

Is Height a Contributing Factor of Laryngopharyngeal Reflux Disease? A Case-Series of 463 Patients[☆]

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Summary: Objective. To investigate the influence of height on pharyngeal reflux characteristics, clinical presentation, and therapeutic outcomes in patients with laryngopharyngeal reflux disease (LPRD).

Methods. Data of patients with a positive diagnosis of LPRD at the 24-hour hypopharyngeal-esophageal multi-channel intraluminal impedance-pH monitoring (HEMII-pH) were collected from the European Reflux Clinic and Elsan Hospital from January 2017 to October 2024. Analysis included HEMII-pH parameters (number and pH of pharyngeal reflux events), pretreatment and post treatment reflux symptom scores (RSS), reflux sign assessment (RSA), and gastrointestinal endoscopy findings stratified by patient height.

Results. The study included 463 patients (257 females (55.5%) and 206 males (44.5%). The mean ages of females and males were 51.7 ± 15.4 and 50.4 ± 16.1 , respectively. Females demonstrated higher frequency of weakly acidic pharyngeal reflux events and RSS compared to males. Height did not influence HEMII-pH parameters or endoscopic findings in either sex. However, shortest females reported higher baseline digestive symptoms and demonstrated higher 3-month post treatment RSA scores. In males, therapeutic response varied by height, with significant RSS improvements observed in groups <171 cm and 171-180 cm, while the tallest group showed no significant improvement.

Conclusion. Height does not influence objective HEMII-pH findings. RSS did not differ across height-stratified cohorts, either at baseline or 3 months post treatment. Future studies should investigate the role of physiological, anatomical, and behavioral factors in height-related therapeutic variations.

Key Words: Laryngeal—Laryngopharyngeal—Reflux—Gastroesophageal—Symptoms—Height—Voice—Treatment—Otolaryngology—Head neck surgery—Laryngology.

INTRODUCTION

Laryngopharyngeal reflux disease (LPRD) is defined as a disease of the upper aerodigestive tract resulting from the direct and/or indirect effects of gastroduodenal content reflux, inducing morphological and/or neurological changes in the upper aerodigestive tract.¹ Numerous contributing factors of LPRD have been identified, including high-fat, low-protein diet, lifestyle, tobacco, anxiety, depression, hiatal hernia, and lower and upper esophageal sphincter (UES) relaxation.²⁻⁵ In a recent retrospective chart review, Chung et al demonstrated that height represents an independent risk factor for LPRD development, with particularly strong associations observed in young male patients.⁶ This new finding was reinforced by the correlation observed between an individual's height and esophageal length, as indicated by external anthropometric

measurements.⁶ Although numerous studies have examined weight-related effects on both gastroesophageal reflux disease (GERD) and LPRD,⁷⁻⁹ Chung et al⁶ conducted the first investigation analyzing height as a potential determinant of pharyngeal reflux patterns and clinical manifestations in LPRD patients.

In the present study, the author investigated the influence of height on pharyngeal reflux event features, gastrointestinal (GI) endoscopy findings, symptoms, findings, and therapeutic responses in LPRD patients.

METHODS

Subjects and setting

This study was a retrospective case series of LPRD patients who were consecutively recruited from September 2017 to August 2024 in two European Hospitals (Poitiers Elsan Polyclinic and CHU Saint-Pierre of Brussels). Patients were followed by the author of the study (J.R.L.) and a retired laryngologist (F.B.) with the same protocol. The LPRD diagnosis was based on the Dubai Consensus Criteria,¹ which consider the LPRD diagnosis for the occurrence of more than one acid, weakly acid, or alkaline pharyngeal reflux event at the 24-hour hypopharyngeal-esophageal multichannel intraluminal impedance-pH testing (HEMII-pH). GI endoscopy was carried out in patients with GERD symptoms and findings, history of Barrett metaplasia, and for aging patients (>60 years). Patients were excluded if they had severe neurological or psychiatric disorders, head and neck malignancies, and a history of neck radiotherapy. Moreover, the author excluded medical records without

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demographic information, eg, age, height, weight, and gender. The ethics committee approved the protocol (CHU Saint-Pierre, Brussels, n°BE076201837630-2017). Patient consent was obtained. The STROBE Statement was followed for the present manuscript.

Hypopharyngeal-esophageal multichannel intraluminal impedance-pH monitoring

The placement of the HEMII-pH probe was consistent with the Dubai Consensus Criteria.¹ The catheter was composed of eight impedance ring pairs and 2 pH electrodes (Versaflex Z®, LPR ZNID22+8R FGS 9000-17; Digitrapper pH-Z testing System, Medtronic, Hauts-de-France, France). Six impedance segments were placed along the esophagus zones (Z1-Z6) below the UES. Two pharyngeal impedance segments were placed 1 and 2 cm above the UES. The LPRD was diagnosed for more than one acid, weakly acid, or alkaline hypopharyngeal reflux event at the 24-hour HEMII-pH. A hypopharyngeal reflux event was an episode reaching the pharyngeal sensors. Acid, weakly acid, and alkaline hypopharyngeal reflux events consisted of events with pH $\leq$ 4.0, 4.0-7.0, and $\geq$ 7.0, respectively. GERD diagnosis was based on the Lyon guidelines, which consisted of Los Angeles grade C and D esophagitis, long segment Barrett's mucosa, peptic esophageal stricture, and acid exposure time in the distal esophagus $>6\%$ of 24 hours.¹⁰

Symptoms and findings

Reflux Symptom Score (RSS) and Reflux Sign Assessment (RSA) were used to document symptoms and findings. RSS rates the frequency, severity, and impact of quality of life of otolaryngological, digestive, and respiratory symptoms.¹¹ The RSS-related quality-of-life score (RSS-QoL) was used to evaluate the severity of LPRD, including mild (RSS-QoL of up to 25), moderate (RSS-QoL between 26 and 38), and severe LPRD (RSS-QoL greater than 38).¹¹ The RSA findings were assessed in a blinded manner by the two laryngologists,¹² who reported an adequate interclass coefficient ($r_s = 0.663$) regarding previous studies.¹²

Therapeutic strategies and responses

All patients received a 3-month standardized therapy combining proton pump inhibitor (pantoprazole 40 mg/day) with postmeal supplements—either alginate (Gaviscon®, Reckitt Benckiser, Slough, UK) or magaldrate (Riopan®, Takeda, Zaventem, Belgium), both administered three times daily. Treatment allocation followed specific criteria: patients with GERD or acid LPRD received PPI plus alginate, those with weakly acidic LPRD received alginate alone, while magaldrate was preferred for patients with predominantly alkaline reflux events. All patients were instructed to follow standardized anti-reflux dietary and lifestyle protocols.¹³ Treatment response was assessed using 3-month RSS changes, with the following criteria: no response (RSS increase, no change, or $<20\%$ reduction), mild-to-moderate response (20.1%-60% RSS reduction), and high-to-complete response (60.1%-100% RSS reduction).^{1,14,15}

Statistical methods

Statistical Package for the Social Sciences for Windows (SPSS version 30.0; IBM Corp, Armonk, NY) was used for statistical analyses. The pretreatment to post treatment symptom and finding changes were assessed with the Wilcoxon Rank Test. Based on normative data in the local population (median male = 170.8 ± 6.5 cm, median female = 158.6 ± 6.0 cm),¹⁶ patients were stratified into four groups based on height values distributed around the median (quartiles). The following height were considered for males: <161 cm, 161-170 cm, 171-180 cm, and >180 cm. For females, the following thresholds were used <149 cm, 149-158 cm, 159-167 cm, and >167 cm, respectively. The Kruskal-Wallis test and Chi-square were used for the group comparison. In addition, a bivariate association between demographics, HEMII-pH, RSS, and RSA outcomes was carried out with the Spearman correlation coefficient, which was considered as low ($k < 0.40$), moderate ($k = 0.40$ - 0.60) and strong ($k > 0.60$), respectively. A level of significance of $P < 0.05$ was used.

RESULTS

The study included 463 patients (257 females [55.5%], 206 males [44.5%]), with comparable mean ages between females (51.7 ± 15.4 years) and males (50.4 ± 16.1 years). Detailed demographics and clinical characteristics are presented in [Tables 1 and 2](#). The flow chart is available in [Figure 1](#). While weight, GI endoscopy findings, and GERD features showed no significant sex-based differences, females demonstrated a significantly higher frequency of weakly acidic pharyngeal reflux events compared to males (43.6 ± 53.6 versus 23.2 ± 22.8 ; $P = 0.038$).

Baseline symptom and clinical findings analyses revealed significant sex-based differences ([Tables 3 and 4](#)). Females exhibited higher baseline RSS subscores and total score ($P = 0.001$), including RSS-QoL ($P = 0.001$). Conversely, males demonstrated significantly higher baseline oral ($P = 0.001$) and laryngeal ($P = 0.039$) RSA subscores. The initial sex-based disparities in RSS and RSA parameters normalized following 3 months of treatment, with no statistically significant differences remaining.

Influence of height in females

Female patient characteristics stratified by height are detailed in [Table 1](#). Mean height was significantly lower in older female cohorts compared to younger age groups. Across height groups, there were no significant differences in LPRD severity, GI endoscopy, HEMII-pH, number of pharyngeal reflux events, and GERD features ([Table 1](#)).

The symptom and sign evaluations of females are summarized in [Table 3](#). Females with the smallest height reported significantly higher digestive symptom scores compared to the highest females ($P = 0.037$). RSS and RSS subscores significantly reduced from pre- to 3-month post treatment in all groups without exhibiting significant differences across groups. RSA score and subscores

TABLE 1.
Demographics and Gastrointestinal Findings in Females

	Females				P value
	N = 57	N = 127	N = 73	N = 257	
Characteristics	<159 cm	159-167 cm	>167 cm	Total	
Mean age (range, years)	58.2 ± 13.9	52.4 ± 15.4	47.4 ± 14.9	51.7 ± 15.4	0.005
Body Mass Index	26.2 ± 6.6	25.2 ± 6.3	23.5 ± 4.2	24.9 ± 5.9	NS
Weight (mean, SD)	63.3 ± 12.8	67.6 ± 14.1	69.0 ± 12.8	67.1 ± 13.5	0.023
Height (mean, SD)	154.3 ± 3.2	162.5 ± 2.4	171.4 ± 3.7	163.2 ± 6.9	0.001
<i>Severity of reflux (RSS-QoL)</i>					
Mild reflux (<26)	15 (26.3)	49 (38.6)	27 (37.0)	43 (30.0)	NS
Moderate reflux (26-38)	18 (31.6)	31 (24.4)	15 (20.5)	42 (29.4)	NS
Severe reflux (>38)	24 (42.1)	47 (37.0)	31 (42.5)	58 (40.6)	NS
<i>Gastrointestinal endoscopy</i>					
	N = 40	N = 87	N = 45	N = 172	
Normal	9 (22.5)	21 (24.1)	11 (24.4)	41 (23.8)	NS
Esophagitis	16 (40.0)	32 (36.8)	15 (33.3)	63 (36.6)	NS
Hiatal hernia	10 (25.0)	31 (35.6)	16 (35.6)	57 (33.1)	NS
LES insufficiency	13 (32.5)	43 (49.4)	18 (40.0)	74 (43.0)	NS
Gastritis	16 (40.0)	25 (28.7)	12 (26.7)	53 (30.8)	NS
Helicobacter Pylori infection	3 (7.5)	4 (4.6)	5 (11.1)	12 (7.0)	NS
<i>HEMII-pH feature (mean, SD)</i>					
<i>Pharyngeal events</i>					
Pharyngeal acid reflux events	9.8 ± 13.1	12.3 ± 15.7	12.6 ± 19.5	11.8 ± 16.2	NS
Pharyngeal weakly acid reflux events	32.9 ± 31.4	46.6 ± 55.4	47.8 ± 68.0	43.6 ± 53.6	NS
Pharyngeal nonacid reflux events	9.1 ± 11.9	6.7 ± 10.1	11.3 ± 17.1	8.4 ± 12.7	NS
Total number of pharyngeal events	31.8 ± 22.8	42.0 ± 51.2	40.5 ± 45.1	39.2 ± 44.5	NS
<i>Position events</i>					
Pharyngeal event upright	29.4 ± 10.8	35.7 ± 43.1	36.3 ± 43.2	34.4 ± 39.0	NS
Pharyngeal event supine	3.1 ± 4.6	5.9 ± 16.4	4.7 ± 7.8	4.9 ± 12.5	NS
<i>GERD</i>					
Number of patients (%)	24 (42.1)	52 (40.9)	23 (31.5)	99 (38.5)	NS
Percentage of time with distal pH < 4	10.6 ± 16.9	14.7 ± 22.2	11.9 ± 21.8	13.1 ± 21.0	NS

Severity of reflux was classified according to the IFOS classification.¹⁷ Abbreviations: GERD, gastroesophageal reflux disease; HEMII-pH, hypopharyngeal-esophageal multichannel intraluminal impedance-pH monitoring; LES, lower esophageal sphincter; RSS-QoL, reflux symptom score quality of life; SD, standard deviation.

significantly reduced from baseline to 3-month post treatment in females with intermediate and high height but not in females with the low height (Table 3). At 3-month post treatment, laryngeal RSA and total RSA scores were significantly higher in females with the smallest height.

The Spearman correlation reported that height was negatively associated with the age of females ($r_s = -0.242$; $P = 0.001$) and the 3-month post treatment laryngeal RSA ($r_s = -0.229$; $P = 0.005$).

Influence of height in males

Male anthropometric analysis revealed significant interrelationships between age, weight, and height, while BMI values showed no significant between-group differences (Table 2). There was no significant difference in HEMII-pH, GI endoscopy GERD findings, and LPRD severity across groups. Baseline RSS scores and most RSA parameters showed no significant differences across male height categories. Height-specific analysis revealed distinct RSA patterns: males in the lowest height category demonstrated significantly higher laryngeal RSA scores, while those in the intermediate height range showed significantly elevated

pharyngeal RSA scores compared to other height categories. Treatment response analysis demonstrated height-dependent variations: significant reductions in RSS sub-scores and total scores were observed in males of short (<171 cm) and intermediate (171-180 cm) stature after 3 months of therapy, while those in the tallest category (>180 cm) showed no significant RSS improvement. However, RSA scores improved significantly across all height categories following treatment (Table 4). The height was positively correlated with the weight of patients ($r_s = 0.347$; $P = 0.001$). There was no significant association between age and clinical outcomes.

DISCUSSION

The recent study of Cheung et al was the first investigation supporting a significant influence of height on the occurrence of pharyngeal reflux events in LPRD. They identified an association in young male patients, though this relationship was not observed in older males or females.⁶ Our current investigation, however, did not corroborate these findings. Analysis of HEMII-pH parameters, GERD

TABLE 2.
Demographics and Gastrointestinal Findings in Males

	Males				<i>P</i> value
	<i>N</i> = 53	<i>N</i> = 108	<i>N</i> = 45	<i>N</i> = 206	
Characteristics	<171 cm	171-180 cm	>180 cm	Total	
Mean age (range, years)	58.3 ± 15.8	48.6 ± 15.9	45.6 ± 14.1	50.4 ± 16.1	0.013
Body mass index	25.7 ± 4.1	25.5 ± 4.1	24.1 ± 3.9	25.2 ± 4.1	NS
Weight (mean, SD)	70.5 ± 11.8	70.2 ± 12.5	82.2 ± 13.3	77.6 ± 13.2	0.001
Height (mean, SD)	165.8 ± 4.3	176.5 ± 2.9	184.9 ± 3.6	175.6 ± 7.5	0.001
<i>Severity of reflux (RSS-QoL)</i>					
Mild reflux (<26)	28 (52.8)	57 (52.8)	16 (35.6)	101 (49.0)	NS
Moderate reflux (26-38)	13 (24.5)	31 (28.7)	17 (37.8)	61 (29.6)	NS
Severe reflux (>38)	12 (22.6)	20 (18.5)	12 (26.7)	44 (21.4)	NS
<i>Gastrointestinal endoscopy</i>					
	<i>N</i> = 40	<i>N</i> = 72	<i>N</i> = 34	<i>N</i> = 146	
Normal	13 (32.5)	21 (29.2)	9 (26.5)	43 (29.5)	NS
Esophagitis	11 (27.5)	23 (31.9)	16 (47.1)	50 (34.2)	NS
Hiatal hernia	5 (12.5)	16 (22.2)	8 (23.5)	29 (19.9)	NS
LES insufficiency	11 (27.5)	30 (41.7)	9 (26.5)	50 (34.2)	NS
Gastritis	15 (37.5)	22 (30.6)	7 (20.6)	44 (30.1)	NS
Helicobacter Pylori infection	2 (5.0)	3 (4.2)	3 (8.8)	8 (5.5)	NS
<i>HEMII-pH feature (mean, SD)</i>					
<i>Pharyngeal events</i>					
Pharyngeal acid reflux events	13.1 ± 16.7	10.2 ± 14.6	11.9 ± 15.8	11.3 ± 15.4	NS
Pharyngeal weakly acid reflux events	21.2 ± 24.2	22.8 ± 20.6	26.5 ± 26.1	23.2 ± 22.8	NS
Pharyngeal nonacid reflux events	10.2 ± 15.5	10.4 ± 13.9	8.4 ± 13.4	9.9 ± 14.1	NS
Total number of pharyngeal events	32.1 ± 25.4	28.8 ± 23.4	30.2 ± 25.6	29.9 ± 24.3	NS
<i>Position events</i>					
Pharyngeal event upright	29.4 ± 22.7	23.5 ± 19.9	24.5 ± 20.5	25.2 ± 20.8	NS
Pharyngeal event supine	6.8 ± 12.8	4.3 ± 8.3	6.2 ± 13.4	5.3 ± 10.9	NS
<i>GERD</i>					
Number of patients (%)	15 (28.3)	35 (32.4)	15 (33.3)	65 (31.6)	NS
Percentage of time with distal pH < 4	13.8 ± 27.1	8.3 ± 15.6	10.8 ± 18.4	10.3 ± 19.8	NS

Severity of reflux was classified according to the IFOS classification.¹⁷ Abbreviations: GERD, gastroesophageal reflux disease; HEMII-pH, hypopharyngeal-esophageal multichannel intraluminal impedance-pH monitoring; LES, lower esophageal sphincter; RSS-QoL, reflux symptom score quality of life; SD, standard deviation.

characteristics, and GI endoscopic findings revealed no significant height-dependent variations in either sex. Moreover, bivariate analysis failed to demonstrate significant associations between height and key clinical parameters in both male and female cohorts. Cheung et al based their investigation on the linear relationship observed between individuals' height and esophageal length, and they postulated that longer esophagi might confer protection against pharyngeal reflux events through enhanced proximal-to-distal contractile capabilities during esophageal clearance.⁶ However, the pathophysiology of pharyngeal reflux primarily involves coordinated transient relaxations of both lower and UES.^{14,18} These sphincter relaxation events are predominantly triggered by multiple factors, including autonomic nervous system dysfunction (manifesting as stress, anxiety, or depression), diet, and lifestyle behaviors, operating through complex and partially elucidated mechanisms.²⁻⁵

The relationship between esophageal body dysmotility and LPRD remains controversial, as the majority of LPRD patients demonstrate normal high-resolution manometry (HRM) findings.^{19,20} Sivaki et al investigated the

prevalence of dysmotility in patients with LPRD. They documented abnormal HRM in 43.3% of cases, representing the predominant abnormality (30.9%).¹⁹ In the same vein, Forges et al demonstrated that ineffective swallows independently correlated with higher LPRD symptom scores, maintaining statistical significance even after controlling for MII-pH-documented reflux events. Their findings suggest that esophageal dysmotility may contribute to LPRD symptoms through mechanisms independent of reflux patterns.²⁰

Although our findings do not support height as a contributory factor in pharyngeal reflux events for either sex, these results warrant careful interpretation given the absence of HRM data in our cohort. As demonstrated by Sikavi et al¹⁹ and Borges et al,²⁰ LPRD populations comprise heterogeneous subgroups with and without esophageal body dysmotility. Theoretically, patients without dysmotility, whose LPRD manifestations are primarily driven by sphincter relaxation mechanisms, should demonstrate both effective swallowing and height-dependent effects related to esophageal length. Future investigations incorporating HRM data are essential to evaluate height's

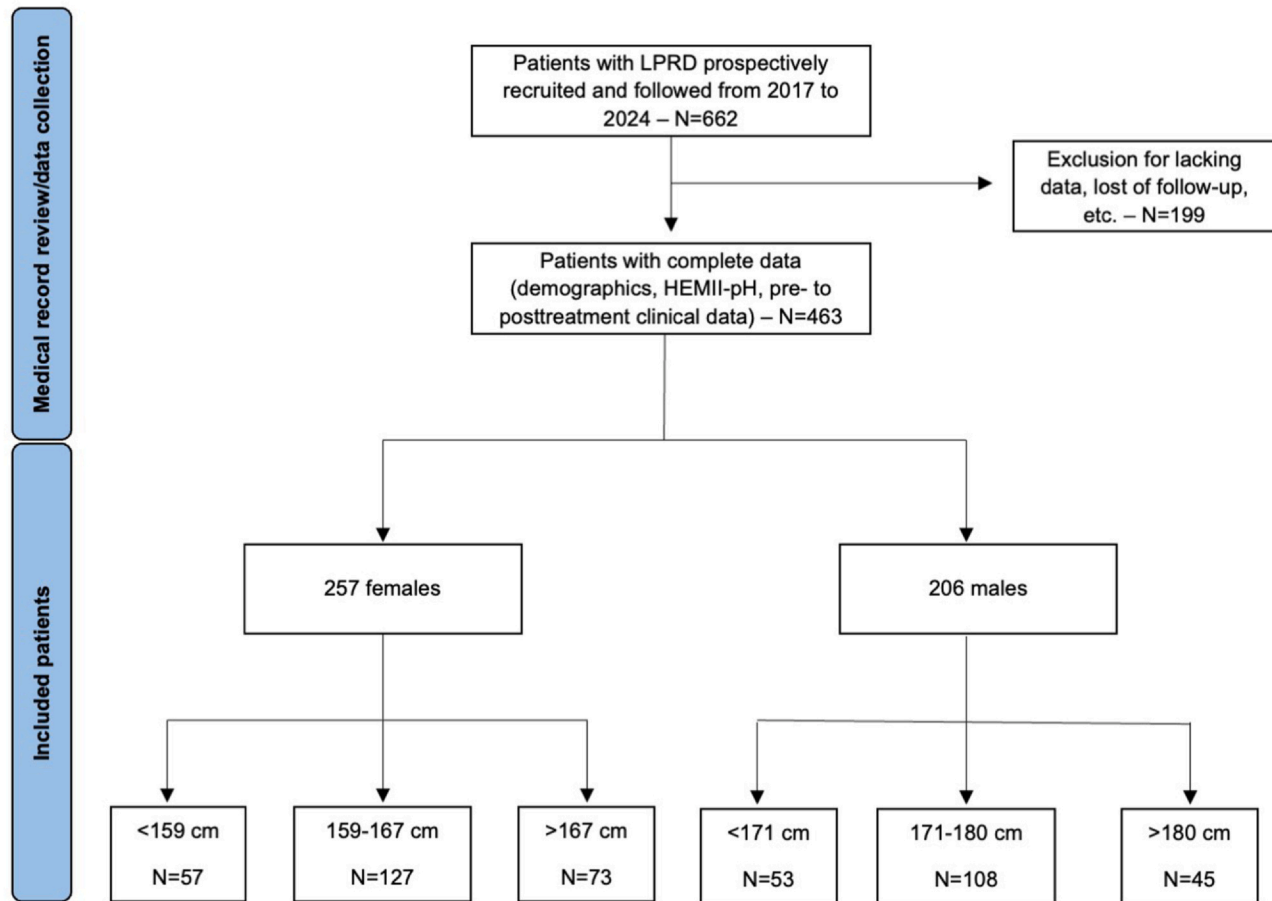


FIGURE 1. Flow chart.

influence on pharyngeal reflux patterns specifically within LPRD subpopulations (dysmotility versus non-dysmotility). Given the established distinctions between LPRD and GERD pathophysiology,¹ concurrent analysis of GERD parameters would be valuable in these subpopulation studies.

In this study, females reported higher pharyngeal reflux events at the 24-hour HEMII-pH and baseline RSS compared to males. This observation corroborated the findings of previous studies suggesting gender-related differences in the clinical presentation of LPRD,^{21,22} and therapeutic responses.²¹ Current evidence suggests that enhanced female susceptibility to inflammatory responses and consequent mucosal injury can be related to X-chromosomal mechanisms rather than sex hormone variations.^{23,24} Multiple inflammation-regulatory genes residing on the X chromosome demonstrate resistance to X-inactivation. The resultant female-specific mosaic expression pattern, characterized by cellular heterogeneity in paternal versus maternal X chromosome activation, may confer enhanced inflammatory response capabilities.^{23,24}

Males in the highest height category demonstrated suboptimal therapeutic response. This finding may be explained by height-associated anatomical variations, particularly in esophagogastric junction morphology. The

hypothesized mechanism involves an increased esophagogastric angle in taller individuals, potentially compromising LES tonicity and maintaining pathological reflux patterns, thus attenuating treatment response at 3-month follow-up.²⁵ Increased abdominal pressure, which is commonly associated with greater body size, can further compromise LES function. Finally, tall male can consume larger quantities of foods and beverages due to their greater body size, which can further increase the risk of recalcitrant GERD. While these anatomical, physiological, and behavioral findings can theoretically support our observation, the lack of HRM and HEMII-pH testing at 3-month post treatment limit the drawing of valid explanation.

The lack of HRM is the primary limitation of this study. Moreover, some important conditions were not explored in patients, including diet, lifestyle habits, and autonomic nerve dysfunction. These parameters significantly influence pharyngeal reflux pathophysiology, and their potential uneven distribution across height categories may have impacted our findings. Furthermore, methodological heterogeneity in HEMII-pH monitoring equipment between our study and Cheung et al's investigation—specifically, varying device sensitivities for esophageal and pharyngeal reflux detection—limits direct inter-study comparison of results. The significant negative correlation between age

TABLE 3.
Clinical Features of Females

Characteristics	Baseline reflux symptom score				3 months post treatment reflux symptom score				Intergroup	
	<159 cm	159-167 cm	>167 cm	P value	Total = 257	<159 cm	159-167 cm	>167 cm	Total = 257	P value
Otolaryngological Reflux Symptom Score	67.8 ± 47.5	61.8 ± 44.5	60.8 ± 42.4	NS	62.8 ± 44.5	39.2 ± 34.5*	38.9 ± 38.8*	36.8 ± 34.7*	38.4 ± 36.7*	NS
Digestive Reflux Symptom Score	54.3 ± 41.1	41.2 ± 36.4	49.0 ± 39.8	0.037	46.3 ± 38.7	27.4 ± 25.9*	25.6 ± 31.6*	33.0 ± 35.9*	27.8 ± 31.6*	NS
Respiratory Reflux Symptom Score	27.8 ± 25.3	21.3 ± 21.7	19.9 ± 32.1	NS	22.3 ± 23.0	15.0 ± 18.6*	14.4 ± 20.1*	12.2 ± 22.7*	14.0 ± 10.4*	NS
QoL Reflux Symptom Score	40.5 ± 22.9	34.8 ± 20.3	36.5 ± 20.9	NS	36.5 ± 21.1	27.3 ± 19.5*	25.3 ± 23.0*	24.5 ± 17.9*	25.5 ± 21.0*	NS
Total Reflux Symptom Score	149.9 ± 99.0	124.3 ± 83.3	129.7 ± 85.3	NS	131.5 ± 87.7	81.5 ± 66.4*	78.8 ± 79.6*	82.0 ± 76.9*	80.2 ± 75.8*	NS
Oral Reflux Sign Assessment	5.2 ± 2.2	5.5 ± 2.1	5.3 ± 1.7	NS	5.4 ± 2.0	4.5 ± 2.5	4.7 ± 2.1*	4.5 ± 2.1	4.6 ± 2.1*	NS
Pharyngeal Reflux Sign Assessment	8.4 ± 4.1	9.7 ± 4.1	9.9 ± 5.1	NS	9.5 ± 4.4	8.4 ± 4.1	6.9 ± 4.2*	8.2 ± 3.2*	7.5 ± 4.0*	NS
Laryngeal Reflux Sign Assessment	13.0 ± 5.8	12.4 ± 5.4	11.5 ± 5.0	NS	12.3 ± 5.4	11.5 ± 5.2	7.9 ± 4.7*	7.2 ± 5.3*	8.5 ± 5.2*	0.002
Total Reflux Sign Assessment	25.9 ± 8.4	26.8 ± 8.5	26.1 ± 8.7	NS	26.4 ± 8.5	24.5 ± 9.1	19.4 ± 8.0*	19.2 ± 7.1*	20.4 ± 8.3*	0.025

*Pretreatment to post treatment significant changes. Abbreviations: mo, month; NS, non-significant.

TABLE 4.
Clinical Features of Males

Characteristics	Baseline reflux symptom score			P value	3 months post treatment reflux symptom score			Intergroup	
	<171 cm	171–180 cm	>180 cm		<171 cm	171–180 cm	>180 cm	Total = 206	P value
Otolaryngological Reflux Symptom Score	52.7 ± 36.8	46.3 ± 32.6	46.2 ± 37.3	NS	33.7 ± 28.6*	28.5 ± 30.9*	33.7 ± 32.0	30.6 ± 30.5*	0.040
Digestive Reflux Symptom Score	33.1 ± 29.2	32.6 ± 28.3	35.7 ± 30.3	NS	14.4 ± 14.3*	20.2 ± 24.6*	29.6 ± 34.7	20.9 ± 25.6*	NS
Respiratory Reflux Symptom Score	18.0 ± 21.3	13.5 ± 16.9	12.0 ± 15.9	NS	10.8 ± 13.5*	7.8 ± 13.4*	10.2 ± 15.2	8.9 ± 13.7*	NS
QoL Reflux Symptom Score	28.6 ± 16.5	27.1 ± 15.1	29.4 ± 14.8	NS	18.8 ± 11.2*	19.8 ± 14.3*	21.1 ± 16.2*	19.8 ± 14.0*	NS
Total Reflux Symptom Score	103.9 ± 66.4	92.5 ± 63.7	93.9 ± 63.4	NS	59.0 ± 43.7*	57.3 ± 55.1*	73.5 ± 63.7	60.9 ± 54.8*	NS
Oral Reflux Sign Assessment	5.9 ± 2.4	6.3 ± 2.2	5.3 ± 2.5	0.030	4.8 ± 2.6	5.3 ± 2.2	5.8 ± 2.1	5.3 ± 2.3*	NS
Pharyngeal Reflux Sign Assessment	8.5 ± 3.8	9.9 ± 4.2	8.6 ± 4.0	NS	6.2 ± 4.1*	6.9 ± 3.9*	8.2 ± 4.0	7.0 ± 4.0*	NS
Laryngeal Reflux Sign Assessment	14.7 ± 4.5	13.6 ± 5.8	12.1 ± 4.7	0.019	10.8 ± 5.1*	8.2 ± 5.1*	9.0 ± 4.6*	8.9 ± 5.1*	0.021
Total Reflux Sign Assessment	28.7 ± 6.0	29.2 ± 8.2	26.1 ± 7.5	NS	21.8 ± 7.8*	20.5 ± 7.9*	22.9 ± 7.1*	21.3 ± 7.7*	NS

*Pretreatment to post treatment significant changes. Abbreviations: mo, month; NS, non-significant.

and height in our cohort can be attributed to dual mechanisms: the documented secular increase in population height across European generations since the mid-20th century, combined with the established phenomenon of age-related height diminution. This demographic distribution aligns with expected population parameters.^{26,27} The age distribution pattern represents a significant methodological consideration, given the established inverse relationship between age and mucosal sensory function.²¹ This physiological phenomenon, characterized by reduced symptom perception in elderly populations, may have introduced systematic bias in clinical assessments, particularly affecting the lower-height cohorts.²¹

CONCLUSION

The relationship between height and objective parameters, including HEMII-pH, GI endoscopic findings, and GERD characteristics, remains incompletely understood. RSS did not differ across height-stratified cohorts, either at baseline or three months post treatment. Future research protocols should systematically evaluate esophageal motility dynamics, esophagogastric junction morphology, and dietary behavior patterns to better understand the potential relationship between height and LPRD.

Author Contributions

Jerome R. Lechien: Patients were recruited from the Reflux Consultation of the author of the paper. Contributions: design, acquisition of data, data analysis and interpretation, drafting, final approval, and accountability for the work; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Declaration of Competing Interest

The author has no financial interest in the subject under discussion. All authors have read and approved the manuscript.

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