

Introduction

Lifestyle modifications, pharmacotherapy, and laparoscopic surgeries have been the mainstay treatments for gastroesophageal reflux disease (GERD) until the late 2000s when transoral incisionless fundoplication (TIF) was introduced into the field of surgery. Throughout the years, TIF procedures have evolved and are classified into three Eras for this study; Era 1 (pre TIF 2.0), Era 2 (TIF 2.0), and Era 3 (TIF 2.0 with hiatal repair for Hill 3 or greater, axial displacement > 2.0 cm). Data showing how the evolution of TIF and its guidelines has lead to improved GERD outcomes has not yet been analyzed. The aim of this study is to evaluate and compare the outcomes of TIF in three ERAs.

Methods and Materials

- A systematic review was conducted using EMBASE, PubMed, and Cochrane Library databases (from Feb. 2008 to Sept. 2021) to identify studies investigating the outcomes of TIF and TIF 2.0 + hiatal hernia repair.
- Outcomes include: Gastroesophageal Reflux Symptom Scale (GERSS), GERD-Health Related Quality of Life Questionnaire (HRQL), Acid Exposure Time (AET), DeMeester, Reflux Symptom Index (RSI), and % cessation of PPI.
- Statistical analysis was done using Microsoft Excel (Microsoft, Redmond, WA) to compare the mean averages of the three groups.

Era 1							
Author (year)	GERD-HRQL		DeMeester		AET		% PPI Cessation
	Pre-TIF	Post-TIF	Pre-TIF	Post-TIF	Pre-TIF	Post-TIF	Post-TIF
Chimukangara (2019)	24	7					47
Smeets (2015)	26	10					67
Muls (2013)	24.2	7.9					74
Witteman (2013)	32	23			7.1	9	
Witteman (2012)	33	4	21	17	7.4	5.5	
Svoboda (2011)	21.2	5.8					50
Romario (2011)	45	10					
Demyttenaere (2010)	22	10					
Repici (2010)	40	7					
Cadière (2009)	17	7					
Bergman (2008)	8	3.3					
Cadière (2008)	24	58	34	28	10	7	85
Cadière (2008)	17	6					82

Table 1. Characteristics of studies included in Era 1 of the meta-analysis

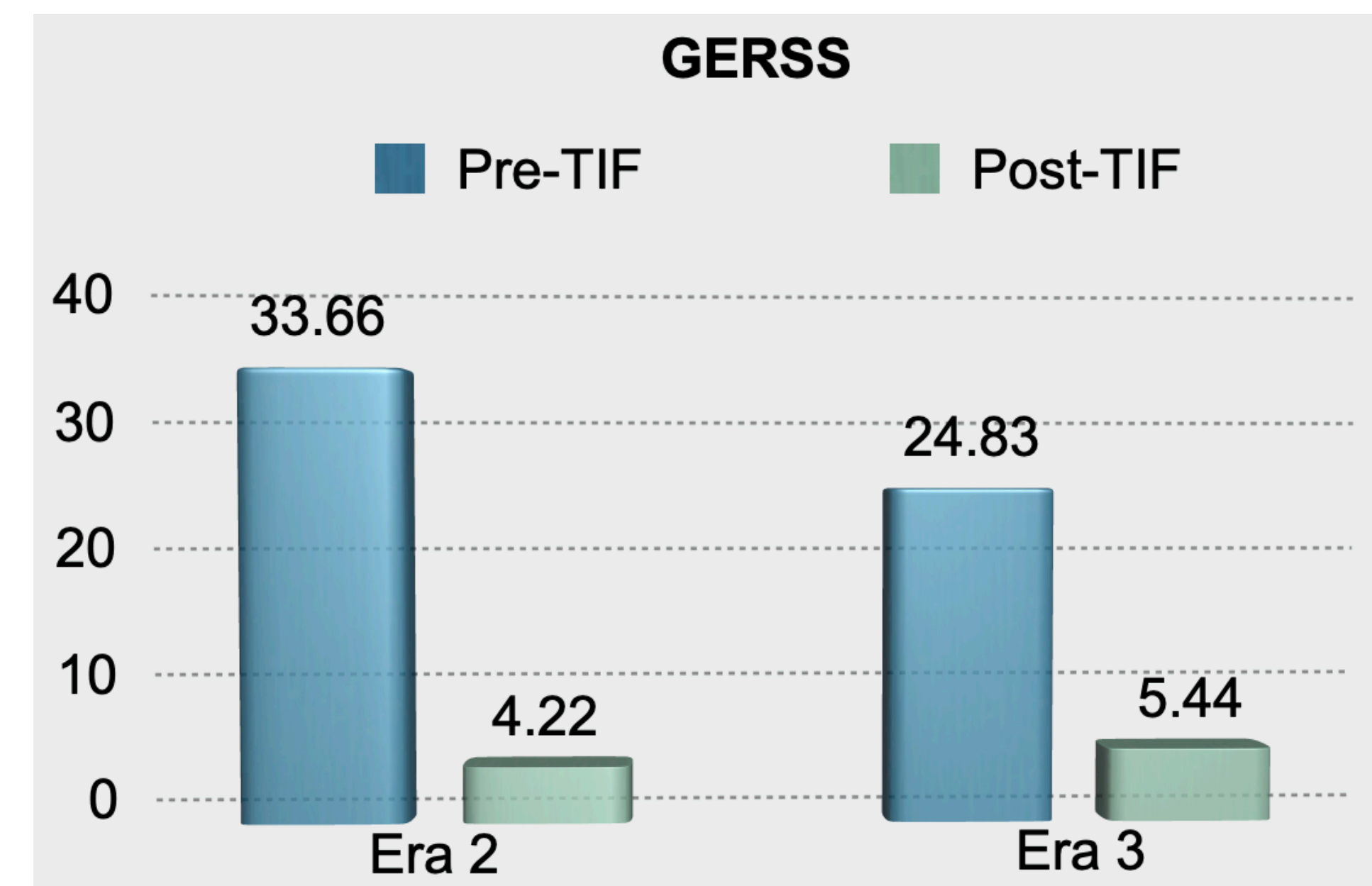


Figure 1. GERSS scores in Era 2 and Era 3 pre- and post-TIF

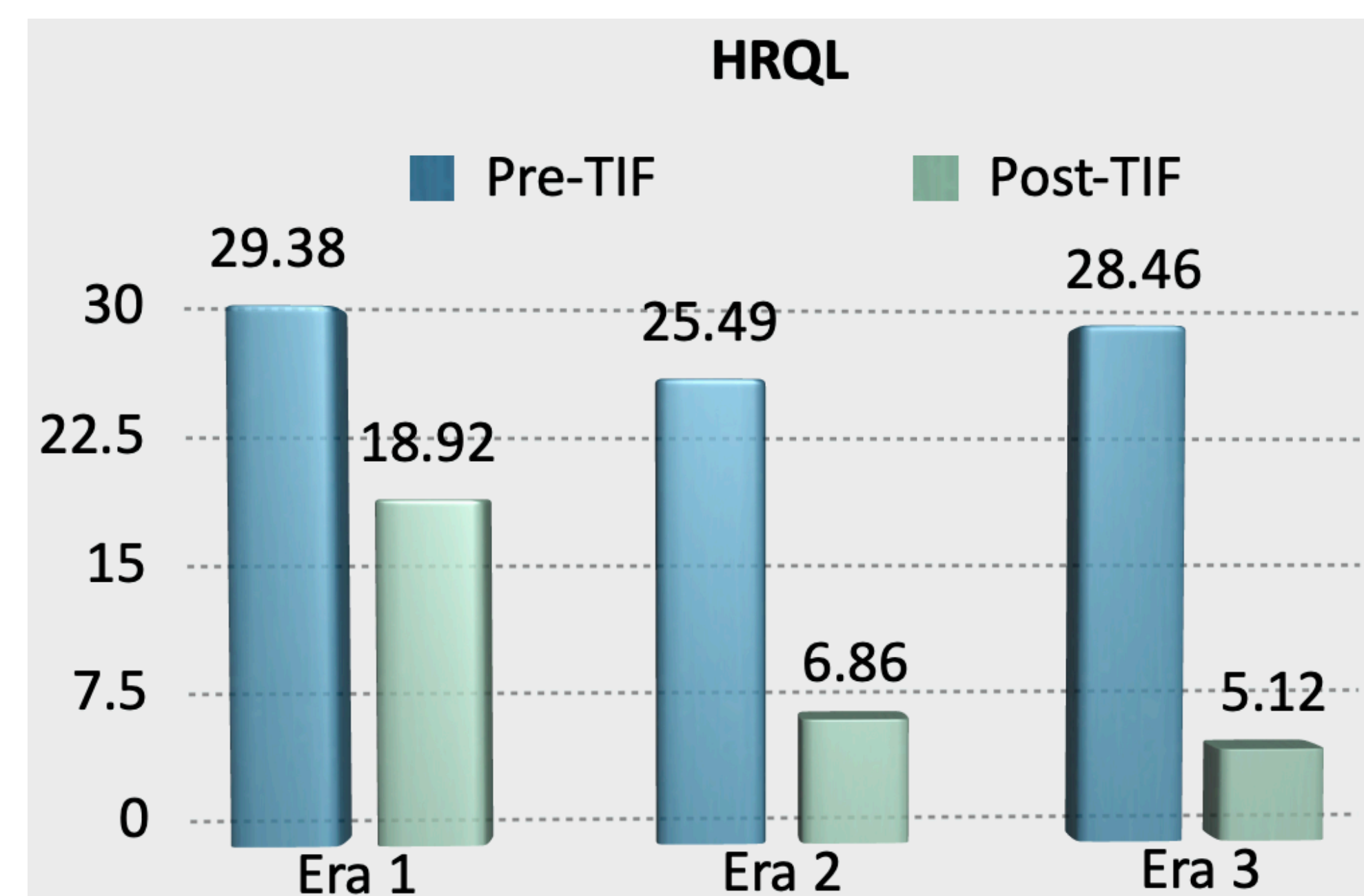


Figure 2. GERD-HRQL scores in Era 1, Era 2 and Era 3 pre- and post-TIF

Era 2											
Author (year)	GERSS		GERD-HRQL		RSI		DeMeester		AET		% PPI Cessation
	Pre-TIF	Post-TIF	Pre-TIF	Post-TIF	Pre-TIF	Post-TIF	Pre-TIF	Post-TIF	Pre-TIF	Post-TIF	Post-TIF
Huang (2015)	32.4	6.7	27.4	10.9	15.3	7.2					
Trad (2018)			26.4	6.9	22.2	6.3					
Trad (2017)			34	16			36	26.5	10.5	7.6	78
Trad (2015)									9.6	6.2	90
Håkansson (2015)									7.8	3.6	59
Hunter (2015)			25	5			33.6	23.9	9.3	6.4	72
Rinsma (2014)			27.5	13.2					10.9	7.3	67
Trad (2012)	26.8	4.6	26.4	6	19.2	6.1					82
Narsule (2012)			23	6.7							54
Petersen (2012)					10.5	6.2	32.5	19.3	8.9	3.8	43
Bell (2012)	29.6	8.3	26.2	7.8	21.2	7.9	40.3	21.9	10.5	6.2	90
Velanovich (2010)			25	5							79
Witteman (2015)			26.5	12.4					10.8	7.7	75
Witteman (2015)			27.1	10.3					11.0	9.1	66
Bell (2021)			19.6	3.5							
Testoni (2019)			46	10							
Fanous (2018)	17	2.4	29.6	4.8	22.3	6.1					100
Fanous (2017)	5	0	20	0	11	0					
Ebright (2017)			22	10							
Stefanidis (2017)			27	4							
Testoni (2015)			20	16			22	18			84
Rinsma (2015)			23.7	8.5					9.7	6.9	
Bell (2014)	35	5	26	6	24	6	34.4	19			
Bell (2014)			28	5							70
Trad (2014)			26.43	10.05	22.62	8.76	35.79	28.60	10.50	7.87	
Wilson (2014)	26	4	24	2	20	5					
Testoni (2012)			22	17			21	19			
Rosen (2012)			13.4	5.7							
Bell (2011)			15.3	5.0	22.8	12.9					
Barnes (2011)	46	0	28	2	29	4					
Testoni (2010)			20	16			20	18			

Table 2. Characteristics of studies included in Era 2 of the meta-analysis

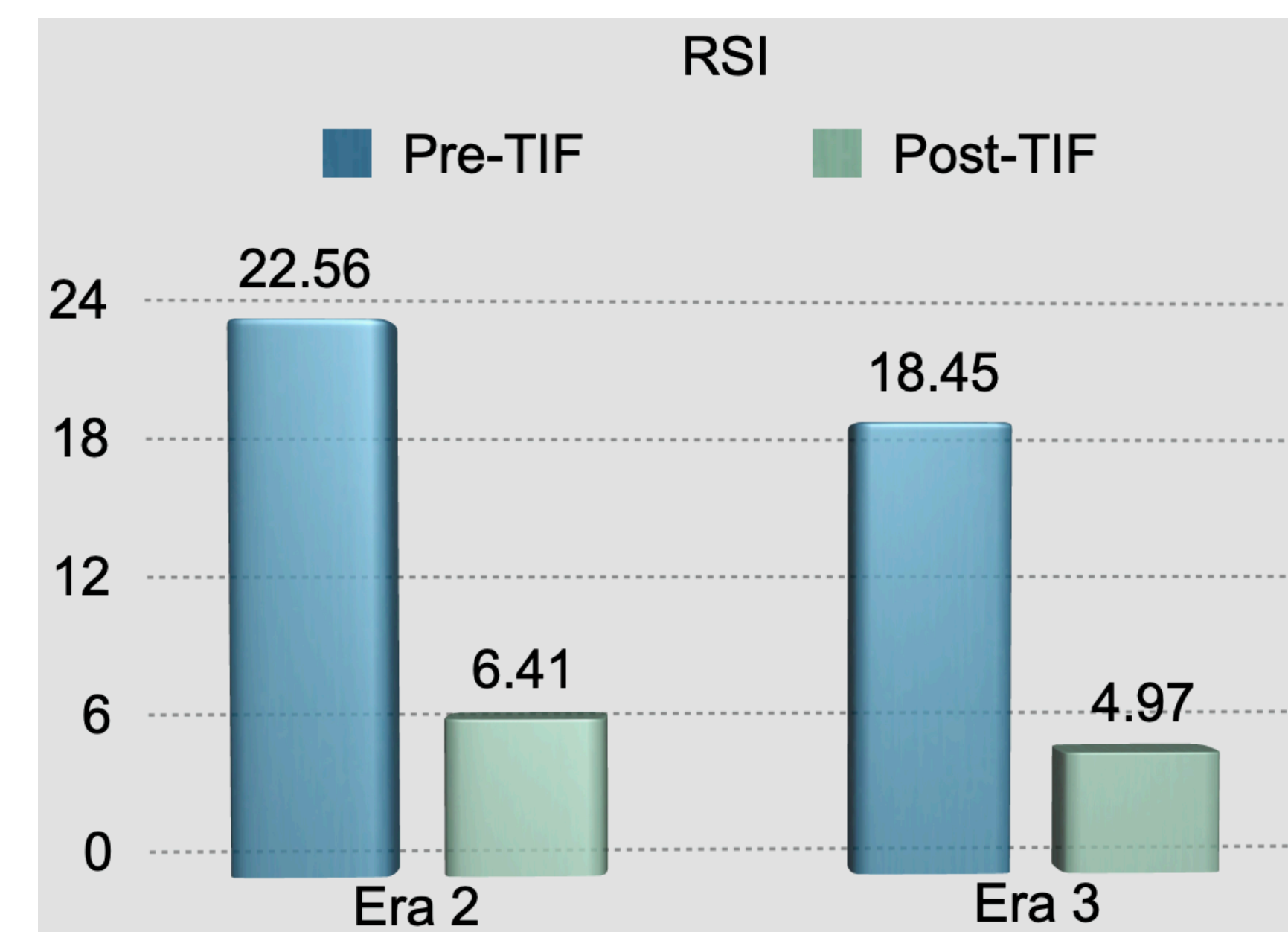


Figure 3. RSI scores in Era 2 and Era 3 pre- and post-TIF

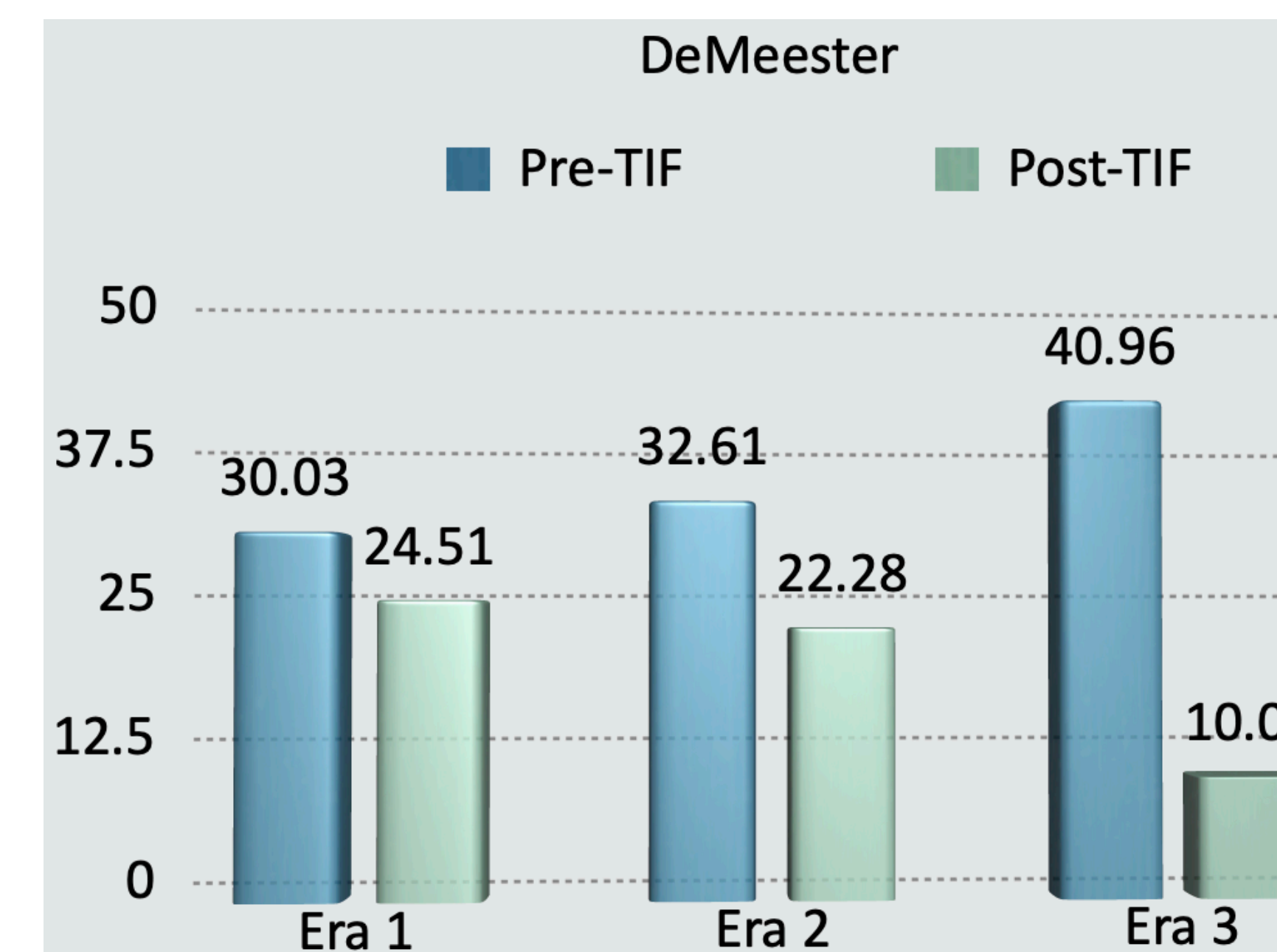


Figure 4. DeMeester scores in Era 1, Era 2 and Era 3 pre- and post-TIF

Era 3										
Author (year)	GERSS		GERD-HRQL		RSI		DeMeester		% PPI Cessation	
	Pre-TIF	Post-TIF	Pre-TIF	Post-TIF	Pre-TIF	Post-TIF	Pre-TIF	Post-TIF	Pre-TIF	Post-TIF
Ihde (2019)			33.75	9.07	20.32	8.07	35.3	10.9		
Janu (2019)	25.8	5.3	25.1	4.6	28.5	8.9				
Snow (2021)										94
Ihde (2011)	28.9	8.3	26.2	6.3	20.2	7.7				
Choi (2021)			23.26	7.37	17.67	8.1	43.7	4.9		90
Gisi (2021)	9.23	2.84	38.6	9.46	25.6	11.7				81
Fanous (2020)	44	0	56	0	42	2				
Fanous (2019)	40	7	30	2						
Fanous (2019)			33.6	4.9						
Fanous (2018)			28.7	1.5	23	0.5				
Chang (2016)			26.4	5.9						
Choi (2020)			23.3	7.37	17.7	8.1				86
Wang (2018)										85
Janu (2017)					3.42	0.47				
Huang (2015)	24.7	4.9	22.4	5.2	12.1	3.4				

Table 3. Characteristics of studies included in Era 3 of the meta-analysis

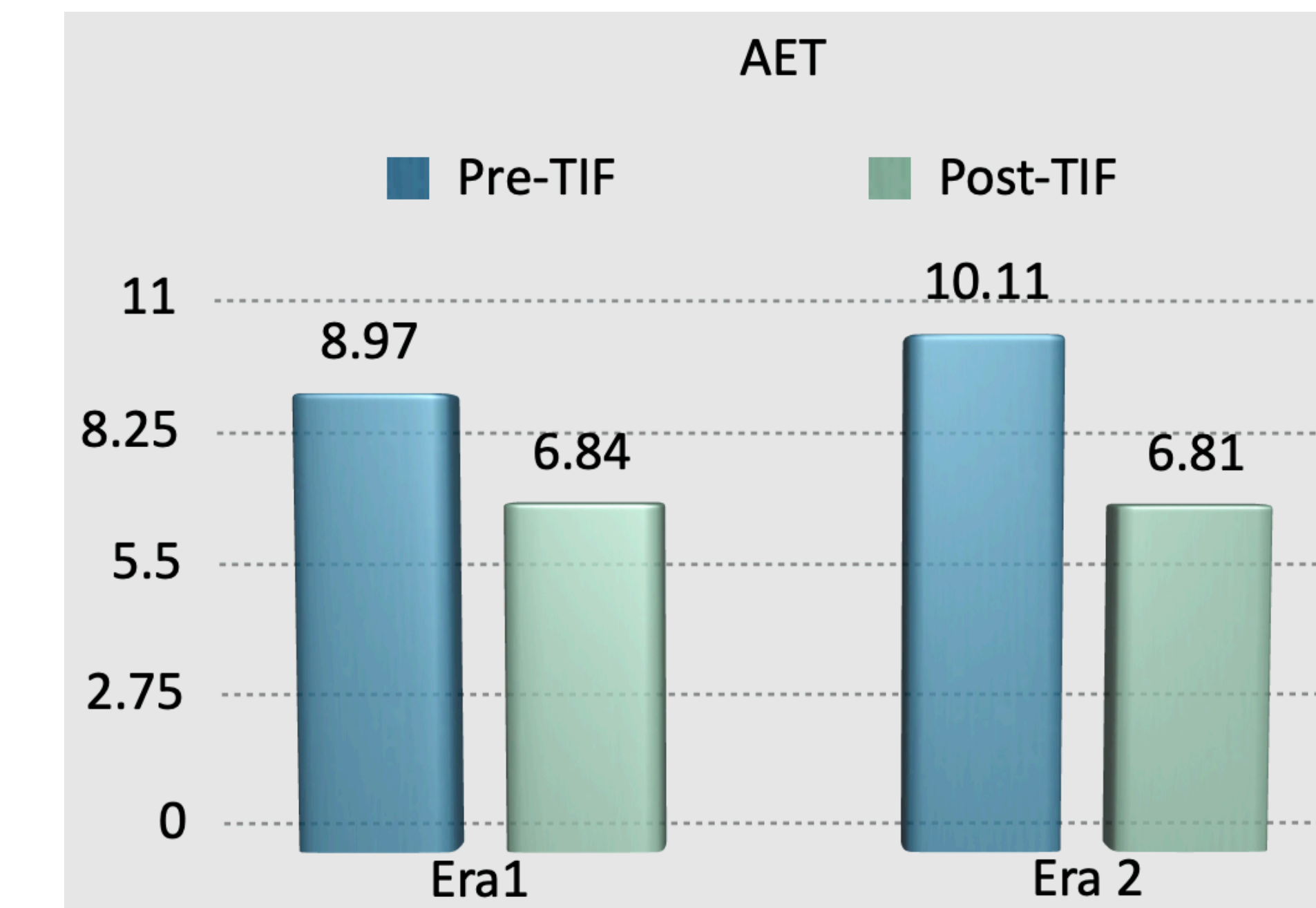


Figure 5. AET scores in Era 1 and Era 2 pre- and post-TIF

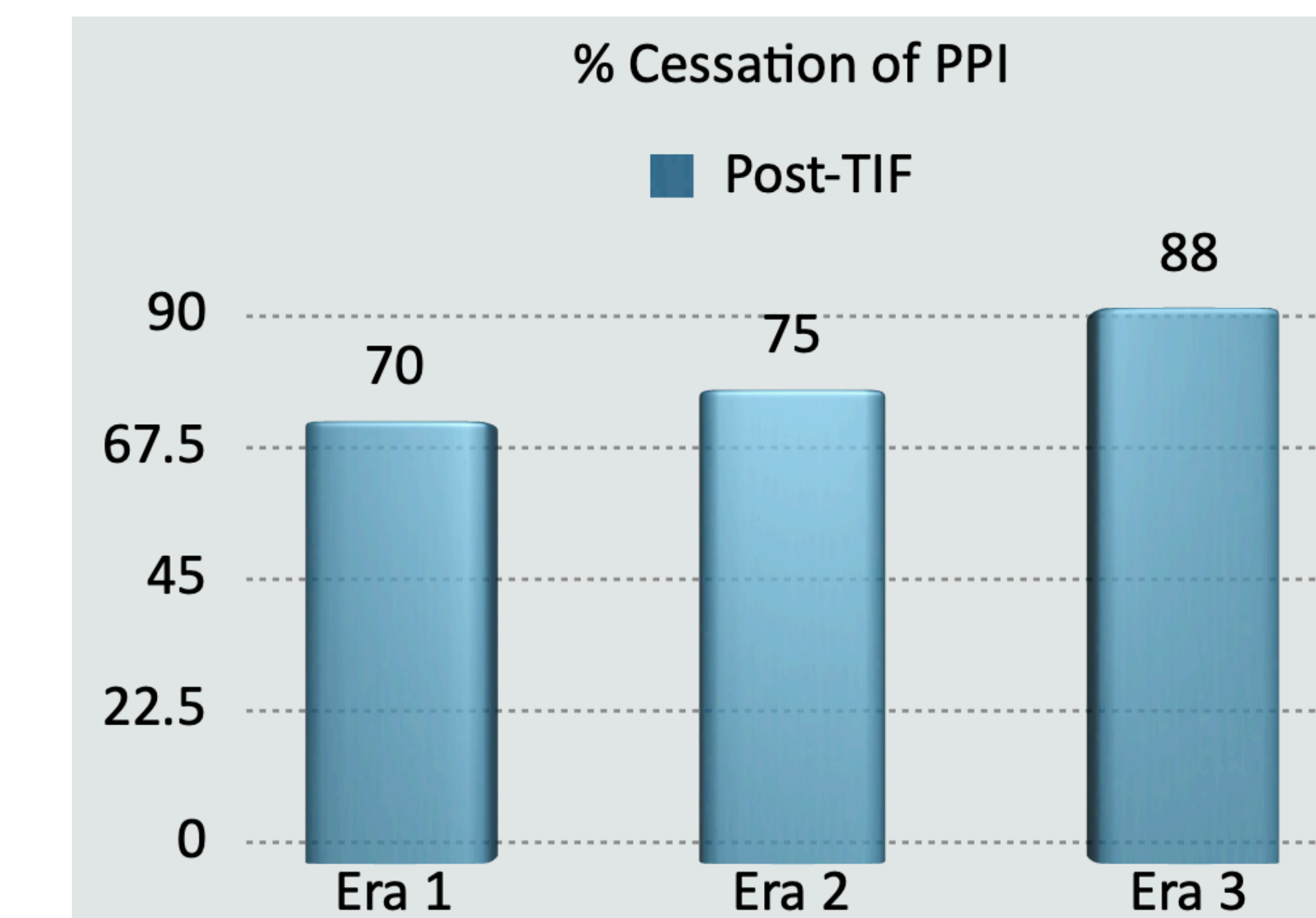


Figure 6. Percent Cessation of PPI in Era 1, Era 2 and Era 3 post-TIF (%)

Results

- 59 studies are included in the meta-analysis with a total of 2,905 patients.
- 782 patients underwent TIF 2.0 + hiatal hernia repair.
- 1,695 patients underwent TIF 2.0.
- 428 patients underwent TIF 1.0.
- Era 2 showed a slightly greater GERSS improvement than Era 3 (4.22 vs 5.44).
- HRQL improved from Era 1 to Era 2 to Era 3 (18.92 vs 6.86 vs 5.12).
- Era 3 had greater RSI improvement than Era 2 (4.97 vs 6.41).
- DeMeester improved significantly from Era 1 to Era 2 to Era 3 (24.51 vs 22.28 vs 10.02).
- AET improvement was about the same from Era 1 to Era 2 (6.84 vs 6.81).
- The percentage of PPI cessation improved from Era 1 to Era 2 to Era 3 (70% vs 75% vs 88%).

Conclusion

HRQL, RSI, and DeMeester scores as well as the percentage of PPI cessation among patients have improved with the evolution of TIF in the three eras.

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