

# Oral colonisation with *Candida* of newborn children: risk factors associated with pregnancy and delivery

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## Abstract

**Aims.** The overall aim of the present study was to examine the risk factors that influence oral colonisation with *Candida* during pregnancy, delivery, and following birth of the child. Within this overall aim there were two specific aims which were: to study early oral colonisation with *Candida* in children immediately after birth and to study oral colonisation with *Candida* during pregnancy. **Methods.** The study investigated 79 newly borne infants for two maternity homes in Sofia and Rousse, Bulgaria. Parameters of child and maternal health were recorded using a standardise form. Swabs were taken from the children's mouths and assayed after cultivation for 48 hours at 35 °C. The resulting data were statistically tested. **Results.** *Candida* was isolated from the mouths of 13 newborn children. Of the mothers of children studied, 28.37% had complications during pregnancy, referred to as a high-risk pregnancy. A statistical comparison of the oral candidal infection between children born normally and by Caesarean section shows no significant difference between the two groups ( $\chi^2_{1,2} = 0.0041, P > 0.05$ ). Examination of the relationship between vaginal candidosis in the mother during pregnancy and the presence of oral *Candida* in the newborn child suggested that this is an important risk factor for the early transmission of *Candida*. **Conclusions.** In this study: *Candida* carriage in newborn children was 16%, with quantities of *Candida* ranging between  $10^3$  to  $10^6$  cells/ml without any clinical manifestation of oral candidosis. High-risk pregnancies and premature birth were most frequently associated with the early colonisation of the oral cavity with *Candida*. For the majority of newborn children, there was a strong relationship between maternal vaginal *Candida* and oral colonisation by *Candida* in the child. Feeding methods did not influence oral colonisation with *Candida*.

**Key words:** *Candida*, fungi, oral candidosis, thrush, interuterine development, risk factors, pregnancy delivery method, vaginal candidosis, breast feeding.

## Introduction

*Candida* fungi are part of the resident oral microflora that can, under certain conditions, develop into opportunistic pathogens and thus lead to oral candidosis. Such infections are called opportunistic as they appear only when the human host develops imbalance or collapse of the system as a result of other diseases, pathological conditions, immunosuppressive treatment, and so on [1, 2, 3, 4, 5, 6].

Oral colonisation with *Candida* in children may happen during or immediately following birth. Thus these microorganisms participate in the initial building of the oral ecosystem. It is interesting to

note that not all newborn children with initial *Candida* colonisation develop overt disease. For most children, *Candida* remains as a part of the residual oral microflora [7, 8].

Oral candidosis in newborn children is most often observed as oropharyngeal candidosis or "thrush". Other neonatal fungi infections, which cause 10-15% of sepsis cases in this age group, are also observed [4, 9].

The presence of oral *Candida* in early childhood, when immunity of a child is still developing, is influenced by different environmental factors, such as the mother's condition during pregnancy as well as the child's development *in utero* and postpartum [10, 11, 12].

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### Aims

The overall aim of the present study was to examine the risk factors that influence oral colonisation with *Candida* during pregnancy, delivery, and following birth of the child. Within this overall aim there were two specific aims which were:

1. To study early oral colonisation with *Candida* in children immediately after birth with particular regard to:
  - The relationship between maternal vaginal candidosis and colonisation with *Candida* in the neonate.
  - The relationship between the feeding regimen during the breast-feeding period of neonates and oral colonisation with *Candida*.
2. To study oral colonisation with *Candida* during pregnancy.

### Methods

The study was carried out with 79 newborn children aged between one and ten days consisting of 43 males and 36 females from two maternity homes in Sofia and Rousse, Bulgaria.

The following parameters of the health status of the children and mother's pregnancy were recorded:

- Interuterine development of the child.
- Height and weight upon birth, presence of chronic disease.
- Clinical symptoms of oral candidosis in the child.
- Data on maternal candidosis.
- Feeding method (breast feeding or artificial feeding).

Data were collected with the active cooperation of parents and paediatricians and recorded in a specifically designed form.

Newborn children were examined for the development of thrush during the first month after birth.

### Microbiological investigation

Material for microbiological study was taken from the mouth of the children being investigated by means of a sterile tampon.

The quantitative determination of *Candida* was performed by the Gould method as follows; after cultivation for 48 hours at 35°C, the colonies grown were determined and their numbers calculat-

ed from a standard table [13]. When in doubt, a microscope sample by Leffere (staining with methylene blue for five minutes) was prepared from the colonies and cell morphology examined in parallel cultures grown on CHROMagar™ *Candida* for 48 hours at 35°C to determine the type of *Candida*.

Data were examined using statistical software (SPSS version 15, SPSS Inc, Chicago, USA). A nonparametric test was used ( $\chi^2$ ), and an independent samples *t*-test and Pearson correlation coefficient performed.

### Results

#### 1. Oral colonisation with *Candida* in children immediately after birth.

Children studied had average height of 49.76 cm ( $\pm 2.4$  cm) and average weight at birth of 3112 g ( $\pm 541.33$ g)

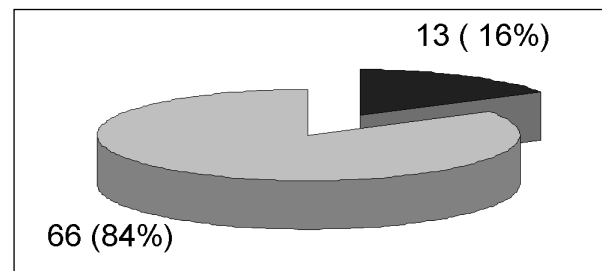


Figure 1. *Candida* carriers in newborn children.

*Candida* was isolated from the mouths of 13 newborn children. *Candida albicans* was isolated from all of these children. In nine of the children, *Candida* was isolated during the first four days after birth, and in the other four cases, from the sixth to the tenth day after birth. *Candida* carriers represented 16% of the newborn children, as shown in Figure 1.

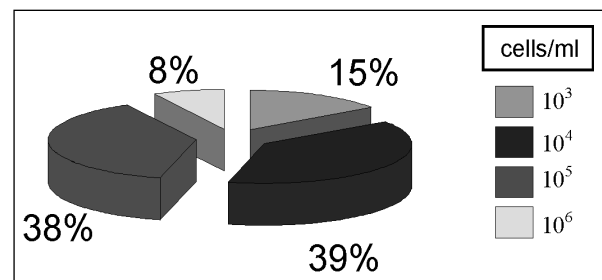


Figure 2. Quantitative evaluation of *Candida* isolated in newborn children.

Figure 2 illustrates the differing quantities of *Candida* in newborn children, which ranged from

10<sup>3</sup> to 10<sup>6</sup> cells/ml. None exhibited clinical signs of oral candidosis. Over 70% of the children studied had *Candida* in quantities from 10<sup>4</sup> to 10<sup>5</sup> cells/ml and 8% had 10<sup>6</sup> cells/ml.

## 2. Pregnancy and oral colonisation with *Candida* newborn children.

Factors influencing the development of a child and its health status may arise during interuterine development. Of the mothers of children studied, 28.37% had complications during pregnancy, referred to as a high-risk pregnancy. Thirty per cent had been hospitalised to avoid miscarriage or premature delivery of the fetus, 20% suffered from high blood pressure, and others were pregnant with twins

The influence of high-risk pregnancy on the frequency of children with oral *Candida* can be determined by comparing the frequency of candidal infection with risk status (Table 1).

Table 1. Risk pregnancy and oral *Candida*

Pregnancy	Total		With <i>Candida</i>	Without <i>Candida</i>
	n	%		
Risk pregnancy	12	15.2	8	4
Normal pregnancy	67	84.8	5	62
$\chi^2$	$\chi^2_{1,2} = 25.948$			
P	$P < 0.0001$			
Pearson correlation (PC)	PC = 0.654*			

\* Pearson correlation: correlation is significant at the 0.01 level.

The level of statistical significance ( $P < 0.0001$ ) between the two groups suggests that high-risk pregnancy as an important factor in determining oral colonisation with *Candida*.

## 3. Delivery method and oral *Candida* in newborn children.

As *Candida* was found in 16% of the children immediately after birth, it can be assumed that infections occur during delivery or that they may be congenital. Pregnancy, delivery, and complications during this period directly influence the development of the newborn child. For mothers with vaginal candidosis, bacterial transmission of *Candida* may occur during birth.

A statistical comparison of the oral candidal infection between children born normally and by Caesarean section shows no significant difference

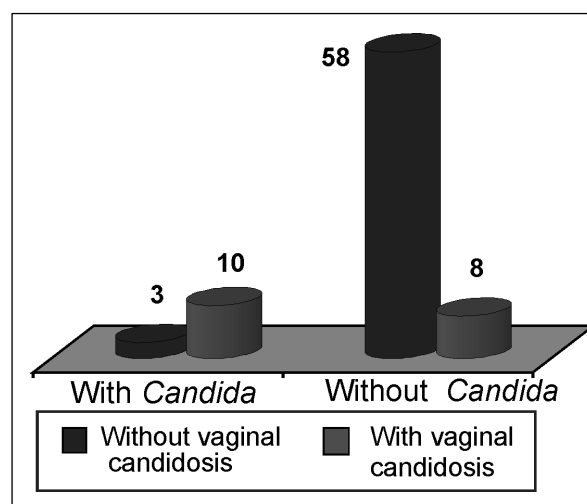
between the two groups ( $\chi^2_{1,2} = 0.0041$ ,  $P > 0.05$ ). Therefore, delivery method is not a factor in determining oral colonisation with *Candida* (Table 2).

Table 2. Dependence of orally isolated *Candida* and the delivery method of newborn children

Delivery	Total		With <i>Candida</i>	Without <i>Candida</i>
	n	%		
Born normally	48	60.8	8	40
Born by Caesarian section	31	39.2	5	26
$\chi^2_{1,2} = 0.0041$				
$P > 0.05$				

## 4. Vaginal candidosis of the mother and oral *Candida* in newborn children.

Examination of the relationship between vaginal candidosis in the mother during pregnancy and the presence of oral *Candida* in the newborn child suggested that this is an important risk factor for the early transmission of *Candida*. The value of  $\chi^2$  ( $\chi^2 = 25.923$ ) indicates that there is an association between candidal infection in the child and vaginal candidosis in the mother, and this is significant ( $P < 0.0001$ ). The high correlation coefficient (PC = 0.573) supports this relationship (Figure 3).



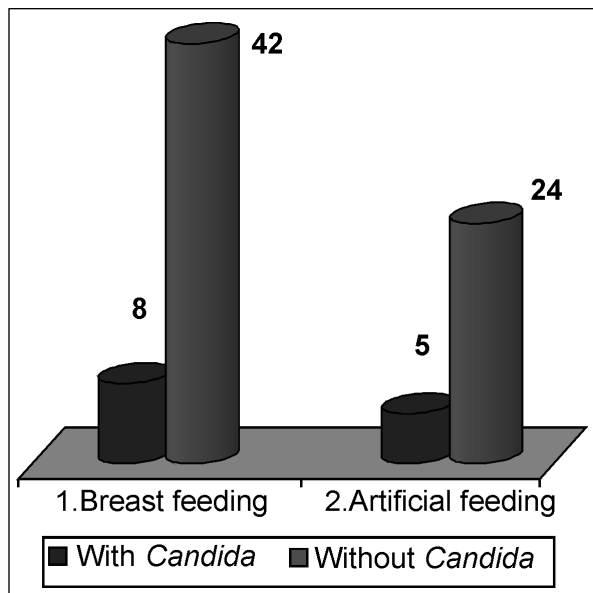
$\chi^2 = 25.923$   $P < 0.0001$   $PC = 0.573^*$

Figure 3. Dependence between oral *Candida* of newborn children and the vaginal candidosis of the mother.

## 5. *Candida* and feeding method during the early breast-feeding period.

The acidic oral environment maintained in the mouth of newborn children due to destruction of milk sugar creates favourable conditions for the

development of *Candida* already colonised in the oral cavity. The effect of different feeding methods on oral *Candida* is shown in Figure 4.



$$\chi^2_{1,2} = 0.021 \quad P > 0.05 \quad PC = 0.886$$

**Figure 4.** *Candida* and feeding methods in the group of newborn children.

The results show an absence of any relationship between in the frequency of *Candida* infection and the feeding method ( $P > 0.05$ ).

### Discussion

The quantitative evaluation of oral *Candida* is not sufficient to state that *Candida* is the reason for a specific disease (oral candidosis). The clinical evaluation of this type of disease is complex and should include, in addition to the quantity and type of *Candida*, an evaluation also of the risk factors lead-

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ing to development of the disease as well as the presence of typical clinical findings.

The increased quantity of *Candida* in the birth passages is not always a condition sufficient for transmission to the newborn child. A terrain for colonisation is also necessary: namely, a child with deviations from the normal development, with interwomb or birth trauma, or complications.

Feeding methods do not influence the appearance of oral candidosis (thrush) in the newborn child, but *Candida*'s predilection for environments such as the crypts of the mother's breast nipple and plastic nipples represents an additional factor that can maintain high microbe numbers during development of disease.

### Conclusions

In the current study

1. *Candida* carriage in newborn children was 16%, with quantities of *Candida* ranging between  $10^3$  to  $10^6$  cells/ml without any clinical manifestation of oral candidosis.
2. High-risk pregnancies and premature birth were most frequently associated with the early colonisation of the oral cavity with *Candida*.
3. For the majority of newborn children, there was a strong relationship between maternal vaginal *Candida* and oral colonisation by *Candida* in the child.
4. Feeding methods did not influence oral colonisation with *Candida*.

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