

Oral *Candida albicans* carriage in healthy preschool and school children

Rożkiewicz D¹, Daniluk T², Zaremba ML^{2*}, Cylwik-Rokicka D³, Stokowska W⁴,
Pawińska M⁴, Dąbrowska E⁵, Marczuk-Kolada G⁶, Waszkiel D⁶

¹ Department of Pediatric Infectious Diseases, Medical University of Białystok, Poland

² Department of Microbiology, Medical University of Białystok, Poland

³ Department of Prosthodontics, Medical University of Białystok, Poland

⁴ Department of Conservative Dentistry, Medical University of Białystok, Poland

⁵ Department of Social and Preventive Dentistry, Medical University of Białystok, Poland

⁶ Department of Paedodontics, Medical University of Białystok, Poland

Abstract

Purpose: The purpose of the present study was to detect *Candida albicans* carriage in the oral cavity of healthy preschool and school children. The second aim was the determination of correlation between *C. albicans* occurrence and dental caries in children population.

Material and methods: The samples for mycological examinations were collected from the pharynx and supragingival plaque, and carious lesions in 102 children, aged 4-7 years (preschool children) and 104 children and adolescents, aged 12 and 18 (school children). All samples were cultured directly on Sabouraud agar medium. Isolated yeasts were identified based on API 20C AUX (bioMérieux).

Results: A total of 123 *C. albicans* strains were isolated, in which 61 (49.6%) derived from supragingival plaque, 48 (39%) – from carious lesions, and 14 (11.4%) – from pharyngeal swabs. *C. albicans* was isolated from the samples of single material in 61 children (35 – school children, 26 – preschool children) while from the rest of 29 children, *C. albicans* was isolated from two (25x) or three materials (4x). *C. albicans* was detected in 48/75 (64%) children with dental caries; the rate was statistically significantly higher as compared to the overall number of children with *C. albicans* carriage (90/206; 43.7%) ($p=0.0026$). Similar results was obtained in preschool children (38/61; 62.3% and 47/102; 46.1%, respectively) ($p=0.0449$), as in school children (10/14; 71.4% and 43/104; 41.3%, respectively) ($p=0.0336$).

Conclusions: 1) *Candida albicans* was observed in the oral cavity of healthy children with high (approximately 40%) – comparable rate in school and preschool children

($p>0.05$). 2) *C. albicans* was isolated with high comparable rate from carious lesions in preschool and school children. The statistically significant differences between the rate of *C. albicans* in carious lesions in preschool children (62.3%) and school children (71.4%) and the overall number of children with *C. albicans* carriage in the oral cavity of children in both age groups ($p<0.05$) were showed.

Key words: *Candida albicans*, oral carriage, preschool and school children, dental caries, supragingival plaques, pharynx.

Introduction

Candida albicans is frequently carried in the oral cavity without causing disease [1,2], but asymptomatic carriage may place some individuals at higher risk of complications through yeast infections if they become immunosuppressed [3,4]. Among subjects initially asymptomatic for *C. albicans* infection, clinical thrush developed only in those patients who are permanent carrier of *C. albicans* prior to developing symptoms [5,6].

Despite the potential clinical relevance of *C. albicans* carriage, little is known about carriage patterns in school children [6-10]. Hence, the purpose of the present study was to analyse *C. albicans* carriage in preschool and school-age children. The second aim of this study was to correlate the presence of *C. albicans* with dental caries prevalence in this population.

Material and methods

The samples for mycological study were collected from the pharynx and supragingival plaques, and carious lesions in 102 children, aged 4-7 (preschool children) and 104 children and adolescents, aged 12 and 18 (school children). All samples were cultured directly on Sabouraud agar medium. Isolated yeasts

* CORRESPONDING AUTHOR:

Department of Microbiology
Medical University of Białystok
ul. Mickiewicza 2C, Białystok 15-230, Poland
e-mail: zaremba@amb.edu.pl (Maria Lucyna Zaremba)

Table 1. Prevalence of *Candida albicans* in oral cavity depending on the age group of children

	Supragingival plaques n=206	Carious specimens n=75	Pharynx n=206	Total
Preschool children (102)*	26	38	8	72
4-5 years (52)	18	19	6	43
6-7 years (50)	8	19	2	29
School children (104)	35	10	6	51
12 years (52)	16	7	3	26
18 years (52)	19	3	3	25
Total (206)	61	48	14	123

* Number of children

Table 2. Frequency of *Candida albicans* carriage of different group children with and without caries

Children	Total	Caries	Non-caries	p-value
Preschool children	102/47*	61/38	41/9	0.0001
Female	47/23	28/16	19/7	>0.05
Male	55/24	33/22	22/2	0.0000
4-5 years	52/26	31/19	21/7	0.0479
Female	24/12	13/7	11/5	>0.05
Male	28/14	18/12	10/2	0.0180
6-7 years	50/21	30/19	20/2	0.0002
Female	23/11	15/9	8/2	>0.05
Male	27/10	15/10	12/0	0.0016
School children	104/43	14/10	90/33	0.0140
Female	63/25	6/4	57/21	>0.05
Male	41/18	8/6	33/1	>0.05
12 years	52/22	9/7	43/15	0.0458
Female	11/4	1/1	10/3	>0.05
Male	41/18	8/6	33/12	>0.05
18 years	52/21	5/3	47/18	>0.05
Female	52/21	5/3	47/18	>0.05
Male	0	0	0	
Total	206/90	75/48	131/42	0.0000
Female	110/48	34/20	76/28	0.0317
Male	96/42	41/28	55/14	0.0000

* No. of children/ No. of *C. albicans*

were identified based on API 20C AUX (bioMérieux). The procedures for mycological studies were described previously [11]. After we had obtained informed consent from the parents and/or the guardians of the children as well as the children's own assent to participate, children were screened for health and dental disease. None of the children had clinical signs of oral candidiasis, and all were free of systemic disease.

The Ethics Committee of the Medical University of Białystok approved the study protocol.

Statistics

The prevalence of *Candida albicans* carriage was calculated as a function of age and gender of children. The differences in *C. albicans* colonization between preschool and school children were evaluated using Chi-squared test. The levels of significance were fixed at $P \leq 0.05$.

Results

A total of 123 *C. albicans* strains were isolated, in which 61 (49.6%) derived from supragingival plaques, 48 (39.0%) – from carious lesions, and 14 (11.4%) – from pharyngeal swabs (Tab. 1). *C. albicans* was isolated from the samples of single material in 61 children (35 – school children, 26 – preschool children) while from the rest of 29 children, *C. albicans* was isolated from two (25x) (17 – preschool, 4 – school) or three specimens (4x) only from preschool children with caries.

Candida albicans carriage was observed in a total of 90/206 (43.7%) examined children (Tab. 2). The difference in the frequency of *C. albicans* carriage between preschool and school children was not significant (46.1% vs 41.3%) ($p=0.493$) as well as between 4-5 years and 18 years (50.0% vs 41.2%) ($p=0.3687$). *C. albicans* was isolated with high comparable rate from carious lesions in preschool (62.3%) and school children (71.4%) ($p=0.5208$). No difference was seen between

non-carriers preschool (21.9%) and school children (36.7%) ($p=0.0943$). The statistically significant differences were observed between *C. albicans* carriage in caries and non-carries groups of preschool and school children (Tab. 2). With the exception of 18-years-old group with caries and non-carries in which the differences was comparable (60.0% vs 38.3%) ($p>0.05$). The difference in the frequency of *C. albicans* carriage between preschool girls (36.8%) and boys (9.1%) was significant ($p=0.0323$) (Tab. 2).

Candida albicans was detected in 48/75 (64.0%) children with dental caries; the rate was statistically significantly higher as compared to the overall number of children with *C. albicans* carriage (90/206; 43.7%) ($p=0.0026$). Similar results was obtained in preschool children (38/61; 62.3% and 47/102; 46.1%, respectively) ($p=0.0449$), as in school children (10/14; 71.4% and 43/104; 41.3%, respectively) ($p=0.0336$).

Discussion

The study indicates that host age is a determining factor in yeast carriage [1,6,7,9,10,12-14]. From the neonatal period, humans go through several dentition periods, and the emergence and substitution of teeth and changes in living habits greatly change the environment of the oral cavity, and therefore influence colonization by oral commensal organisms, certainly including *Candida* spp. [12]. Russell and Lay [13] showed that the frequency of oral yeast carriage at birth was low, doubled by the time that infants were discharged from the hospital at about seven-day old, and increased sharply after one month old. Kleinegger et al. [14] demonstrated that the frequency of oral yeast carriage was 44% of the examined individuals in a group aged from 0.5 to 1.5, 24% in a 5-7-year-old group, 40% in a 15- to 18-year-old group.

Starr et al. [6] investigated the prevalence of oral *C. albicans* in children aged 8-11 at baseline (before dental treatment), post-treatment, and 12, 24, 36 months post-baseline, respectively, 47, 21, 27, 28% of children were positive.

In a review by Odd in 1988 [1], the highest reported frequencies were 71% of school children in the United Kingdom, and 56% of children in Israel.

Recently, Qi et al. [12] showed that the yeast carriage frequency is very low in the neonatal group in China, just 7.5%, which accords with the 5.7% in the study by Russel and Lay [13]. The highest frequency (70.0%) of carriage of yeast and *C. albicans* was in the primary dentition group (3-5 years) of China children [12]. The authors observed, with increasing age, the frequency of *C. albicans* decreases (6-8 years – 56.4%, early mixed dentition; 12-14 years – 49.1%, late mixed dentition and 18-21 years – 60.0%, secondary dentition) [12]. However, the frequency of yeast carriage does not decrease, because there was a large proportion of individuals in 18-21-year group with *Candida glabrata* isolated [12].

Our study did not show the differences in the frequency rate of oral *C. albicans* carriage according to age of children; positive *C. albicans* was high from 41.2% in 18-year-old to 50% in 4-5-year-old.

In the school children described in this report, *C. albicans*

carriage occurred far more frequently (41.3%) than the average carriage rate of 10-15% reported in literature [1]. *C. albicans* prevalence in healthy school children Portuguese population was as high as 47% at baseline and decreased to 27% during 3 years, even with regular dental care [6].

The above presented results indicate that the frequency of oral yeast, mainly *Candida albicans* species, is different in different-aged children. *Candida albicans* is the most important commensal organism in the oral cavity, and the yeast carriage frequency varies not only by the age but also according to geographical area. It is therefore a reasonable possibility that these changes in frequency may be due to physiological changes related to age: changes relating to body fluids, changes at mucosal surfaces, changes related to natural barriers against yeast colonization, and changes in the living environment and habits of the individual and to the ecological environment of the oral cavity.

Different sampling and identification methods for *Candida* spp. would also certainly influence the results [1,2,6]. Because of the uneven distribution of *C. albicans* throughout the oral cavity, swab samples can yield false-negative culture more often than oral rinse samples or imprint culture [1]. The number of false-negative cultures was reduced by the swabbing of two sites rather than one [1,6]. According to our study, the frequency of *C. albicans* carriage was only 29.6% for a single samples tested and increased to 41.7% for two swab samples ($p=0.01$) or to 43.7% when three samples evaluated ($p=0.003$).

Moreover, other risk factors for *C. albicans* carriage, such as recent or current antibiotic use, were not taken into account [1].

Apart from bacteria, the importance of the presence of yeasts in the oral cavity and the incidence of dental caries have been demonstrated for adults and for children [6-10]. Our own studies revealed that the oral cavity of children with healthy teeth is almost devoid of *Candida albicans*. *Candida albicans* species only from children with caries have been detected in 64.0% (48/75) compared to 32.1% (42/131) from children caries-free ($p=0.0000$); it is concerning the preschool and school children.

Since caries prevalence is associated with *C. albicans* carriage [1,6-9], the eligibility requirement of the parent study of a carious lesions in at least one deciduous or permanent tooth may have elevated these carriage rates in comparison to the general Polish preschool and school population.

In conclusion, our observations indicate that there is an increased risk of dental caries with *C. albicans* carriage rates in preschool and school children.

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