# Assessment of Quality of Life and Exercise Intolerance in Congenital Heart Disease

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## ABSTRACT

***Background:*** Congenital heart disease (CHD) is a chronic condition caused by a heart defect or structural anomaly present at birth. During the last few years, the assessment of children with CHD focused solely on their physical abilities and any remaining anatomical issues. However, the true impact of CHD is seen in the quality of life (QOL) of the affected individuals. While exercise was once advised against for cardiac conditions, including both pediatric and adult congenital heart disease (ACHD), recent findings show that physical fitness and exercise capacity are linked to improved lung function in teenagers and young adults.

***Aim of the Work:*** To assess the degree of exercise intolerance in children with congenital heart diseases and its impact on QOL using stress ECG and Pulmonary function testing.

***Patients and Methods:*** This cross sectional study was carried out in outpatient pediatric cardiology clinic**,** Children's Hospital, Ain Shams University on 104 children and adolescents aged 8-18 years suffering from congenital heart diseases during the period from July 2022 to May 2023. , operated or not, cyanotic or acyanotic and its impact on QOL using KIDSCREEN -52 questionnaire, Stress Electrocardiogram (ECG), Pulmonary function. Statistical analysis utilized IBM SPSS presenting qualitative and quantitative data Significance of the obtained results was judged at the 5% level.

***Results:*** This study was done on 104 children with CHD and found that there was a significant decrease in QOL in non-operated, cyanotic and multiple CHD lesion, there was a significant decrease in all parameters of pulmonary function test in non-operated, also there was a significant increase in HR after exercise in non-cyanotic children, a significant increase in HR before and after exercise in non-operated children and a significant decrease in $SpO_2$ before and after exercise in non-operated and cyanotic children.

***Conclusion:*** Our results showed that CHD children with cyanosis, multiple lesions, non-operated, or with delayed operation time had worse quality of life domains, pulmonary function, and worse Stress ECG.

***Keywords:*** congenital heart disease, quality of life, The KIDSCREEN-52 questionnaire.

## INTRODUCTION

It is statistically estimated that approximately 8 out of every 1,000 infants have congenital heart disease (CHD), which is the most prevalent birth abnormality. Many patients with congenital heart disease face unique psychosocial, educational, and behavioral challenges. In this regard, feeling different from peers, social impediments due to physical limitations, these impediments have an impact on patients' quality of life ***(Kovacs & Bellinger, 2021).*** Healthcare-related quality of life, or HRQOL, is a crucial factor to take into account for individuals suffering from congenital heart disease (CHD). Regular clinical evaluations, including HRQOL assessments, can yield verified metrics of functional data that align with the results of standardized clinical assessment instruments ***(Bellinger et al., 2017).***

Exercise capacity and physical fitness have recently been linked to improved lung function in adolescents and young adults, despite the fact that exercise was traditionally contraindicated in cardiac disorders, such as pediatric and adult congenital heart disease (ACHD) ***(Hancox & Rasmussen, 2018).*** Exercise intolerance is also a significant predictor of outcome and negatively impacts quality of life ***(Dimopoulos et al., 2008)***.

A previous study by ***Hancox and Rasmussen (2018)*** found a correlation between physical fitness and exercise capacity and improved lung function in adolescents and young adults, despite the fact that exercise has historically been advised against those with cardiac conditions, such as adults and children with congenital heart disease (ACHD). Exercise intolerance significantly lowers quality of life and is a powerful predictor of outcome ***(Dimopoulos et al., 2008)***.

**-Sample size:**

This study included **104** patients with CHD, after sample size was calculated by using PASS 11 program, assuming that quality of life (QOL) is affected in 50% CHD patients. Based on this assumption, the 104 patients enrolled in this study produced a two-sided 95% confidence interval with a width equal to 0.2 when the sample proportion was 0.5.

Pulmonary function is a dynamic, non-invasive assessment of the pulmonary system, to our knowledge, the objective of pulmonary function is to determine functional capacity in the individual ***(Mantegazza et al., 2017).*** Spirometry is the most frequently used measure of pulmonary function provides a window on cardiac function, ***(Topalovic et al., 2019).*** An Electrocardiogram (ECG) stress test monitors the heart's electrical activity during exercise with the exercise stress comes from walking on a treadmill or pedaling a stationary bike. ***(Teferra et al., 2019).***

## PATIENTS AND METHODS

This is a cross sectional study was conducted in outpatient pediatric cardiology clinic**,** Children's Hospital, Ain Shams University on 104 children and adolescents aged 8-18 years suffering from congenital heart diseases, this age was selected to be cooperative, therefore they were able to do the pulmonary function and stress electrocardiogram (stress ECG) easily, during the period from (July 2022 to May 2023).

**-Ethical consideration:**

Approval by the Ethical Committee of pediatric department at the Faculty of Medicine at Ain Shams University under the registration number was obtained before the study.

Patients were enrolled in the study after getting informed oral and written consent from their parents.

Patients data confidentiality was preserved during all study procedures.

The patients and parents have the right to withdraw at any time.

There was no conflict of interest regarding the study or publication.

There is no financial support or sponsorship.

**-The Inclusion criteria**

Patients with CHD, operated or non-operatic

Patients with CHD, cyanotic or acyanotic type.

**-The exclusion criteria**

Children with any other severe chronic disease.

Children with chromosomal disorders for example: Down syndrome.

Children and families unable to understand the quality of life (QOL) questionnaire (Kidscreen 52).

Children with known pulmonary dysfunction and Children suffering from arrhythmia or ischemia.

**Study Tools and procedures:**

**All patients included in this study will be subjected to the followings:**

**1-** Complete medical and surgical history stressing on symptoms of chest pain, excessive shortness of breath, fatigue and orthopnea.

**2-** Clinical examination includes general and local examination; which focused on chest and heart examination mainly.

**3-Health related quality of life (HRQOL) assessment.**

***(Ravens-Sieberer et al., 2005)***

The kidscreen-52 questionnaire is used for children and adolescent, aged between 8 to 18 years, with 52 items covering ten dimensions of HRQOL. The chosen development strategy was based on relevant literature on health-related quality of life as well as on the construction of psycho-metric measurement instruments in the context of quality-of-life research

***The kidscreen-52 ten Dimensions:***

1. Physical Well-Being (5 items)
2. Psychological Well-Being (6 items)
3. Moods and Emotions (7 items)
4. Self-Perception (5 items)
5. Autonomy (5 items)
6. Parent Relation and Home Life (6 items)
7. Financial Resources (3 items)
8. Peers and Social Support (6 items)
9. School Environment (6 items)
10. Bullying (3 items)

- HRQOL score is given by each dimension and varies from 0 (lowest HRQOL) to 100 (highest HRQOL).

-The **stress ECG** ***(Fletcher et al., 2013)***

Stress ECG parameters which were done in Pediatric Cardiology Unit at the Children's Hospital, Ain Shams University and included the following:

- Heart rate: Maximal heart rate is noted during entire procedure.
- ECG monitoring during exercise to detect any sign of arrhythmia.
- Blood pressure.
- Oxygen saturation at rest and during exercise.

**-Echocardiography** ***(Lai et al., 2006)***

Trans-thoracic conventional Echocardiography assessment was done for all patient in supine position or left lateral semi-recumbency, using 6MHz transducer frequency by pediatric cardiologist (vivid E95 cardiac ultrasound GE healthcare USA) with probe S3 or S6 according to patient age and ability to get best images.

6- **Spirometric pulmonary function testing:** ***(Graham et al., 2019)***

Forced spirometry was conducted in a spirometry laboratory designed for use by children using (Jaerger apparatus, care fusion Germany, 2011) in Pediatric Pulmonology Unit at the Children's Hospital, Ain Shams University and included the following:

- Forced expiratory volume 1% of predicted(FEV1)
- Forced vital capacity % of predicted(FVC)
- Forced expiratory volume 1/Forced vital capacity(FEV1/FVC)
- Maximum mid expiratory flow 75/25(MMEF)

**-Arterial blood gas (ABG) analysis *(Dev et al., 2011)***

Arterial blood gas analysis is a commonly used diagnostic tool to evaluate the partial pressures of gas in blood and acid-base content.

**Statistical Analysis:** The Statistical Package for Social Science (IBM SPSS), version 23 (Armonk, NY: IBM Corp.), was used to collect, edit, code, and enter the data. When the quantitative data were determined to be non-parametric, they were displayed as median with inter-quartile range (IQR), range (minimum and maximum), mean, and standard deviation (SD). Additionally, numerical and percentage representations of the qualitative factors were provided. The significance of the acquired outcomes was assessed at the 5% level.

To compare between groups with qualitative data, ***Chi-square test*** was applied. The comparison between two independent groups with quantitative data and non-parametric distribution were done by using ***Mann-Whitney test,*** the correlation between two normally distributed quantitative variables were done by using **Pearson coefficient.**

The confidence interval was established at 95%, and the accepted margin of error was 5%. Consequently, the p-value was interpreted as follows: $P > 0.05$ indicated non-significance, while $P < 0.05$ indicated significance.

**RESULTS:**

**Our results will be demonstrated in the following tables:**

**Table (1)**: Demographic data of the studied group (No=104)

| | | **Mean ± SD** |
|---|---|---|
| **Age (years)** | | 11± 2.35 |
| | | **no** |
| **Sex** | **Male** | **54** |
| | **Female** | **50** |
| **Consanguinity** | **Negative** | **68** |
| | **Positive** | **36** |
| | **2nd degree** | 17 |
| | **3rd degree** | 19 |

No=number, SD=standard deviation, 2nd=second, 3rd=third.

Table (1) shows that the study included 54 males (51.9%) and 50 females (48.1%), their age was distributed as 11 ± 2.35, consanguinity was prevalent among 34.6% of the studied children with 52.7% were 3rd degree and the rest 47.2% were 2nd degree.

**Table (2)** Clinical diagnosis of the studied group

| **Disease** | **No. (%)** |
|---|---|
| VSD | 20 (19.2) |
| Coarcitation of aorta | 22(21.2) |
| Tetralogy of Fallot | 17 (16.3) |
| L TGA | 14 (13.5) |
| D TGA | 26 (25) |
| DORV | 27 (26) |
| DORV, TGA | 4 (3.8) |
| D TGA, VSD | 6 (5.8) |
| DORV, PS | 6 (5.8) |
| Fallot, ASD | 2 (1.9) |
| Coarcitation of aorta, VSD | 8 (7.7) |
| **Disease characteristics** | |
| Single lesions no (%) | Multiple lesions no (%) |
| 61 (58.7) | 43 (41.3) |
| Cyanotic heart disease | Acyanotic heart disease |
| 76 (73.1) | 28 (26.9) |
| Non-Operated | Operated |
| 38 (36) | 66 (64) |

Table (2) shows that most of cases in our study were DORV, D TGA, COA and VSD, with percentage 27%, 26%, 22% and 20% respectively. Children with single congenital heart disease lesion were 58.7% of the studied population and who have cyanotic heart disease were 73.1%; while 64% of the studied children were operated.

**Table (3):** Anthropometric measures among studied group (N0=104)

| **Item** | | **Mean ± SD** |
|---|---|---|
| **Weight (kg)** | | 37.5± 11.6 |
| **Weight percentile** | | 41± 32 |
| no (%) | **> 50 percentiles** | 6 (5.8) |
| | **50-5 percentile** | 34 (32.7) |
| | **< 5 percentiles** | 64 (61.5) |
| **Height (cm)** | | 135± 12.6 |
| **Height percentile** | | 18.6± 18.9 |
| no(%) | **> 50 percentiles** | 5 (4.8) |
| | **50-5 percentile** | 25 (24) |
| | **< 5 percentiles** | 74 (71.2) |
| **BMI kg/m$^2$** | | 20± 3.8 |
| no (%) | Under weight | **48 (46.2)** |
| | Normal weight | **44 (42.3)** |
| | Over weight | **10 (9.6)** |
| | Obese | **2 (1.9)** |

No=number, SD=standard deviation, BMI=body mass index, cm=centimeter, kg=kilogram, m=meter.

Table (3) shows that most of children were below 50th percentile weight for age ,61.5% were below5th percentile, , larger percentage (95.2%) of children were below 50th percentile height for age; while 71.2% were below 5th percentile height for age. Results represented both weight and height were affected in the studied cases with height more affected. Regarding BMI most of cases (46.2%) were under weight (below 18.5)

**Table (4):** Kidscreen 52 questionnaire results of the studied patients (mean of T value)

| Item | Mean ± SD |
|---|---|
| **Physical well-being** | 47.99 ±16.7 |
| **Psychological well-being** | 44.55 ±15.9 |
| **Moods and emotions** | 45.28 ±16.5 |
| **Self-perception** | 47.3 ±14.4 |
| **Autonomy** | 44.6 ±12.9 |
| **Parent relation and home life** | 46.67 ±6.7 |
| **Financial resources** | 40.8 ±6 |
| **Peers and social support** | 59.6 ±10 |
| **School environment** | 42.8 ±6 |
| **Bullying** | 37.1 ±11 |

Table (4) shows mean of T values of all items of Kidscreen 52 questionnaire of the studied children, all these values were compared to mean of T value for the entire European sample which was used as population reference (11 countries).

**Table (5):** Relation between operated and non-operated children as regard Kidscreen-52 questionnaire

| | Non-operated No=36 | Operated No=66 | Test | Z | p |
|---|---|---|---|---|---|
| Physical well-being | 30.8±3 | 57.8±12.8 | mw | -8.51 | **<0.001** |
| Psychological well-being | 28.2±4.4 | 53.9±12 | mw | -8.5 | **<0.001** |
| Moods and emotions | 28.7±3.5 | 54.6±13.3 | mw | -8.52 | **<0.001** |
| Self-perception | 32.8±3.4 | 55.6±11.3 | mw | -8.02 | **<0.001** |
| Autonomy | 32.1±5.2 | 51.8±10 | mw | -7.96 | **<0.001** |
| Parent relation and home life | 49.7±6 | 44.8±6.3 | mw | -3.87 | **0.008** |
| Financial resources | 39.4±4.8 | 41.6±6.5 | mw | -1.42 | 0.192 |
| Peers and social support | 61.4±8.1 | 58.6±10.9 | mw | -1.33 | 0.94 |
| School environment | 39.1±5.6 | 45±5.7 | mw | -4.94 | **<0.001** |
| Bullying | 28.3±3 | 42.1±10.9 | mw | -7.044 | **<0.001** |

* MW=Mann-Whitney Test.
P-value > 0.05: Non significant; P-value < 0.05: Significant.

Table (5) shows that there was a significant enhancement in children who underwent surgical operations compared to their non-operated peers. Specifically in physical well-being ,psychological well-being, self-perception, autonomy, and moods and emotions. However, areas such as peers and social support and financial resources did not exhibit significant differences.

**Table (6):** Relation between type of congenital heart disease (cyanotic and acyanotic) and Kidscreen-52 questionnaire

| | **Cyanotic** No=76 | **Acyanotic** No=28 | **Test** | **Z** | **p** |
|---|---|---|---|---|---|
| **Physical well-being** | 42.99±16 | 49±16.8 | mw | -2.062 | **0.048** |
| **Psychological well-being** | 41.3±16 | 45.7±15.7 | mw | -4.28 | **0.03** |
| **Moods and emotions** | 41.2±16.6 | 43.7±16.4 | mw | -1.56 | 0.118 |
| **Self-perception** | 44.2±14 | 48.5±14.4 | mw | -1.37 | 0.17 |
| **Autonomy** | 42.4±12.6 | 45.5±13 | mw | -1.175 | 0.24 |
| **Parent relation and home life** | 46.5±7 | 46.9±5.4 | mw | -0.76 | 0.443 |
| **Financial resources** | 40.6±6.3 | 41.4±5.2 | mw | -0.25 | 0.799 |
| **Peers and social support** | 58.6±10.9 | 60±10.5 | mw | -0.45 | 0.45 |
| **School environment** | 40.7±4.6 | 43.6±6.7 | mw | -2.25 | **0.025** |
| **Bullying** | 37±10.7 | 37.3±12.1 | mw | -0.072 | 0.941 |

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Table (6) shows that children with acyanotic CHD generally fared better in physical and psychological well-being compared to those with cyanotic CHD. However, no significant differences were observed in moods and emotions, self-perception, and autonomy

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**Table (7):** Relation between single and multiple cardiac lesions as regard Kidscreen-52 questionnaire

| | **Single Lesion** No=61 | **Multiple Lesions** No=43 | **Test** | **Z** | **p** |
|---|---|---|---|---|---|
| **Physical well-being** | 42.3±11.1 | 29.6±5.1 | mw | -6.26 | **<0.001** |
| **Psychological well-being** | 51.9±14.4 | 34±11.5 | mw | -5.459 | **<0.001** |
| **Moods and emotions** | 52.8±15.4 | 34.6±11.5 | mw | -5.66 | **<0.001** |
| **Self-perception** | 53.9±13.1 | 37.9±10.3 | mw | -5.8 | **<0.001** |
| **Autonomy** | 50.2±11.2 | 36.6±10.9 | mw | -5.74 | **0.002** |
| **Parent relation and home life** | 46.9±5.3 | 46.3±8.2 | mw | -0.266 | 0.79 |
| **Financial resources** | 40.5±5.3 | 41.2±6.99 | mw | -0.942 | 0.346 |
| **Peers and social support** | 58.1±10.2 | 61.7±9.5 | mw | -1.75 | 0.08 |
| **School environment** | 44.2±6.5 | 40.9±5.6 | mw | -3.011 | **0.003** |
| **Bullying** | 42.3±11.1 | 29.6±5.1 | mw | -6.26 | **<0.001** |

***** MW Mann-Whitney Test.

P-value > 0.05: Non significant; P-value < 0.05: Significant

Table (7) shows that children with a single cardiac lesion demonstrated superior outcomes in several key areas such as physical and psychological well-being, moods and emotions, self-perception, and the school environment compared to those with Multiple cardiac Lesions.

**Table (8):** Pulmonary function test of the studied group

| | **FEV1** | **FVC** | **FEV1/FVC** | **MMEF** |
|---|---|---|---|---|
| **Mean ± SD** | 80.7±14.5 | 89.6±10.1 | 0.9±0.11 | 81.7±14.6 |
| **Non operated** | 86.4±11.1 (65-98) | 91±8 (70-104) | 0.94±0.08 (0.68-0.99) | 86.9±11.2 (60-95) |
| **Operated** | 77.5±15.3 (50-95) | 88.3 ±10.9 (60-98) | 0.87±0.12 (0.59-1) | 78.8±15.5 (58-95) |
| **Test Z** | **MW -3.198** | **MW -2.07** | **MW -2.82** | **MW -2.869** |
| **P value** | **0.001** | **0.035** | **0.005** | **0.004** |
| **Cyanotic** | 79.9±14.8 (55-98) | 91.7±8.3 (72-104) | 0.87±0.13 (0.59-0.99) | 79.5±15.6 (60-95) |
| **Acyanotic** | 81±14.5 (50-95) | 88.9±10.6 (60-98) | 0.91±0.1 (0.63-1) | 82.25±14.2 (58-95) |
| **Test Z** | **MW -0.65** | **MW -1.31** | **MW -1.063** | **MW -1.03** |
| **P value** | 0.516 | 0.187 | 0.303 | 0.288 |
| **Single lesion** | 81.2±14.6 (50-95) | 92±8 (70-104) | 0.90±0.1 (0.63-1) | 82.7±14.3 (58-95) |
| **Multiple lesions** | 80±14.6 (55-95) | 88.3 ±10.9 (60-98) | 0.89±0.12 (0.59-0.99) | 80.4±15 (60-95) |
| **Test Z** | **MW -0.619** | **MW -2.25** | **MW -0.731** | **MW -1.007** |
| **P value** | 0.536 | **0.033** | 0.314 | 0.465 |
| **Pulmonary function test results in the studied group no(%)** | | | | |
| Normal | | | 62 (59.2) | |
| Obstructive lung disease | | | 20 (19.2) | |
| Restrictive lung disease | | | 22 (21.2) | |

Table (8) shows that there was a significant decrease in all parameters of pulmonary function test in operated children compared to non-operated children, also there was no significant difference between cyanotic and acyanotic disease regarding spirometeric parameters. Children of multiple congenital heart lesions showed more restrictive pattern with a significant lower FVC than in single cardiac lesion.

**Table (9):** Stress Electrocardiogram **(**ECG) results of the studied group

| **Stress ECG results** | | | | | | |
|---|---|---|---|---|---|---|
| **Negative changes no(%)** | | | | **88 (84.6)** | | |
| **Positive results no(%)** | | | | **16 (15.4)** | | |
| Arrythmia* no(%) | | | | **9 (8.6)** | | |
| Ischemic changes no(%) | | | | **7 (6.7)** | | |
| **ECG Result** | **Cyanotic** | **Acyanotic** | **Operated** | **Not Operated** | **Single** | **Multiple** |
| **Negative** | 64 (84.2) | 24(85.7) | 52(78.8) | 36(94.7) | 57(93.4) | 31(72) |
| **Positive** | 12(15.8) | 4(14.3) | 14(21.2) | 2(5.3) | 4(6.6) | 12(28) |
| $X^2$ **p** | **0.042** | | **0.012** | | **0.009** | |

Table (9) shows that treadmill exercise was done noticing ECG changes from baseline and recorded positive in 16 cases with 9 showed Arrhythmia all were extra systole; while 7 showed ischemic changes. These changes were statistically more observed in cyanotic, non-operated and multiple lesions than in acyanotic, operated and single lesion.

**Table (10):** Vital signs changes in Stress Electrocardiogram (ECG) results of the studied group

| **Vital signs changed** | | | | |
|---|---|---|---|---|
| | **$HR^r$** | **$HR^e$** | **$SpO2^r$** | **$SpO2^e$** |
| Median(range) | 86 (75-100) | 94 (77-123) | 93 (84-99) | 89 (79-97) |
| | Wilcoxon Signed Ranks Test | | | |
| P | **<0.001** | | **<0.001** | |
| | **$HR^r$** | **$HR^e$** | **$SpO2^r$** | **$SpO2^e$** |
| **Cyanotic** | 85(75-100) | 92(77-120) | 92(84-98) | 86.5(75-92) |
| **Acyanotic** | 87(78-100) | 99(80-123) | 97(96-99) | 93.5(92-97) |
| **MW z** | -1.632 | -1.763 | -7.29 | -7.728 |
| **P** | 0.1 | **0.049** | **<0.001** | **<0.001** |
| **Operated** | 83(75-90) | 88(77-95) | 94(90-99) | 89(81-97) |
| **Not operated** | 92(80-100) | 113(94-123) | 88(84-98) | 80(75-93) |
| **MW z** | -7.41 | -8.26 | -4.48 | -4.46 |
| **P** | **<0.001** | **<0.001** | **<0.001** | **<0.001** |

P-value > 0.05: Non-significant; P-value < 0.05: Significant

HR= heart rate, r= at rest, e during exercise, $X^2$= chi-square test. MW= Mann-Whitney test, $SpO2^r$=oxygen saturation at rest, $SpO2^e$=oxygen saturation during exercise

Table (10) shows that there was a significant increase in HR and decrease in $SpO_2$ after exercise in all studied children, more significant increase in HR after exercise in acyanotic cardiac children; while there was a significant decrease in $SpO_2$ before and after exercise in children with cyanotic heart disease, a significant increase in HR before and after exercise in non-operated children and in children with multiple lesions; while there was a significant decrease in $SpO_2$ before and after exercise in non-operated children and in children with multiple lesions.

## DISCUSSION

A standardized exam called the KIDSCREEN-52 questionnaire was used to evaluate children and adolescents who are both healthy and have long-term illnesses in terms of their general health-related quality of life ***(The KIDSCREEN Group Europe, 2006).***

In our study the mean weight was 37.5± 11.6 Kg with most of children (94.2%) below 50$^{th}$ percentile weight for age ,61.5% were below5$^{th}$ percentile, as well as mean height 135± 12.6 cm distributed with maximum 145 and minimum 124 cm, larger percentage (95.2%) of children were below 50$^{th}$ percentile; while 71.2% were below 5$^{th}$ percentile height for age. BMI mean was 20± 3.8 kg/m$^2$ with 46.2% of cases were under weight (below 18.5).

This came in line with ***El-latef and Anany (2021)*** who conducted a cross sectional observational study of 68 children, with CHD. They showed that most of children were below 50th percentile for weight and length.

Our results revealed that weight, weight percentiles, height, height percentiles and BMI were significantly lower in non-operated children.

In the same line with ***Ratanachu-Ek and Pongdara (2011)*** who detected a significant decrease in the prevalence of underweight and wasting in postoperative CHD children.

In our study there was a significant enhancement in children who underwent surgical operations compared to their non-operated peers. Specifically in physical well-being ,psychological well-being, self-perception, autonomy, and moods and emotions. However, areas such as peers and social support and financial resources did not exhibit significant differences. all means of T values were compared to mean of T value for the entire European sample which was used as a population reference(11countries).

According to ***Aguilar-Alaniz et al. (2021),*** patients who underwent cardiac heart repair scored higher on nearly every factor, including psychological well-being, self-perception, autonomy, parent-child relationships, and school environment

In our study children with acyanotic CHD generally fared better in physical and psychological well-being compared to those with cyanotic CHD. However, no significant differences were observed in moods and emotions, self-perception, and autonomy.

***Aguilar-Alaniz et al. (2021)*** conducted a previous study in which they reported that in cases with cyanotic defects, patients had higher quality of life (QOL) for certain dimensions, such as physical well-being, mood and emotions, autonomy, and financial resources. On contrary, they reported better quality of life (QOL) for psychological health and the educational setting.

In our study, children with a single cardiac lesion demonstrated superior outcomes in several key areas such as physical and psychological well-being, moods and emotions, self-perception, and the school environment compared to those with multiple cardiac Lesions.

Physical well-being is significantly affected in children with multiple CHD lesions than in those with a single CHD lesion. This disparity can be attributed to the level of physical activity, which is influenced by several factors, including medical recommendations, social environments, and personal experiences ***(Van Deutekom and Lewandowski, 2021)***.

Regarding pulmonary function in the current study there was a significant decrease in all parameters of pulmonary function test in operated children compared to non-operated children, also there was no significant difference between cyanotic and acyanotic disease regarding spirometeric parameters.

Our findings are consistent with the research conducted by Hawkins et al. (2014), which found that following heart surgery, children with congenital heart disease had a higher prevalence of restricted lung function compared to non-operated patients or controls. Following cardiopulmonary and cardiac bypass surgery, a variety of variables, including postoperative inflammation and hypercortisolemia, may impede pulmonary function ***(Roncada et al., 2015)***. The existence

of postoperative atelectasis, pulmonary edema or pleural effusion, changes in the mechanics of the chest wall brought on by sternotomy, and decreased respiratory attempts as a result of postoperative discomfort are other factors that contribute to lung dysfunction ***(Al-Ebrahim et al., 2019)***.

In our study, children with multiple congenital heart lesions are more likely to show restrictive lung patterns with a significant lower FVC than those with a single cardiac lesion. This is due to the abnormalities in lung development and physiology caused by the heart defects. The unique relationship between the heart and lungs during development can lead to prenatal pulmonary complications in children with CHD. Abnormal cardiac development can cause abnormalities in blood flow to the lungs, which can alter the growth of the vascular systems and the division of airspaces into alveoli ***(Ginde et al., 2013)***.

In the present study, treadmill exercise was done noticing ECG changes from baseline which is positive in 16 cases with 9 showed arrhythmia all were extra systole; while 7 showed ischemic changes. These changes were statistically more observed in cyanotic, non-operated and multiple lesions than in acyanotic, operated and single lesion.

An association is found between extrasystolic arrhythmias and illnesses including ischemia and cardiac abnormalities, as well as processes that cause inflammation in the heart tissue and excessive myocardial growth in people who exercise more ***(Hsieh et al., 2018).***

In our study all children had a substantial increase in HR and drop in $SpO_2$ following exercise. When it comes to controlling heart rate during exercise, the sympathetic and parasympathetic nervous systems interact. A variety of factors, including as ischemia and/or denervation from surgery, or in the case of cyanotic CHD due to prolonged hypoxemia, can alter this in CHD patients ***(von Scheidt et al., 2019)***.

Supporting our results, ***Takken et al. (2009)*** demonstrated that HR peak normally increases with exercise but patients with cardiac dysfunction may have a more rapid than normal HR response.

In our result there was a significant increase in HR after exercise in acyanotic cardiac children, while there was a significant decrease in $SpO_2$ before and after exercise in children with cyanotic heart disease. Along with our finding, ***Sadegh Fakhari et al. (2023)*** showed that the oxygen saturation was significantly lower in the cyanotic group compared to acyanotic group. But in contrast to our results, they showed that heart rate was significantly higher in the cyanotic group compared to a cyanotic group.

In our results there was a significant increase in HR before and after exercise in non-operated children; while there was a significant decrease in $SpO_2$ before and after exercise in non-operated children. In agreement with our results, ***Altamirano-Diaz et al. (2017)*** performed their study on thirty-four youth, previously diagnosed with CHD and reported that the HR was higher in non-operated group compared to the operated group.

In our results there was a significant increase in HR before and after exercise in children with multiple lesions; while there was a significant decrease in $SpO_2$ before and after exercise in children with multiple lesions. Children with multiple CHD lesions may exhibit a more significant increase in HR both before and after exercise compared to children with a single lesion. This is because these children are often dependent on HR to increase cardiac output, particularly in the presence of sinus node dysfunction, which may be incapable of developing a normal HR response to exercise. Children with multiple CHD lesions are at a higher risk of sinus node dysfunction, which can lead to impaired HR regulation during exercise ***(Nederend et al., 2016)***.

## CONCLUSION

Based on the results obtained in this study, CHD children with cyanosis, multiple lesions, non-operated, had worse quality of life domains, pulmonary function, and worse Stress ECG.

### Recommendations

Further prospective multicenter studies would be more informative.

The current finding supports the use of the Kidscreen questionnaire as a generic health related QoL questionnaire for CHD children.

Undergoing the appropriate operations early could improve the child wellbeing and their function.

A larger sample of congenital heart disease patients would permit the inclusion of more diagnostics and the generalization of these results for this population.

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