

## Childhood Obesity and Its Relation To The Development of Acute Appendicitis

Lourdes Reyes Polo<sup>1\*</sup>, José Leonardo Balmaceda Montejo<sup>2</sup>, Juan Pablo Gualdrón Moncada<sup>3</sup>, María Camila Oliveros Riveros<sup>4</sup>, Diego Alejandro Largo Córdoba<sup>5</sup>, Oscar Ivan Avendaño Solano<sup>6</sup>, Jorge Julian Mendoza Anguila<sup>7</sup>, and Yudy Andrea Chicaiza Guerrero<sup>9</sup>

<sup>1</sup>Pediatrician, Universidad del Norte, Barranquilla

<sup>2</sup>Pediatrician, Universidad de Cartagena

<sup>3</sup>Pediatric Resident, Corporación Universitaria Remington, Colombia

<sup>4</sup>General Physician, Universidad Javeriana de Bogotá, Colombia

<sup>5</sup>General Physician, Universidad de Antioquia, Colombia

<sup>6</sup>General Physician, Corporación Universitaria Remington, Colombia

<sup>7</sup>General Physician, Universidad Cooperativa de Colombia, Sede Santa Marta

<sup>8</sup>Intern Physician, Universidad Autónoma de Bucaramanga

<sup>9</sup>General Physician, Universidad Cooperativa de Colombia

### \*Corresponding author

Lourdes Reyes Polo, Pediatrician, Universidad del Norte, Barranquilla

Submitted: 08 Nov 2021; Accepted: 13 Nov 2021; Published: 20 Nov 2021

**Citation :** Lourdes Reyes Polo, José Leonardo Balmaceda Montejo, Juan Pablo Gualdrón Moncada, María Camila Oliveros Riveros, Diego Alejandro Largo Córdoba, Oscar Ivan Avendaño Solano, Jorge Julian Mendoza Anguila, Marggy Stephania Saenz Gomez and Yudy Andrea Chicaiza Guerrero (2021) Childhood Obesity and Its Relation To The Development of Acute Appendicitis. *J Pediatr Neonatal Biol* 6(2): 44-48.

### Abstract

Acute appendicitis is caused by the inflammation of the appendix and is the disease associated with the largest number of cases of emergency surgery in pediatrics and involves 1% to 2% of children who consult the emergency service, on the other hand, the Obesity is a multicausal, chronic and systemic disease, not only present in countries with great economic development, but also involved in all ethnic groups, ages and social classes, for this reason, the relationship between these two pathologies should be better studied especially from the pediatric approach. In patients with childhood obesity, the diagnosis of appendicitis is usually difficult and challenging despite advances in imaging diagnosis and in the treatment of acute appendicitis. In this age group, misdiagnosis is common, which is associated with a high incidence of complications, increased morbidity and mortality and prolonged hospitalizations that allow the development of this disease.

**Keywords:** Acute Appendicitis, Obstruction, Overweight, Childhood Obesity, Postoperative Complications

### Introduction

Within the framework of common pathologies in childhood, inflammation of the appendix or appendicitis constitutes the most frequent diagnosed cause of acute surgical abdomen and acute surgical pathology in childhood and in older children [1]. However, in patients with childhood obesity, the diagnosis of appendicitis is usually difficult and challenging, so it could be stated that childhood obesity is a mediator or important risk factor to trigger acute appendicitis and affect the results before and after surgery in pa-

tients pediatric overweight [2].

Obesity is a multicausal, chronic and systemic disease, not only present in countries with great economic development, but also involved in all ethnic groups, ages and social classes, this pathology has achieved considerable proportions throughout the world, for which the World Health Organization (WHO) considers it as “the epidemic of the XXI century” [3]. Additionally, from the pediatric point of view and according to the WHO, childhood obesity

is defined as a chronic disease, characterized by abnormal accumulation and excessive fat, as a consequence of a diet with high caloric density due to the excess consumption of carbohydrates and fats caused by multiple factors as shown in figure 1, and that, in a certain way, are harmful to health, in fact, in recent years, the prevalence of obesity in children and adolescents has increased considerably [4, 5]. This pathology can be determined according to the Body Mass Index (BMI), a parameter that allows calculating the relationship between height and weight, obtained by dividing a person's weight in kilograms by the square of his height in meters, being obese those with more than two standard deviations above the average weight standardized by age or by a body mass index (BMI) greater than 30 kg / m. These WHO standards have been accepted and incorporated into clinical practice in 125 countries and are the only published standard based on longitudinal monitoring of the infant growth of healthy children, children of mothers who are also healthy and non-smokers, who have eaten an ideal diet. (Breastfeeding for a minimum of 4 months) [6]. In childhood obesity, children currently register diseases that were common in adults, such as diabetes, arterial hypertension, coronary heart disease, cerebrovascular disease, dyslipidemia, and even their condition mediates the development of acute appendicitis [7].

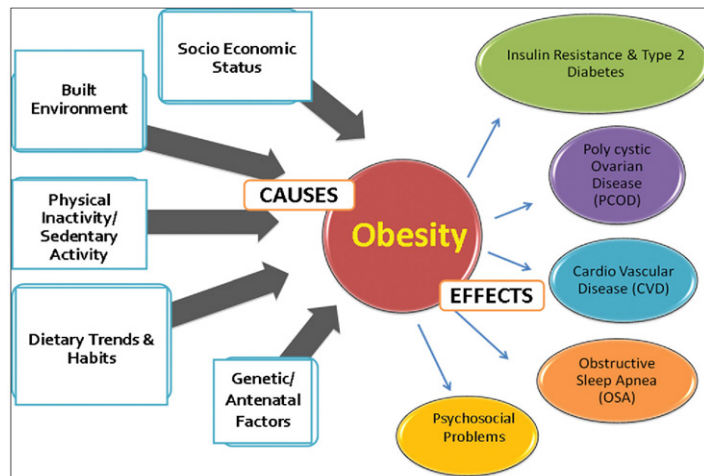


Figure 1. Factors Related to Obesity

### Pathophysiology of Acute Appendicitis in The Obese Pediatric Patient

Acute appendicitis is the disease associated with the largest number of cases of emergency surgery in pediatrics and involves 1% to 2% of children who consult the emergency service. The pathophysiology of acute appendicitis is the same in all patients, that is, it does not discriminate between sex or age, however, in pediatric patients this disease is generally caused by enlarged lymphoid follicles, obese patients being mostly affected with an increase of the mortality rate associated with the development of the disease as well as with post-surgery complications (Figure 2). However, the pathophysiology remains enigmatic, but even so, there are several theories that try to explain this pathology. The one most accepted by surgeons describes an initial phase characterized by obstruction of the appendicular lumen caused by lymphoid hyperplasia, fecaliths, tumors or foreign bodies such as bones of small animals, or seeds, among others [8]. Subsequently, said obstruction favors mucus secretion and bacterial growth, and after the obstruction, it

continues with intraluminal bacterial growth, invasion of the wall by these germs, ischemia and, finally, gangrene, which induces perforation and peritonitis. The normal fecal flora is responsible for infection, even in young children, and includes aerobic and anaerobic gram-negative germs, Escherichia coli, Peptostreptococcus spp., Bacteroides fragilis, and Pseudomonas spp.

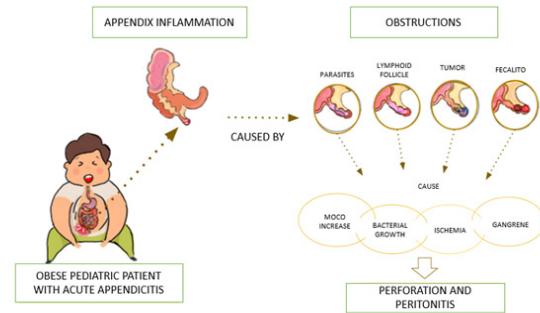


Figure 2: Process of Development of Appendicitis in The Obese Pediatric Patient

### Childhood Obesity-Development of Acute Appendicitis Relationship

Appendicitis is known as inflammation of the appendix, which may well be due to several causes as shown in Table 1, among the most frequent due to obstruction mediated by a fecalith in the lumen of the appendix, however, in children the cause The most common obstruction is attributed to the lymphoid follicles [9]. From a pediatric point of view, it is one of the most frequent causes of acute abdomen that requires emergency surgery in patients, this pathology is more frequent in older children and adolescents than in younger children and, In particular, that in preschool-age patients (up to 5 years), because these preschool-age patients usually present a form of atypical and nonspecific appendicitis associated generally, these children are apprehensive, they are upset and have communication difficulties, Therefore, the diagnosis is more difficult and complex and, therefore, delayed even more if it is obese patients [10, 11].

Table 1. Causes of Acute Appendicitis in Children under 5 Years of Age

CAUSE
Enlarged lymphoid follicles
Fecalitho
Strange body
Parasites
Tumors
Appendicular torsion
Blunt trauma

In addition, the difficulty of the diagnosis is not only based on the difficult communication with the pediatrician but also on the difficulty of determining the pathology due to excess body fat, which delays the diagnosis and the appearance of the manifesta-

tions. It has been described that time is crucial in patients with a suspected clinical picture of appendicitis since, as in most pathologies of infectious origin, it is a key element that must be fought against to avoid the evolution to more serious forms, appearance of complications and even some fatal outcome, in fact, some tests such as ultrasound have limitations that include the numerous false positives and false negatives in obese patients [12, 13]. However, when the condition of appendicitis in an obese pediatric patient has already been determined, the problems go from being difficult to communicate and limiting some examinations to post-operative problems because the surgical interventions in these patients are often more complex. given the greater technical and anesthetic difficulties, which include greater difficulty in visualizing anatomical landmarks. The excess visceral adipose tissue in these patients contributes to generating a pro-inflammatory state that leads to metabolic alterations that can influence the postoperative immune response and explain some of the postoperative complications [14]. Generally, childhood obesity constitutes a risk factor for the development of postoperative complications in acute appendicitis, such as infection and dehiscence of the surgical wound, as well as a longer hospital stay.

## Materials and Methods

A detailed bibliographic search of information published since 2012 is carried out in the databases pubmed, scielo, medline, national and international libraries specialized in the topics covered in this review article. The following descriptors were used: Acute appendicitis, obstruction, overweight, childhood obesity, postoperative complications, risk factor. The data obtained oscillate between 5 and 10 records after the use of the different keywords. The search for articles was carried out in Spanish and English, it was limited by year of publication and studies published from 2012 to the present were used.

## Results

According to the World Bank report, in low- and middle-income countries the prevalence of childhood overweight and obesity in preschool children exceeds 30%; if this trend continues, the number of overweight children under 5 will increase to 70 million in 2025 [15]. Similarly, the most recent data indicates that 12% of the population on our planet is obese; the American continent has the highest prevalence of obesity with 26.7%. Worldwide, it is said that excess body weight (overweight or obesity) would be responsible for 2.8 million deaths and 35.8 million disability-adjusted life years lost per year. Due to these associations, obesity is considered a risk factor for surgery and the difficult diagnosis of many pathologies. Many studies have investigated the impact of obesity on outcomes after elective surgery in various disciplines and are not favorable in a percentage of patients [16]. In a study carried out by C. Delgado-Miguel et al., In a pediatric population, 593 patients operated on for acute appendicitis were taken (January 2017-December 2018) of which, 403 patients were included being exposed cohort (overweight-obesity)  $n = 97$  and Cohort not exposed (normal weight)  $n = 306$ , Regarding the development of postoperative complications, the group of patients with overweight and obesity presented a higher rate of surgical wound infection when compared with patients with normal weight (10.3% vs. . 4.2%; RR 1.90 95% CI [1.15-3.14];  $p < 0.001$ ), additionally, there was a higher rate in obese patients of surgical wound dehiscence (7.2% vs.

2.3%; RR 2.16 95% CI [1.24-3.76];  $p < 0.001$ ) [17]. These results are similar to those obtained by Davies et al. Who retrospectively analyzed 282 patients with acute appendicitis, and observed that obese children required longer surgical times and a greater number of days of hospitalization. Furthermore, Witt et al. Observed an increase in the frequency of the appearance of postoperative complications with increasing the BMI category (4.5% in patients with normal weight, 5.3% in overweight, 5.7% in obesity and 7.3% in morbid obesity;  $p = 0.014$  [18]. Additionally, in a study carried out by AJ Muñoz-Serrano, et al, a population was analyzed that included 592 patients under 16 years of age with a median follow-up of 12 months after acute appendicitis surgery treated with antibiotic therapy, of 21.1% of this sample correspond to obese or overweight patients, and the rest correspond to thin or normal weight patients, observing that at the beginning of antibiotic therapy in the first 4 hours after diagnosis, the wound infection rate decreased significantly in patients without overweight [2.9 vs. 13.6%; OR 0.19 (95% CI 0.045-0.793);  $p = 0.042$ ] without observing differences in the appearance of dehiscence of the surgical wound, contrary to what occurs in patients overweight or obese ad [19]. Of each and every one of these studies, although scarce, they support the importance of an increase in BMI or obesity as a risk factor during the development of appendicitis as well as after its surgery.

## Discussion

The results of the review have revealed the mechanisms involved in the pathophysiology of acute appendicitis in the obese pediatric population, generating axes for discussion. In the first place, it is confirmed that childhood overweight and obesity constitute a risk factor for the development of postoperative complications in acute appendicitis, such as infection and dehiscence of the surgical wound [20]. Which is confirmed by other reports that their results indicate that the group of obese and overweight patients had a statistically significant higher incidence in inflammation of the epiploic appendix [21]. In an observational, prospective, cross-sectional cohort study, whose study universe consisted of 410 overweight patients, acute appendicitis was found in 58 patients, representing 14.14% [22]. However, the diagnosis of appendicitis and appendectomy in extremely obese children can sometimes be difficult and challenging. This is mainly due to the fact that physical examination in obese patients can be more difficult, and obesity is associated with a variety of physiological changes that can affect the patient's response to surgery [23]. Therefore, studies have been developed that suggest that laparoscopic appendectomy for acute appendicitis in obese children is associated with significantly shorter operating times, a lower overall rate of complications, and a lower need for postoperative analgesia [24]. In addition to guidelines that allow the clinician to carry out a correct approach, such as the order of diagnostic images such as abdominal ultrasound, which has sensitivity, specificity and precision for factors such as obesity in the child, since it has become a factor risk for patients who have been diagnosed with appendicitis due to the presence of technical difficulties, as well as postsurgical [25]. However, the higher the BMI, the more difficult it is to detect and differentiate the appendix [26]. Rectified by a study where the appendix was detected in 6 out of 8 (75%) children who were classified as underweight, in 70 out of 104 (67%) children who were classified as normal weight, and only in 3 out of 14 (21 %) overweight children. Therefore, their study showed that in children the ultrasound detection and charac-

terization of the appendix is influenced by the BMI. Even, a higher incidence of infection at the site of the surgical wound, deep vein thrombosis and pressure ulcers has been reported, which implies a longer period of hospital stay, which is confirmed by a study where the decrease in the strength of collagen fibers is evidenced, which implies a delay in healing, since 50% of the patients presented obesity and were the who had surgical wound dehiscence [27, 28]. There are other complications that obesity brings with it, such as perforated appendicitis in pediatric patients. The results of a review conducted from 2008 to 2010 identified 319 patients with appendicitis. Obese children were more likely ( $P = .026$ ) to present perforation (28/62, 45%) than non-obese patients (78/257, 30%), thus suggesting that the diagnosis of appendicitis may be more difficult in obese patients or its presentation may be delayed [29]. At the molecular level, mean CRP levels have been found to be significantly higher in extremely obese children with a histologically normal appendix compared to non-obese children with a normal appendix (15.1 vs 3.6 mg / dL,  $p < 0, 05$ ). They found that neutrophil and white blood cell counts had better diagnostic accuracy in obese children [30]. However, obesity predisposes to the development of other abdominal pathologies. Irritable bowel syndrome, fatty liver, pancreatitis, and gallstones have been reported [31-34].

## Conclusion

Childhood obesity in recent decades has had an alarming increase throughout the world. It brings with it multiple physiological changes that affect the development of other pathologies and a less favorable response to surgical treatments. Acute appendicitis is one of the complications of obesity, becoming the most common surgical emergency. However, its diagnosis is challenging due to the anthropometric values of obese patients, leading to an increase in the incidence of perforation of appendages and making post-surgical healing difficult. Despite this, ultrasound and CRP are used as confirmatory diagnostic tests. Observational studies are suggested to reveal the pathophysiological mechanisms for which acute appendicitis is carried out in obese pediatric patients.

## References

- José Luis Cuervo (2014) Apendicitis aguda. *Rev Hosp Niños (B. Aires)* 56: 15-31.
- Palacios RA, Delgado FJM (2013) Apendicectomía laparoscópica en obesidad infantil. *Archivos de Investigación Materno Infantil* 5: 103-106.
- Barrera Cruz A, Rodríguez González A, Molina Ayala MA (2013) Escenario actual de la obesidad en México. *Revista Médica del Instituto Mexicano del Seguro Social* 51: 292-299.
- Rodrigo Cano S, Soriano del Castillo JM, Merino Torres JF (2017) Causas y tratamiento de la obesidad. *Nutrición clínica y dietética hospitalaria* 37: 87-92.
- Muñoz Muñoz FL, Arango Álzate C (2017) Obesidad infantil: un nuevo enfoque para su estudio. *Revista Salud Uninorte* 33: 492-503.
- M De Onis, A Onyango, E Borghi, A Siyam, M Blossner, et al. (2012). Worldwide implementation of the WHO child growth standards. *Public health nutrition* 15: 1603-1610.
- Pretto ADB, Kaufmann CC, Dutra GF, Albernaz EP (2015) Prevalence of factors associated to metabolic syndrome in a cohort of children in South Brazil. *Nutrición hospitalaria* 32: 118-123.
- Fallas González J (2012) Apendicitis aguda. *Medicina legal de costa rica* 29: 83-90.
- Sakellaris G, Partalis N, Dimopoulou D (2015) Apendicitis aguda en niños de edad preescolar. *Salud (i) Ciencia* 21: 284-293.
- Cresswell JA, Campbell OM, De Silva MJ, Filippi V (2012) Effect of maternal obesity on neonatal death in sub-Saharan Africa: multivariable analysis of 27 national datasets. *Lancet* 380: 1325-1330.
- Sakellaris G, Partalis N, Dimopoulou D (2015) Apendicitis aguda en niños de edad preescolar. *Salud (i) Ciencia* 21: 284-293.
- González López SL, González Dalmau LP, Quintero Delgado Z, Rodríguez Núñez BR, Ponce Rodríguez Y, et al. (2020) Apendicitis aguda en el niño: guía de práctica clínica. *Revista Cubana de Pediatría* 92.
- Minneci PC, Mahida JB, Lodwick DL, Sulkowski JP, Nacion KM, et al. (2016). Effectiveness of patient choice in nonoperative vs surgical management of pediatric uncomplicated acute appendicitis. *JAMA surgery* 151: 408-415.
- Delgado Miguel C, Muñoz Serrano AJ, Delfa SB, Cerezo VN, Velayos M, et al. (2020) Influencia del sobrepeso y obesidad infantil en la apendicitis aguda en niños. *Estudio de cohortes. Cir Pediatr* 33: 20-24.
- OMS | Datos y cifras sobre obesidad infantil [Internet]. WHO. Disponible en: <http://www.who.int/end-childhood-obesity/facts/es/>
- Küpper S, Karvellas CJ, Khadaroo RG, Widder SL (2015) Increased health services use by severely obese patients undergoing emergency surgery: A retrospective cohort study. *Can J Surg* 58: 41-47
- Delgado Miguel C, Muñoz Serrano AJ, Delfa SB, Cerezo VN, Velayos M, et al. (2020) Influencia del sobrepeso y obesidad infantil en la apendicitis aguda en niños. *Estudio de cohortes. Cir Pediatr* 33: 20-24.
- Witt CE, Goldin AB, Vavilala MS, Rivara FP (2016) Effect of body mass index percentile on pediatric gastrointestinal surgery outcomes. *J Pediatr Surg* 51: 1473-1479
- Muñoz Serrano AJ, Delgado Miguel C, Cerezo VN, Delfa SB, Velayos M, et al. (2020) ¿Influye el tiempo hasta el inicio de la antibioterapia y la intervención en los resultados de la apendicitis aguda. *Cirugía Pediátrica* 33: 65-70.
- Delgado Miguel C, Muñoz Serrano AJ, Delfa SB, Cerezo VN, Velayos M, et al. (2020) Influencia del sobrepeso y obesidad infantil en la apendicitis aguda en niños. *Estudio de cohortes. Cir Pediatr* 33: 20-24.
- Zuluaga Santamaría A, Mejía Restrepo J, López Amaya JE, Ruiz Zabaleta T, Sánchez L, et al. (2017) Dolor abdominal agudo en pacientes obesos y con sobrepeso: ¿un escenario clínico diferente? Estudio prospectivo con tomografía computarizada multidetector. *Rev colomb Radiol* 21: 4600-4608.
- Yulieska NG, Giselle Lucila VG, Jimmy Javier CT, Jesús Daniel DLRS, Luis Armando MM (2021) CARACTERIZACIÓN CLÍNICO-EPIDEMIOLÓGICA DE PACIENTES CON EXCESO DE PESO HOSPITALIZADOS EN SERVICIO DE CLÍNICAS PEDIÁTRICAS. In *cibamanz* 2021.
- Kutasy Balazs, Prem Puri (2013) Appendicitis in obese children. *Pediatric surgery international* 29: 537-544.
- Palacios RA, Delgado FJM (2013) Apendicectomía lapa-

- ros cópica en obesidad infantil. Archivos de Investigación Materno Infantil 5: 103-106.
25. González López SL, González Dalmau LP, Quintero Delgado Z, Rodríguez Núñez B R, Ponce Rodríguez Y, et al. (2020) Apendicitis aguda en el niño: guía de práctica clínica. Revista Cubana de Pediatría 92.
  26. Kutasy Balazs, Prem Puri (2013) Appendicitis in obese children. Pediatric surgery international 29: 537-544.
  27. Hörmann M, Scharitzer M, Stadler A, Pokieser P, Puig S, et al. (2003) Ultrasound of the appendix in children: is the child too obese?. European radiology 13: 1428-1431.
  28. Yulieska NG, Giselle Lucila VG, Jimmy Javier CT, Jesús Daniel DLRS, Luis Armando MM (2021) CARACTERIZACIÓN CLÍNICO-EPIDEMIOLÓGICO DE PACIENTES CON EXCESO DE PESO HOSPITALIZADOS EN SERVICIO DE CLÍNICAS PEDIÁTRICAS. In cibamanz 2021.
  29. Blanco Felix C, Anthony D Sandler, Evan P Nadler (2012) Increased incidence of perforated appendicitis in children with obesity. Clinical pediatrics 51: 928-932.
  30. Kutasy B, Laxamanadass G, Puri P (2010) Is C-reactive protein a reliable test for suspected appendicitis in extremely obese children?. Pediatric surgery international 26: 123.
  31. Moyao Rodríguez MA (2019) Asma y síndrome de intestino irritable asociado a obesidad y sobrepeso en pacientes de 10 a 16 años.
  32. Verdezoto M, Francisco C (2014). Litiasis vesicular en la infancia y su relación con la anemia hemolítica y la obesidad infantil Hospital Dr. Francisco de Ycaza Bustamante. Enero 2010-Diciembre 2012.
  33. Alfonso Serrano R (2021). Obesidad infantil e hígado graso no alcohólico: actividad física como posible tratamiento.
  34. Castillo Ureña MJ (2007) Prevención de la obesidad infantil desde la escuela. Revista digital práctica docente.

**Copyright:** ©2021 Lourdes Reyes Polo, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.