**

Demographic Parameters	Mean (±SD) or N (%)
Age, years	16.3 ± 1.9 (range, 7 to 21)
Sex, Female	36 F (37.5%)
BMI	26.4 ± 6 (range, 18.3-61.9)
Follow-up, years	1.7 ± 1.1
Surgical Parameters	N (%)
Laterality, R	56 (58.3%)
ACL Graft	
Hamstring	55.8%
Patellar tendon	44.2%
Associated Ligament injury, yes	65 (68.4%)

**Patient self-report outcomes:**

Pedi-IKDC Subjective Knee Evaluation Form (The Pediatric International Knee Documentation Committee)

Tegner Lysholm Knee Scoring Scale (Lysholm Knee Questionnaire / Tegner Activity Scale)

KOOS-Child (Knee and Osteoarthritis Outcome Score for Children)

**Statistics:**

Continuous variables were analyzed using paired t-test, Wilcoxon rank sum test and Spearman correlation.

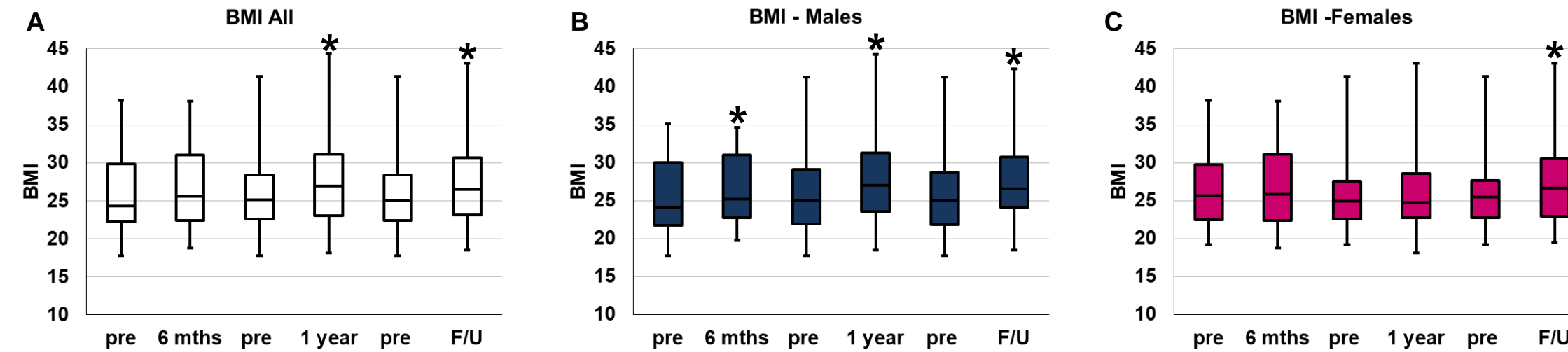
## 1 – BMI changes after ACL-reconstruction

**Comparison of BMI, BMI-for-age percentile and Z-score before and after ACL-reconstruction.**

BMI, BMI% and Z-score were calculated as follows:

Patients ≤20 yrs: <https://zscore.research.chop.edu/>

Patients 21 years old: CDC Adult BMI Calculator

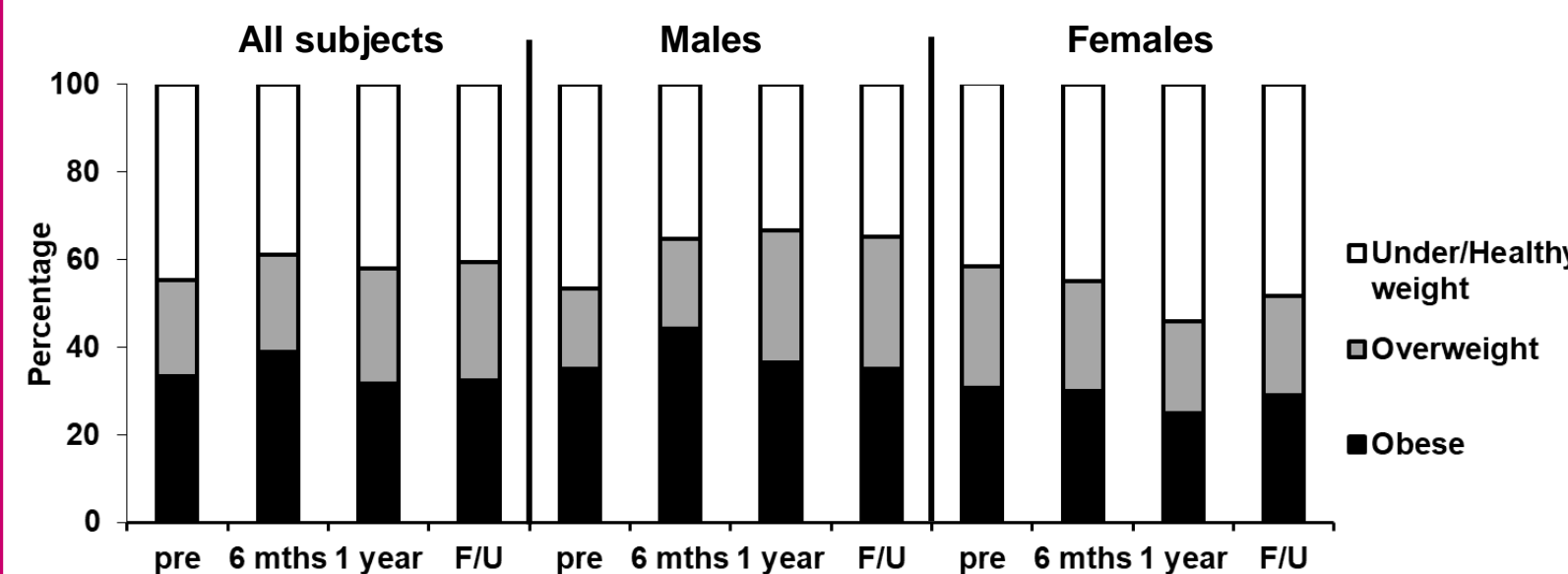


- A: BMI did not change at 6 months after ACL reconstruction, but was significantly higher at 1 year post ACL reconstruction and at most recent F/U compared to BMI at initial surgery (\* p<0.05).
- B&C: Sub-analysis by gender revealed that males had a higher BMI at 6 months, 1 year and most recent F/U (B), whereas BMI of females only increased at most recent F/U, not at any other timepoint (C) (\* p<0.05).

➤ **Table:** BMI-for-age percentile (BMI%) and Z-score were not significantly different at any timepoint after ACL reconstruction.

	BMI%				Z-score							
	pre	6 mths	pre	1 year	pre	F/U	pre	6 mths	pre	1 year	pre	F/U
All, Median (IQR)	88 (22)	92 (24)	86 (25.5)	89 (25)	87 (24)	89 (31)	1.16 (1.1)	1.40 (1.3)	1.09 (1.1)	1.23 (1.2)	1.11 (1.0)	1.17 (1.4)
<b>p-value</b>	0.641		0.978		0.972		0.550		0.611		0.884	
Males, Median (IQR)	91 (24)	92 (24)	86 (32)	91 (23)	86 (35)	89 (31)	1.16 (1.2)	1.40 (1.3)	1.44 (1.6)	1.44 (1.4)	1.11 (1.4)	1.23 (1.6)
<b>p-value</b>	0.803		0.353		0.29		0.226		0.331		0.452	
Females, Median (IQR)	93 (21)	92 (21)	83 (18)	84 (26)	83 (18)	87 (27)	1.48 (1.1)	1.42 (1.1)	0.96 (0.8)	0.99 (1.1)	1.00 (0.9)	1.01 (1.2)
<b>p-value</b>	0.230		0.380		0.242		0.177		0.117		0.204	

## 2 – Distribution of Overweight and Obesity



➤ **Males:**

Before ACL reconstruction, 35% of males were obese, which increased to 44% 6 months after surgery. At most recent follow-up, 75% of males were overweight or obese compared to 55% pre-operatively.

➤ **Females**

58% of females were overweight or obese before surgery, at most recent follow-up 52% of females were overweight or obese.

## 3 – Patient-reported Outcomes

**Spearman correlation between patient-reported outcomes and BMI or Increase in BMI.**

Increase in BMI = BMI @ post-op timepoint – BMI pre-op

Outcome scores at 6 months	Spearman correlation Correlation Coefficient (p-value)	
	BMI @ 6 months	Increase in BMI @ 6 months
Pedi-IKDC	0.307 (0.105)	0.325 (0.085)
Tegner/Lysholm	0.175 (0.354)	0.342 (0.065)
KOOSChild Pain	0.052 (0.787)	0.373 (0.043)
KOOSChild Symptom	0.200 (0.290)	0.443 (0.014)
KOOSChild ADL	0.053 (0.782)	0.163 (0.390)
KOOSChild Sport	0.125 (0.518)	0.143 (0.458)
KOOSChild QOL	0.275 (0.141)	0.277 (0.138)

➤ The Increase in BMI at 6 months, not BMI itself, showed a weak positive correlation with better outcomes in the KOOSChild Pain domain (r=0.373, p=0.043) and KOOSChildSymptom domain (r=0.443, p=0.014) at 6 months after surgery and trended to be weakly correlated with the pedi-IKDC and Tegner/Lysholm outcome measures.

➤ No correlation between BMI or Increase in BMI and patient outcomes was found at 1 year after ACL reconstruction or at most recent follow-up.

## CONCLUSION

- ❖ After ACL-reconstruction, adolescents gain weight, most likely due to limited activity during the rehabilitation phase.
- ❖ This weight gain was more pronounced in males than females.
- ❖ The increase in BMI lasted longer than the period of rehabilitation-related inactivity.
- ❖ Patients with an increase in BMI at 6 months reported less pain and symptoms.