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## EPIDEMIOLOGICAL STUDY ON YERSINIOSIS IN PEDIATRIC ACUTE DIARRHEA

(With 5 Tables and 5 Figures)

By

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دراسة وبائية على اليارسينيوسيس في حالات الإسهال الحاد في الأطفال

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تزايدت في الآونة الأخيرة حالات الإصابة بالنزلات المعوية الناتجة عن الإصابة بميكروب اليارسينيا انتيروكوليتيكا واليارسينيا سيدوتيوبركيلوسيس. وذلك أجريت هذه الدراسة لتحديد نسبة الإصابة بميكروب اليارسينيا انتيروكوليتيكا واليارسينيا سيدوتيوبركيلوسيس لدى مجموعة من الأطفال تعاني من حالات الإسهال المدمم والإسهال الغير المدمم. لذلك فقد تم جمع عدد ١٥٠ عينة عشوائية من براز الأطفال بواقع ١٠٠ عينة من حالات الإسهال الغير المدمم، ٥٠ عينة من حالات الإسهال المدمم من وحدة الجهاز الهضمي في مستشفى الأطفال بجامعة أسيوط في الفترة من يناير إلى ديسمبر ٢٠٠٥. وقد تم عزل ميكروب اليارسينيا انتيروكوليتيكا واليارسينيا سيدوتيوبركيلوسيس بنسبة ١٧,٣٣% و ١٣,٣٣% من براز الأطفال على التوالي. وقد ارتفعت نسبة الإصابة بين الأطفال في الريف (٥٢,٩%) عن الأطفال في المدينة (١١,٢٥%). وقد أثبتت الدراسة أن غالبية المرضى من الأطفال كانت تتراوح أعمارهم بين (٢٤-٦٠ شهر) وكانت نسبة الإصابة (٨٧,٥%) بينما كانت نسبة الإصابة (١٨,٣٣%) بين الأطفال التي تتراوح أعمارهم بين (٧-٢٤ شهر). كما أظهرت النتائج أن الإصابة كانت اعلى بين الإناث (٣٣,٣٣%) عن الذكور (٢٩,٥٢%). وقد تمت دراسة نسبة الإصابة على مدار العام. وقد تمت مناقشة الأهمية الصحية والوبائية ومصادر التلوث المختلفة لميكروب اليارسينيا انتيروكوليتيكا واليارسينيا سيدوتيوبركيلوسيس، هذا بالإضافة إلى مناقشة التوصيات لكيفية الحد من انتشار هذا الميكروب وكيفية الوقاية منه.

### SUMMARY

Yersiniosis is considered one of the most important bacterial foodborne infections as their incidence among humans had increased dramatically. A total of one hundred and fifty random samples were collected from children with acute diarrhea. 50 of them had blood in stools and 100 had no blood in their stools. Samples were collected from the gastroenterology unit of Assiut University Children Hospital during the period from January to December 2005. The present study was designed

to estimate the incidence of *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* among diarrheal children with and without blood in stools. Moreover, demographic and clinical characteristics of the *Yersinia* infected children were investigated. *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* could be detected in 17.33% and 13.33 % of the examined children, respectively. Ecological distribution of the examined children revealed that the rate of infection was higher in rural areas (52.9%) than in urban areas (11.25%). The majority of cases in the present study were in the age group of (> 24-60months ) with a rate of (87.5%), followed by those in age group of (7 –24 months) with a rate of 18.33%. It has been determined that incidence of *Yersinia* species was higher among females (33.33%) than males (29.52%). Seasonal incidence of the infection by *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* was studied. Public health hazard and preventive measures to control infection were discussed.

**Key words:** *Yersinia enterocolitica*, *Yersinia pseudotuberculosis*,  
*pediatric acute diarrhea*

## INTRODUCTION

Foodborne diseases caused by microbial pathogens remains a significant international public health problem in the 21<sup>st</sup> century, so that governments are intensifying their efforts to improve food safety (WHO, 2000). Yersiniosis is considered one of the most important bacterial foodborne infections as their incidence among humans had increased dramatically.

Yersiniosis is an infection associated with either *Yersinia enterocolitica* or *Yersinia pseudotuberculosis*. Epidemiological studies has been implicated animals including pigs, rodents, rabbits, sheep, goats, cattle, horses, dogs and cats as reservoirs of pathogenic *Yersinia* speices (Butler, 1998). Transmission of infection to human occurs by ingestion of contaminated food or water and less commonly by direct contact with infected animals and patients (Butler, 1998). It was been reported that milk, dairy products, powdered milk, cheese, meat and vegetables are considered as the major sources of infection in different reported outbreaks (Toora *et al.*, 1994).

*Yersinia enterocolitica* infection can assume many different forms depending on the strain and dose of the organism as well as the age and physical condition of the person infected (Gray, 1995). Several outbreaks of *Yersinia enterocolitica* food poisoning were reported by different authors (Barret, 1989; Greenwood and Hooper, 1990 & Ackers,

1995). The most frequent manifestation is gastroenteritis, which primarily affects children especially infants are considered highly susceptible to infection in the first year of life. Exudative pharyngitis and septicemia may also occur. Although *Y. enterocolitica* causes a syndrome which mimics appendicitis oftenly in older children and young adults (Naktin and Beaves, 1999 & Lamps *et al.*, 2001), *Y. enterocolitica* is implicated as a major bacterial cause of appendicitis (Shorter *et al.*, 1998; Lamps *et al.*, 2001; Sakellaris *et al.*, 2004 and Sayed and Hassan, 2005). Serious cases of infection may occur with rectal bleeding and perforation of the ileum.

It is interesting to note that, secondary immunological mediated complications may develop after complete recovery of infection such as arthritis, erythema nodosum and to a lesser extent Reiter's syndrome, glomerulonephritis and myocarditis, (Bottone, 1997; and Strobel *et al.*, 2000).

*Yersinia pseudotuberculosis* mainly affects children, adolescents and young adults (Butler, 1998). The most clinical forms are mesenteric adenitis, pseudoappendicitis, fever, vomiting and diarrhea in 20% of the infected patients (Acha and Szyfer, 1991). Moreover, *Y. pseudotuberculosis* has been isolated from cases of appendicitis (Puylaert *et al.*, 1989 & Sayed and Hassan, 2005).

The present investigation was designed to estimate the prevalence of *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* among children with diarrhea and to study the possible risk factors in acquiring the infection.

## **MATERIALS and METHODS**

### **Sample Collection:**

One hundred and fifty random stool samples were collected from children with acute diarrhea (100 had no blood in stools and 50 had blood in stools). Samples were collected from gastroenterology unit of Assiut University Children Hospital during the period from January to December 2005. Precoded questionnaires were completed at the time of recruitment to record demographic details and clinical history.

### **Isolation and identification of *Yersinia* species:**

**Cold enrichment technique:** swabs of stool specimens were enriched in phosphate buffer saline pH 7.6 (PBS) supplemented with 2% peptone and incubated at 4°C for 14 days (Varnam and Evans, 1991).

### **Isolation on *Yersinia* selective agar:**

Loopfuls from the enriched broth were streaked onto *Yersinia* selective agar plates supplemented with Cefsulodin-Irgasan-Novobiocin

(CIN) and incubated at 28°C for 24 hours. Dark red, bull eye-like colonies were screened by biochemical reactions according to the technique described by Varnam and Evans (1991).

**Determination of Virulence markers:**

Autoagglutination and congo red uptake were used to identify virulent strains of *Y. enterocolitica* (Varnam and Evans, 1991).

**RESULTS**

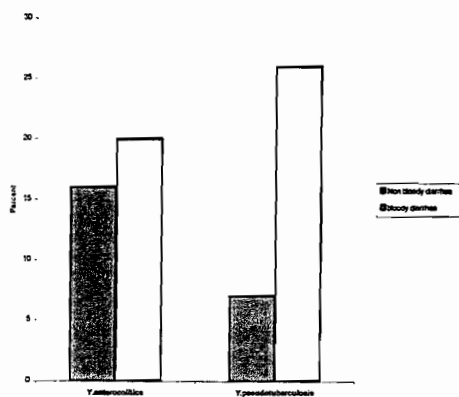
**Table 1:** Prevalence of *Yersinia* species among the examined children

Type of diarrhea	No. of samples	<i>Yersinia</i> species	
		<i>Y. enterocolitica</i>	<i>Y. pseudotuberculosis</i>
Non bloody diarrhea	100	*16 (16 %)	7 (7 %)
Bloody diarrhea	50	*10 (20 %)	13 (26 %)
Total	150	26 (17.33%)	20 (13.33%)

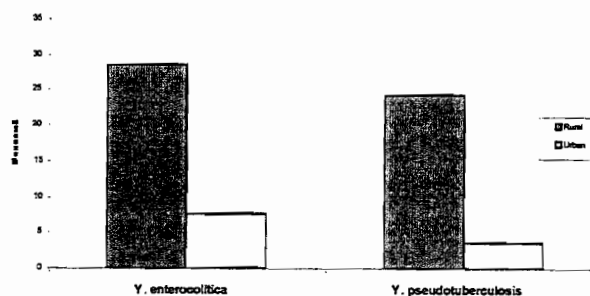
\* All of the isolated *Yersinia enterocolitica* strains were virulent

**Table 2:** Ecological distribution of *Yersinia* infection among the examined children

Residence	No. of samples	<i>Yersinia</i> species		Total
		<i>Y. enterocolitica</i>	<i>Y. pseudotuberculosis</i>	
Rural	70	20 (28.6%)	17 (24.3%)	37 (52.9%)
Urban	80	6 (7.5%)	3 (3.75%)	9 (11.25 %)



**Fig. 1:** Prevalence of *Yersinia* species among the examined children



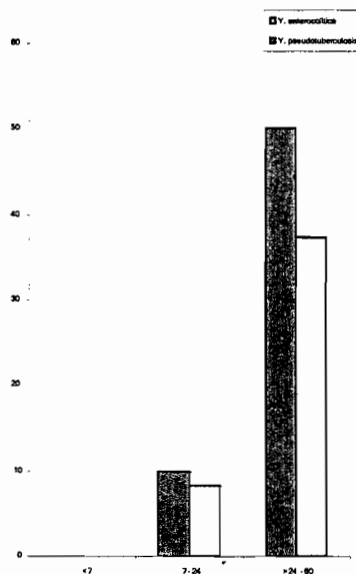
**Fig. 2:** Ecological distribution of *Yersinia* infection in the examined children

**Table 3:** Age-wise prevalence of *Yersinia* infection among the examined children

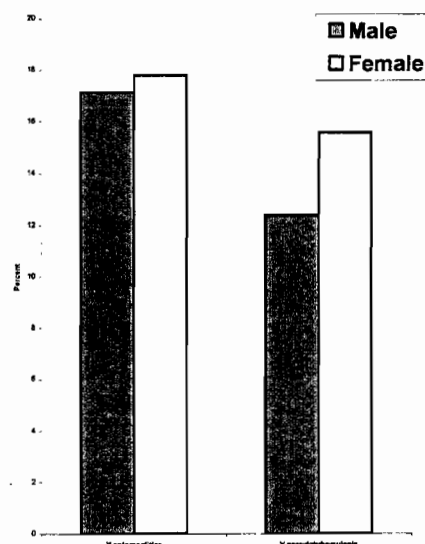
Age-wise (months)	No. of samples	<i>Yersinia</i> species		Total
		<i>Y. enterocolitica</i>	<i>Y. pseudotuberculosis</i>	
<7	50	-	-	-
7- 24	60	6 (10%)	5 (8.33 %)	11( 18.33%)
> 24 -60	40	20 (50%)	15 (37.5 %)	35( 87.5%)

**Table 4:** Occurrence of *Yersinia* infection in male and female children

Sex	No. of samples	<i>Yersinia</i> species		Total
		<i>Y. enterocolitica</i>	<i>Y. pseudotuberculosis</i>	
Male	105	18 (17.14%)	13 (12.38%)	31 (29.52 %)
Female	45	8 (17.8%)	7(15.56%)	15 (33.33 %)



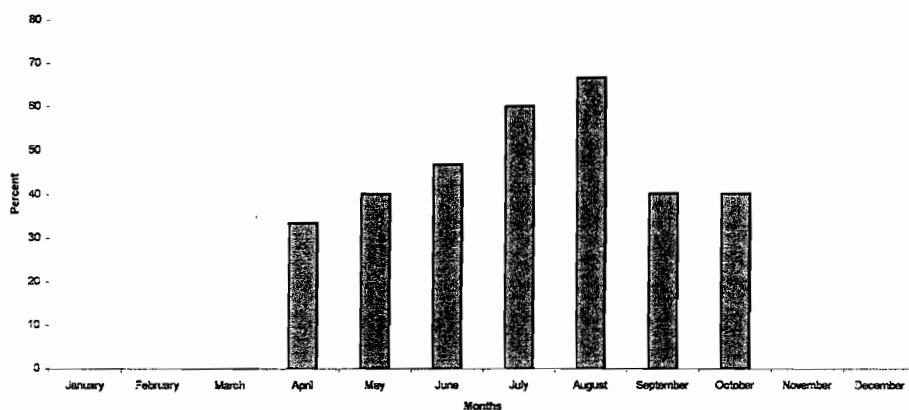
**Fig. 3:** Age-wise prevalence of *Yersinia* infection among the examined children



**Fig. 4:** Occurrence of *Yersinia* infection in male and female children

**Table 5:** Incidence of *Yersinia* species in relation to the months of the year

Month	No.of samples	<i>Y. enterocolitica</i>		<i>Y. pseudotuberculosis</i>	
		No.	%	No.	%
January	10	-	-	-	-
February	10	-	-	-	-
March	10	-	-	-	-
April	12	3	25	1	8.33
May	15	4	26.67	2	13.33
June	15	3	20	4	26.67
July	15	4	26.67	5	33.33
August	12	4	33.33	4	33.33
September	15	4	26.67	2	13.33
October	15	4	26.67	2	13.33
November	11	-	-	-	-
December	10	-	-	-	-



**Fig. 5:** Incidence of *Yersinia* species in relation to the months of the year

## DISCUSSION

Foodborne bacterial gastrointestinal infections are important causes of morbidity and mortality worldwide, and despite successful control programs in some developed countries, these infections continue to have a major impact on public health and economy (Varnam and Evans, 1991). *Yersinia* species are one of the most reported pathogens incriminated in gastrointestinal illness (Kapperud, 1991).

Results of this study revealed that the prevalence of *Yersinia enterocolitica* among the examined children was 17.33% however, the prevalence of *Yersinia pseudotuberculosis* was 13.33% in the examined samples (Table and Figure 1).

Clinical and laboratory investigation revealed that *Y. enterocolitica* was isolated from 16% and 20% of the examined children with nonbloody diarrhea and bloody diarrhea, respectively (Table and Figure 1).

It has been confirmed that all of the isolated strains of *Y. enterocolitica* were virulent (Table 1). It has been noted that the virulence of *Y. enterocolitica* results from a complex interplay between a series of temperature-controlled plasmid borne and chromosomal genes (Robins-Browne, 1997). Moreover, *Y. pseudotuberculosis* was isolated from 7% and 26% of the examined children with nonbloody diarrhea and bloody diarrhea, respectively (Table and Figure 1). Several investigators reported variable prevalence rates in different geographical areas. Higher prevalence rates were detected with rates of 53% and 77.6% reported by Greenwood and Hooper, (1986) and Metchock *et al.* (1991), respectively. However, lower prevalence rates were detected with rates of 0.9%, 0.64%, 2%, 2.7% ,0.54% and 7.1% reported by Ogunsanya *et al.* (1994 ); Essers *et al.* (2000 ); Kafetzis *et al.* (2001) ; Soltan-Dallal and Moezardalan, (2004); Klein *et al.* (2006) and Koehler *et al.* (2006), respectively.

The higher prevalence rate detected in this study may be due to the high prevalence rate of *Yersinia* species among animals in the studied areas as reported previously by El-Prince and Sayed, (2002).

Ecological distribution of the infected children in the present study (Table and Figure 2) revealed that the prevalence of *Yersinia* species were higher in rural areas (52.9%) than in urban areas (11.25%). The high prevalence rate reported in rural areas may be attributed to the high risk of infection from animal as well as high contamination rates of food and water in these area.

Data illustrated in (Table and Figure 3) reveals that the majority of infected children were in the age group (>24-60 months) with a rate of 87.5% followed by children in the age group (7-24 months) with a rate of 18.33%, however *Yersinia* species were not isolated from children with age group younger than (7 months). It has been reported that the peak age related incidence of *Yersinia* species was in young children especially younger than 5 years (Metchock *et al.*, 1991 and Olesen *et al.*, 2005).

Results in (Table and Figure 4) declared that *Yersinia* species were slightly higher among females with a percent of 33.33% than males with a rate of 29.52%. *Y. enterocolitica* was isolated from male and female children with a rate of 17.14% and 17.8%, respectively while, *Y. pseudotuberculosis* were detected in 12.38% and 15.56% of the examined males and females children, respectively. It seems from the obtained results that gender does not play a major role in acquiring infection whereas, the prevalence rate in both sexes was nearly the same.

Studying the seasonal distribution of *Yersinia* infection as illustrated in (Table and Figure 5) revealed that *Yersinia* infection were most common in warm months with incidence rate varied from 20% - 26.67% in case of *Y. enterocolitica*. However, the incidence of *Y. pseudotuberculosis* varied from 8.33% to 33.33%. Results obtained in this study agrees with that reported by Hayashidani *et al.*, (1995). However, several investigators had reported that *Yersinia* infection occurs throughout the year [Fukushima *et al.* (1987); Prentice *et al.* (1991)] and Wormser *et al.* (1996).

In conclusion, results obtained in this study reflect the public health hazard of *Y. enterocolitica* and *Y. pseudotuberculosis* which obligate applying control measures to reduce the risk of human infection by collaboration of governments, food industry and consumers.

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