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Research Paper

# Evaluation of the Prevalence and Severity of Tricuspid Regurgitation in Children

**Seyed Mojtaba Alavi[1], Seyed Mohammad Hashem Montazeri[1], Masoud Hassanvand-Amouzadeh[2], Mohammad Hosein Arjmandnia[3], Hamideh Sadat Lajevardi[3], Mahla Takmili[4]**

*1. Department of Pediatrics, School of Medicine, Qom University of Medical Sciences, Qom, Iran.*
*2. Department of Pediatrics, Neuroscience Research Center, School of Medicine, Hazrat-e Fateme Masoume Hospital, Qom University of Medical Sciences, Qom, Iran.*
*3. Department of Pediatrics, School of Medicine, Hazrat-e Fateme Masoume Hospital, Qom University of Medical Sciences, Qom, Iran.*
*4. Department of Pediatrics, School of Medicine, Kerman University of Medical Sciences, Kerman, Iran.*

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## ABSTRACT

**Background and Aim:** This study aimed to evaluate the prevalence and severity of tricuspid regurgitation (TR) in children who were referred to the Echocardiography Department of Hazrat Masoumeh Hospital in Qom in 2021.

**Materials and Methods:** An observational study was conducted at Hazrat Masoumeh Pediatrics Clinic in Qom, Iran, involving 284 healthy children aged 1 day to 18 years with no previous diseases. The study excluded patients with congenital disorders and those with symptoms of cardiac or pulmonary disease. The severity of TR was assessed using transthoracic echocardiography based on recent guidelines. Data analysis was performed using SPSS software, version 26, and statistical tests were used to compare the data.

**Results:** The study included 284 patients, comprising 164 boys and 120 girls (57.7% vs 42.3%). The youngest participant was two days old, and the oldest was 18 years old, with a mean age of 4.07±4.02 years. Most children (90.2%) had mild to moderate signs of TR , while 8.8% had no signs. Overall, 82.3% of boys and 80% of girls had TR, with no significant association between TR severity and sex. There was also no significant difference in TR severity among different age groups (P>0.05).

**Conclusion:** The study found that over 90% of healthy children have some degree of TR. The presence of mild TR should not be considered pathological, as it does not worsen with age and does not require further follow-up or investigation. Furthermore, over 80% of adults have been reported to have mild TR.

*** Corresponding Author:**
*Mohammad Hosein Arjmandnia,*
***Address:*** *Department of Pediatrics, School of Medicine, Hazrat-e Fateme Masoume Hospital, Qom University of Medical Sciences, Qom, Iran.*
***Phone:*** *+98 (913) 1635313*
***E-mail:*** *mharjmandnia@muq.ac.ir*

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## Introduction

Tricuspid regurgitation (TR) occurs when blood flows backward from the right ventricle (RV) into the right atrium (RA) during ventricular systole, typically due to incomplete closure of the valve leaflets [1]. TR is a common finding in echocardiograms of healthy populations, with an estimated prevalence of 80-90% [2, 3]. Recent studies indicate that up to 67.8% of healthy children might have some degree of valvular regurgitation (VR) [4]. Doppler echocardiography, a noninvasive technique with high sensitivity and specificity, is widely used to diagnose VR, including TR, and assess their severity [5, 6]. Although trivial or mild VR is a normal finding in children, the prevalence of specific types of VR is different [7]. For instance, the prevalence of TR ranges from 3.2% to 72% in children with normal heart structure [3]. This wide range can lead to confusion and misdiagnosis. Evidence indicates that approximately 60% of normal children in the United States exhibit trivial TR [3]. Recently, some studies have reported a prevalence of mild TR in the general Iranian population at approximately 34.8% [8]. Despite the high prevalence of mild TR in the general population of Iran, data on the prevalence of mild TR in healthy children in Iran remain limited. Therefore, the current study aimed to investigate the prevalence of TR in Iranian children to address this knowledge gap.

## Methods

This cross-sectional study was conducted at the Hazrat Masoumeh Pediatrics Clinic in Qom, Iran. A total of 284 children referred to the Clinic between January and March 2022 were enrolled in the study. The children were randomly selected from a healthy population, attending Hazrat Masoumeh Pediatrics Clinic. Inclusion criteria were no symptoms related to cardiac or pulmonary disease, the age range of 1 day to 18 years, and no prior history of illness. Patients with congenital heart disorders were excluded from this study. This study was approved by the Medical Ethics Committee of the Qom University of Medical Sciences and conducted in accordance with the Helsinki ethical standards. Informed consent was obtained from all parents.

Demographic data, including age, age, sex and pressure gradient of each valve, were recorded by a pediatric cardiologist using a researcher-designed checklist, with information provided by the children's parents. The severity of TR was assessed using transthoracic echocardiography (TTE), with TR grades determined according to recent guidelines based on tricuspid valve (TV) anatomy, central jet area, vena contracta, and hepatic vein flow [9]. For instance, jet areas <5 $cm^2$, between 5-10 $cm^2$, and >10 $cm^2$ were classified as mild, moderate, and severe, respectively (Table 1).

## Results

Based on the inclusion criteria, 284 patients were enrolled in our study, of which 164 were boys and 120 were girls (57.7% vs 42.3%, respectively). The participants' ages ranged from 2 days to 18 years, with a mean age of 4.07±4.02 years. Tables 2 and 3 presents demographic data. Most children (256/284) exhibited mild to moderate signs of TR (90.2%). However, 8.8% of children had no signs of TR. Overall, 82.3% of boys and 80% of girls presented with TR (Figure 1), with complete TR detection data shown in Table 4. There was no significant association between TR severity and sex (P>0.05). The severity of TR for all age groups is presented in Table 5, and there was no significant difference between age and TR severity (P>0.05).

## Discussion

Primary TR is associated with intrinsic issues in the TV, such as leaflet dilation. In contrast, secondary TR occurs due to TV deformation from extrinsic factors, such as volume overload. While mild TR is reported in the majority of the general population, moderate and severe TR is generally considered pathological [10]. Although some studies suggest that mild TR is a physiologic finding [3, 10, 11], we observe that some parents feel concerned when informed that their children have mild TR.

To our knowledge, the exact prevalence of mild TR in pediatric patients has not been reported in the Iranian population. Our findings indicated that most children exhibit trivial to mild TR. Therefore, TR could be viewed as a normal variation rather than a pathological condition. Regarding the high prevalence of TR in normal children, we recommend that physicians reassure parents about the benign nature of mild TR once other potential diagnoses are excluded. Parents should be informed that mild TR poses no threat to their child's health, is common in children, and does not require further investigation.

As mentioned previously, the prevalence of TR remains controversial. No comprehensive study has evaluated the prevalence of TR in the Iranian pediatric population. Older studies have suggested that TR prevalence may not be as high as more recent reports indicate. A study in 1988 by Martin et al. demonstrated that only 3% of nor-

**Table 1.** Grading of the TR [9]

| TR Grading | Jet Area ($cm^2$) | Vena Contracta | Hepatic Vein Flow | RA Size | RV Volume |
|---|---|---|---|---|---|
| Mild | <5 | <3mm | Systolic dominance | Normal | <30 |
| Moderate | 5-10 | 3-6.9 mm | Systolic blunting | Normal or dilated | 30-44 |
| Severe | >10 | ≥7 mm | Systolic reversal | Usually dilated | ≥45 |



**Table 2.** Demographic characteristics of the study subjects (n=284)

| Variables | Sub-variables | No. (%) |
|---|---|---|
| Age | Newborn (0 days to 1 month) | 35(12.3) |
| | Infant (1 month to 1 year) | 74(26) |
| | Toddler (1 to 3 years) | 42(14.7) |
| | Pre-school (3 to 6 years) | 61(21.4) |
| | School-age (6 to 12 years) | 62(21.8) |
| | Adolescent (12 to 18 years) | 8(3.6) |
| | Missing | 6(1.4) |
| Gender | Male | 164(57.7) |
| | Female | 120(42.3) |



**Table 3.** Detailed age characteristics

| Variables | No. | Mean±SD |
|---|---|---|
| Male | 164 | 4.09±4.16 |
| Female | 120 | 4.03±3.84 |
| Total | 284 | 4.07±4.02 |



**Table 4.** TR severity in all children

| Variables | | No. (%) | | | | P |
|---|---|---|---|---|---|---|
| | | No TR | Mild TR | Moderate TR | Severe TR | |
| Sex | Male | 14(8.5) | 135(82.3) | 12(7.3) | 3(1.8) | >0.05 |
| | Female | 11(9.1) | 96(80) | 13(10.8) | 0 | |
| Total | | 25(8.8) | 231(81.3) | 25(8.8) | 3(1) | |

**Table 5.** TR severity in all ages

| Variables | | No. (%) | | | | P |
|---|---|---|---|---|---|---|
| | | No TR | Mild TR | Moderate TR | Severe TR | |
| Age | Newborn | 5(1.7) | 29(10.2) | 1(0.35) | 0 | >0.05 |
| | Infant | 8(2.8) | 59(20.7) | 5(1.7) | 2(0.7) | |
| | Toddler | 3(0.1) | 37(13) | 2(0.7) | 0 | |
| | Pre-school | 6(2.1) | 50(17.6) | 5(1.7) | 0 | |
| | School-age | 2(0.7) | 48(16.9) | 11(3.87) | 1(0.35) | |
| | Adolescent | 1(0.35) | 8(2.81) | 1(0.35) | 0 | |
| Total | | 25 (8.8%) | 231(81.33) | 25(8.8) | 3(0.1) | 284 |



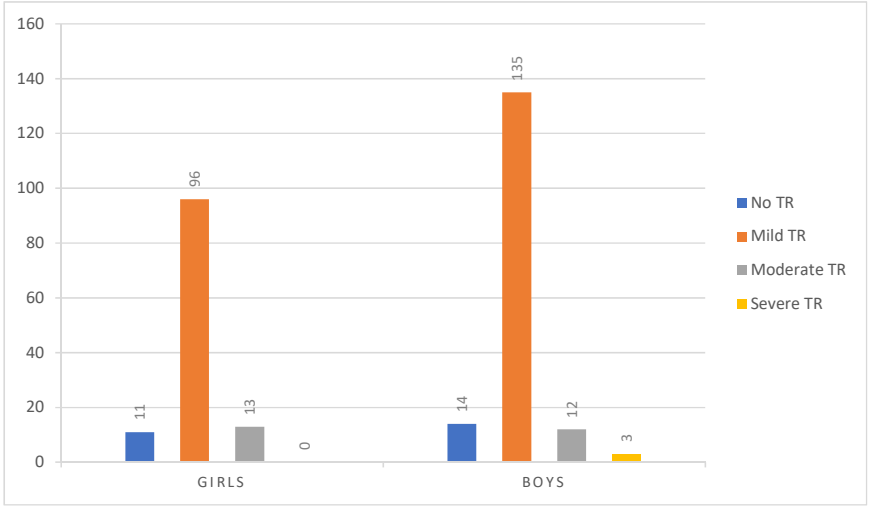


**Figure 1.** TR severity based on sex



mal children had TR [12]. They suggested that TR is uncommon in healthy children. Later, a study by Brand et al. in 1992 acknowledged that VR is a common finding in echocardiographic examinations and increases with age [13]. This study found that pulmonic regurgitation (21.9%) was the most frequent type of VR in children, followed by TR (6.3%). Notably, the prevalence of TR was reported to be higher in this study than in an earlier study by Martine et al. More recently, a study evaluating 200 healthy children without cardiac disease confirmed that some degree of VR is present in healthy pediatric populations [3]. According to their findings, 57% of the participants had echocardiographic findings of TR in the first session and 61.5% in the second session. This constancy might indicate that PR is a stable condition in children. The prevalence of other VRs in both sessions included pulmonary (55–57.5%), mitral (14.5–16%), and aortic (3–3.5%) VRs [6]. Colan et al. recommended that trace and mild VR should not be considered pathological [3]. In a study of 1,333 healthy individuals, over 80% had mild TR across all age groups [11]. Another study on VR in healthy children revealed that approximately 67.8% of them had some degree of VR [4].

The association between TR prevalence and gender remains debated. While some studies found no correlation between gender and VR [4], Ayabakan et al. demonstrated that TR is more prevalent in males [14]. Our findings indicated that there is no association between gender and the presence of TR. Some studies have also

observed a decrease in TR prevalence with age [4], though our results showed no significant variation in TR presence or severity across different age groups. Our results are consistent with those of previous studies. However, the prevalence of mild TR was significantly higher than that reported in older studies. This heterogeneity in TR prevalence in children might be due to the different techniques used and the TR definition [14]. For instance, the duration of regurgitation was defined as more than 100 ms using M-mode color flow mapping in Yoshida et al. 's study, whereas other studies defined VR as >200 msec duration or a velocity >1.2 m/sec [13, 15, 16]. In contrast to other studies that focused on the duration of regurgitant flow, our research highlights the significance of typical flow disturbance visualized by color Doppler [11, 14].

## Conclusion

In summary, the current study showed that more than 90% of healthy children had some degree of TR. The presence of mild TR should not be considered pathologic, as it does not progress with age and does not require follow-up and further investigations. As mentioned earlier, more than 80% of adults have been reported to have mild TR.

### Limitations

Limitations of this study include: 1) The lack of data on the prevalence of other valve regurgitations and 2) A smaller sample size compared to previous studies. Further investigations with larger sample sizes and evaluation of other valves may reveal more accurate findings. Research exploring the causes of variation in TR prevalence is also recommended.

## Ethical Considerations

### Compliance with ethical guidelines

This study was approved by the Ethics Committee of Qom University of Medical Sciences, Qom, Iran (Code: IR.MUQ.REC.1401.037).

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### Authors' contributions

All authors equally contributed to preparing this article.

### Conflict of interest

The authors declared no conflict of interest.

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