Oral *Candida albicans* Colonization and Salivary Biomarkers of Stress and Sleep in Preschool Children with Autism Spectrum Disorder: A Cross-Sectional Study

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SUMMARY

Autism spectrum disorder (ASD) is a neurodevelopmental condition associated with microbial and neuroendocrine alterations. Our goal was to evaluate the prevalence of oral *Candida albicans* and salivary hormone levels in preschool children diagnosed with ASD, to explore the potential relation between fungal load and neuroendocrine markers. This cross-sectional study included 90 children aged 4–6 years (45 with ASD and 45 typically developing peers). In both groups, we collected oral and saliva samples. Oral samples were collected from the dorsal surface of the tongue and the buccal mucosa of the cheeks to detect *C. albicans* colonies, while saliva samples were collected using Salivette® collection devices and then analyzed for cortisol and melatonin levels using ELISA. *Candida albicans* had significantly higher colony counts in the ASD group. It was detected in 35.6% of children with ASD compared to 11.1% of controls ($P = 0.006$). Children with ASD also exhibited elevated salivary cortisol levels ($P < 0.001$) and reduced melatonin concentrations ($P = 0.04$). However, no significant correlations were found between *Candida* load and hormone levels. Age was the only significant predictor of cortisol in the ASD group, while logistic regression revealed non-significant trends. Children with ASD demonstrated increased *C. albicans* colonization, elevated cortisol, and decreased melatonin levels compared to controls. Although no direct associations between hormone levels and fungal presence were established, these findings underscore a potential neuroendocrine-microbial imbalance in ASD, warranting further investigation with larger sample sizes and longitudinal study designs.

KEYWORDS

Autism spectrum disorder; Candida albicans; Salivary biomarkers; Cortisol; Melatonin; Oral microbiota

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by persistent difficulties in social communication and the presence of restricted, repetitive behaviours[1]. Globally, the prevalence of ASD has risen in recent decades, indicating that it is a growing public health concern with a multifactorial etiology and complex multisystemic manifestations[2,3]. Although ASD is primarily diagnosed based on behavioral criteria, increasing evidence highlights the relevance of physiological comorbidities involving the oral and endocrine systems[4].

Oral health disturbances are frequently reported among children with ASD, including higher rates of dental caries, gingival inflammation, and changes in oral microbial composition. Recent investigations have shown that children with ASD often harbor a greater abundance of *Candida* species — particularly *Candida albicans* (*C. albicans*) — compared with neurotypical peers, reflecting broader microbial dysbiosis across oral–gut ecosystems[5]. This oral microbial dysbiosis may be related to distinctive dietary patterns, oral sensory sensitivities, difficulties with oral hygiene practices, and possible immune dysregulation[4]. Oral candidiasis, commonly referred to as oral thrush, is a fungal infection primarily caused by the overgrowth of *C. albicans*, representing a frequent manifestation of disrupted oral microbial homeostasis that has been implicated in both local oral pathology and broader systemic conditions[6]. Furthermore, a preference for sugar-rich diets, often seen in children with ASD, may further promote an oral environment that fosters *Candida* overgrowth. Research now indicates that oral dysbiosis may also influence gut microbial imbalance through the oral–gut axis[7]. However, variability across populations and methodological differences continue to limit the establishment of a consistent oral microbiome profile in ASD[4,5].

Concurrently, increasing attention has been directed towards neuroendocrine dysregulation in ASD, particularly involving the hypothalamic-pituitary-adrenal axis and pineal gland activity. Elevated salivary cortisol concentration is a marker of stress reactivity and has been reported in children with ASD, suggesting altered physiological responses to environmental stimuli[8]. In contrast, melatonin, which is central to circadian regulation and sleep, is frequently reduced in this population and may contribute to sleep disturbances, anxiety, and behavioral challenges[9]. As a result, melatonin-targeted therapies have been explored as adjunctive interventions for sleep and behavioral symptoms in ASD[10].

Saliva has emerged as a valuable biological fluid for non-invasive biomarker assessment in pediatric research[11]. It enables the simultaneous evaluation of microbial presence and neuroendocrine markers without the discomfort associated with blood sampling. Recent technological advancements have improved the accuracy of salivary analysis for cortisol and melatonin[12]. However, as studies have not integrated assessments of neuroendocrine function with measures of oral fungal colonization in ASD, it remains unclear whether increased oral fungal load is incidental or potentially related to stress-related and circadian hormone disturbances characteristic of ASD.

The aim of this study was to address the major knowledge gap regarding the interplay between oral *C. albicans* colonization and alterations in cortisol and melatonin levels among preschool-aged children with ASD. To do so, we quantified and compared the prevalence of oral *C. albicans* and salivary concentrations of cortisol and melatonin in children with ASD and matched neurotypical peers, and evaluated the associations between oral *C. albicans* load and these neuroendocrine biomarkers.

Methods

Ethical approval

The study was approved by the appropriate ethical bodies in Pristina and by an ethics committee in Zagreb. The Municipality of Pristina approved the research permit under municipal health and safety regulations (ref. no: 03-615/03-514). The study was also ethically reviewed and approved by the Dental Chamber of Kosovo under approval code 49/24.05.2024, as well as at the Ethics Committee of the University of Zagreb (file number 05-PA-6 29/2024). Parents or legal guardians provided written informed consent, which was obtained in accordance with the Declaration of Helsinki[13].

Study design and participants

This cross-sectional study was conducted in Pristina, Kosovo, across three institutions: the Centre for Rehabilitation and Education, the Clinical Psychology Specialist Clinic, and the Psychological Services Institution. Ninety children aged 4–6 years participated in the study: 45 with a clinical diagnosis of ASD and 45 typically developing (TD) peers. Children in the TD group were recruited from Pristina public preschools, with health status confirmed through the preschool registration database. Both groups were sampled simultaneously, ensuring equal numbers of male and female children.

The necessary sample size was determined utilizing the G*Power 3.1 application[14]. The minimum sample size was estimated at 72 participants, by incorporating initial data and assuming a medium effect size (Cohen's d = 0.6), along with a designated significance level ($\alpha = 0.05$) and statistical power ($1–\beta = 0.80$). In order to enhance statistical robustness and accommodate for attrition, a sample of 90 participants was selected for the research, comprising 45 individuals diagnosed with ASD and an equal number of individuals in the control group.

Eligibility criteria

The inclusion criteria were as follows: subjects aged 4 to 6 years; subjects diagnosed with ASD without intellectual disability (IQ ≥ 70) based on DSM-5 criteria, verified previously through standardized cognitive assessments such as the Vineland Adaptive Behaviour Scales and intelligence testing (e.g., Wechsler Preschool and Primary Scale of Intelligence and/or Raven's Progressive Matrices)[15-17]; Subjects without systemic conditions; Subjects whose parents agreed to participate.

The exclusion criteria were as follows: subjects with associated conditions such as epilepsy; subjects with genetic abnormalities (e.g., Fragile X or Rett Syndrome); children with an IQ < 70, indicating intellectual disability; subjects on antifungal or antibiotic therapy; subjects taking hormones (e.g., corticosteroids); subjects with hormonal disorders (e.g., hypothyroidism).

Data collection

Detection of C. albicans

Oral samples were taken from the dorsal surface of the tongue and from the buccal mucosa of the cheeks. A single calibrated examiner performed the sampling using sterile transport swabs (Sarstedt AG & Co. KG)[18]. The procedure was non-invasive and took place in a quiet, child-friendly environment, considering the sensory sensitivities and cooperation level of children with ASD. After collection, the swabs were placed directly into sterile transport tubes and sent to the laboratory for detection of *C. albicans.* In the laboratory, samples were cultured on Sabouraud Dextrose Agar following Calderone and Cihlar's protocols[19], supplemented with

chloramphenicol (0.05 g/L) and gentamicin (0.02 g/L). Plates were incubated aerobically at 37 °C for 24–72 h. Colonies consistent with *C. albicans* were counted, and CFU/mL was calculated for each sample. Identification was confirmed using chromogenic or biochemical media (CHROMagar, Paris, France).

Pre-study preparation and feasibility

Pilot testing was conducted one week before data collection with five preschool children who were not included in the main sample. The pilot assessed the clarity of the instructions and the feasibility of saliva collection procedures, and it confirmed full compliance and that adequate saliva volumes were collected. Although the pilot study successfully assessed the clarity of the instructions and the feasibility of the saliva collection procedures, the small sample size (n = 5) is acknowledged as a limitation of this preliminary testing, suggesting that further validation with a larger group would be beneficial.

Two weeks before saliva sampling, flashcards showing a dentist holding a dental mirror and a child undergoing an oral examination were given to the children. This series of cards helped children on the autism spectrum to become familiar with the setting of their upcoming oral examination and saliva sampling, and feel more relaxed about it. The approach supported parents to actively prepare their children for the clinical sampling procedures prior to the study visit as well as reduce anxiety, and increase and improve compliance during saliva collection.

Saliva collection

Saliva samples were collected during visits to therapeutic centers operating in late hours, under dim lighting (< 30 lx), following standard collection procedures, and were assessed by a single calibrated examiner.

Unstimulated saliva samples were collected between 20:00 and 21:00 h, reflecting the atypical hormonal patterns commonly observed in children with ASD. Saliva samples were collected using Salivette® devices (Sarstedt AG and Co., Nümbrecht, Germany)[20]. Children refrained from food, beverages (except water), and oral hygiene products for at least 30 min prior to sampling. After a water rinse, the absorbent swab was placed passively under the tongue or between the cheek and gum for 1–2 minutes. Samples were stored immediately at −20 °C. In the laboratory, samples were thawed, centrifuged, and analyzed for cortisol and melatonin using competitive ELISA kits (DRG Instruments GmbH, Marburg, Germany)[21]. Readings were performed at 450 nm using a spectrophotometer, following the manufacturer's instructions. Results were reported in nmol/L for cortisol and pg/mL for melatonin. Hormone concentrations were expressed in ng/mL (cortisol) and pg/mL (melatonin).

Data analysis

Data analysis was performed using Statistica 7.1 for Windows and SPSS Statistics 23.0 (IBM, Armonk, NY). Statistical significance was set at $P < 0.05$. Continuous variables were assessed for normality. Group differences in *C. albicans* prevalence were analyzed using the Chi-square test. Non-normally distributed hormone and colony count data were compared using the Mann-Whitney U test. Associations between fungal load and hormone levels were examined using Spearman's rank correlation analysis. Logistic regression was used to assess whether age, sex, cortisol, or melatonin predicted fungal presence. In addition to these analyses, multiple linear regression models were implemented to assess how melatonin, age, and the presence of *C. albicans* affect cortisol levels.

Results

Descriptive analysis

Ninety children, aged 4 to 6 years, participated in this study, divided into two groups: 45 children diagnosed with ASD (mean age 4.84 ± 0.77; ± 95.00% CI: 4.61-5.07) and 45 children in a TD group (mean age 5.07 ± 0.72; ± 95.00% CI: 4.85-5.28).

Table 1 presents the descriptive statistics for *C. albicans*, cortisol, and melatonin levels in children from both study groups. The levels of *C. albicans* and cortisol in the ASD group were significantly higher than those in the control group, while

Table 1. Comparison of studied parameters between the ASD and control group

Variable	Group	Valid N	Mean (SD)	(95% CI)	Median (min-max)	Z adjusted	*P* value
C. albicans	Control	45	55.56 (15.89)	(50.78-60.33)	50.00 (50.00-100.00)		
	ASD	45	67.78 (24.20)	(60.51-75.05)	50.00 (50.00-100.00)	2.73	**0.006**
Cortisol	Control	45	1.13 (1.07)	(0.81-1.45)	0.85 (0.04-6.20)		
	ASD	45	3.60 (4.54)	(2.23-4.96)	2.10 (0.15-27.40)	5.21	**0.000**
Melatonin	Control	45	15.27 (10.10)	(12.23-18.30)	14.90 (0.57-40.20)	-1.99	**0.04**
	ASD	45	11.16 (8.76)	(8.53-13.79)	10.60 (0.01-35.20)		

* Mann-Whitney U Test

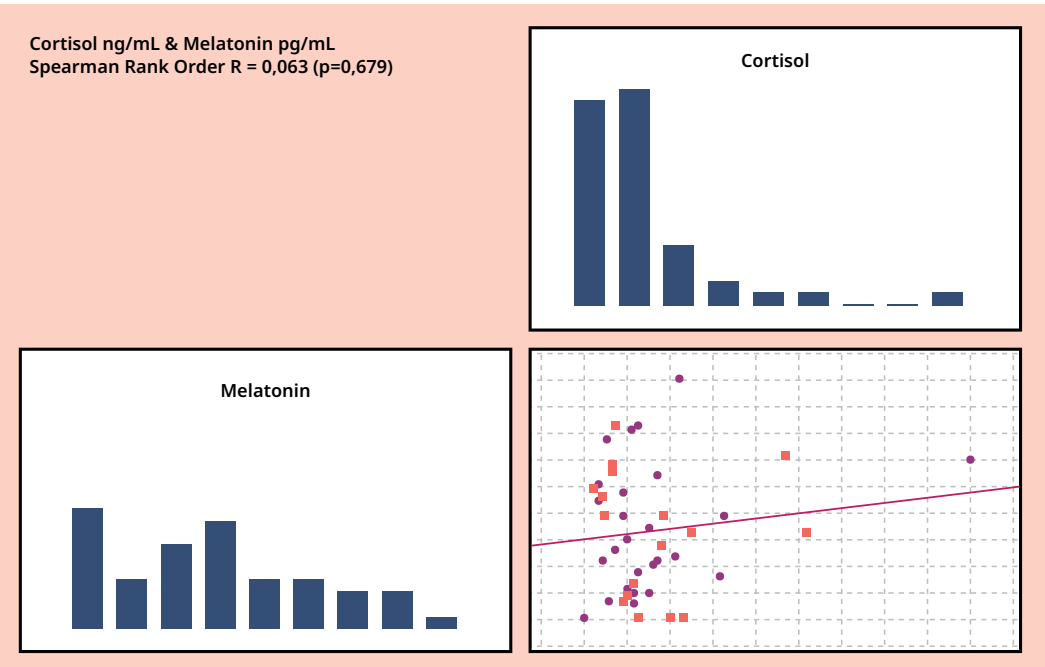


Figure 1. Correlation between melatonin and cortisol levels in the control group.

melatonin levels in the control group were significantly higher than those in the ASD group.

Single correlations

Figures 1 and 2 illustrate the correlation between cortisol and melatonin levels in the control group (Figure 1) and the ASD group (Figure 2). In the control group, the increase in melatonin was associated with a decrease in cortisol, with ρ = –0.06 and P = 0.679, indicating a very weak, non-significant negative correlation. In the ASD group, the increase in the value of melatonin pg/mL was associated with an increase in the value of cortisol ng/mL, where a moderately weak, insignificant positive correlation was determined for ρ = 0.20, P = 0.192. Furthermore, no significant difference was observed in Spearman's rho values between the control and ASD groups (P > 0.05) concerning the relationship between melatonin and cortisol, as well as between cortisol and melatonin levels with the number of *C. albicans* colonies in either group (Figure 3, 4).

Multiple regression analysis

A multiple regression analysis was performed to assess the relationship between cortisol (dependent variable) and melatonin, *C. albicans* presence (positive/negative), and age (independent variables). In both the control (R = 0.336, F = 1.269, P = 0.298, Durbin–Watson = 2.320) and ASD groups (R = 0.348, F = 1.375, P = 0.260, Durbin–Watson = 2.278), a moderately strong but non-significant correlation was observed (P > 0.05).

In the control group, the presence of *C. albicans* had the largest effect on cortisol (Beta = 0.253, P = 0.112), followed by age and melatonin. The

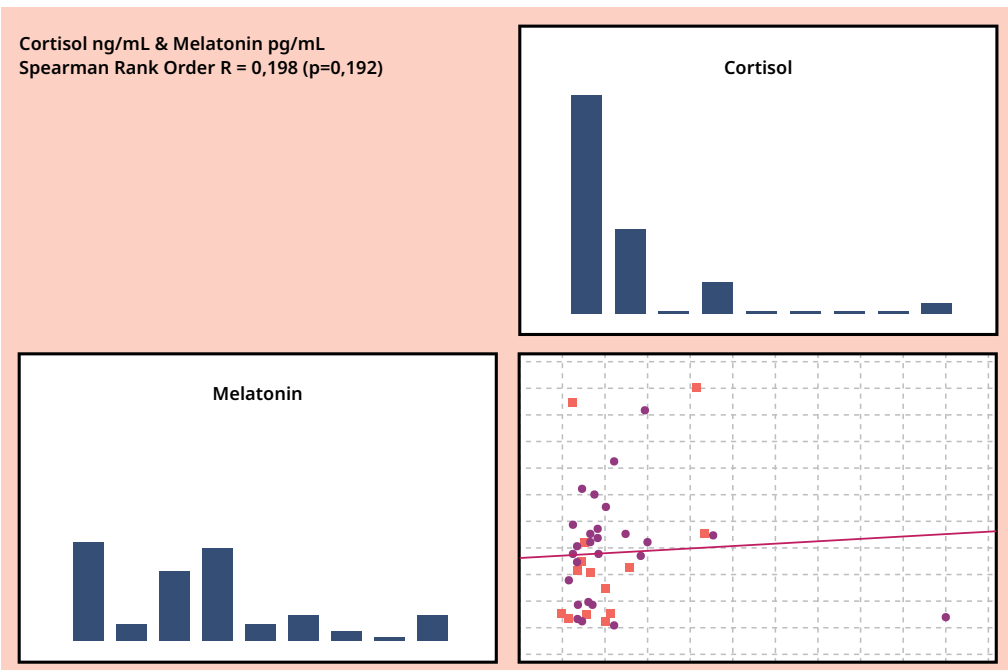


Figure 2. Correlation between melatonin and cortisol levels in the ASD group.

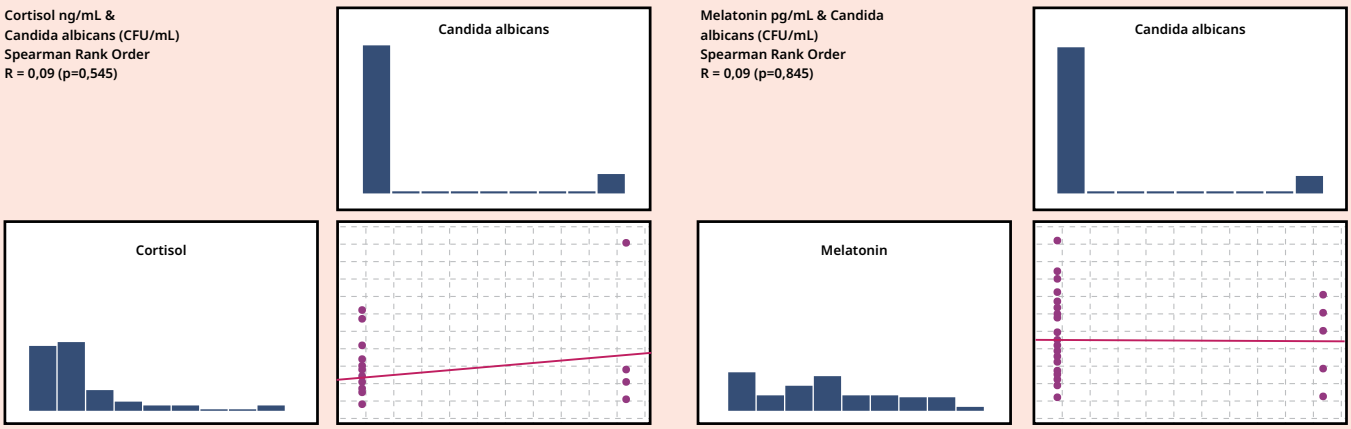


FIGURE 3. Correlation between melatonin and cortisol levels with *C. albicans* in the control group

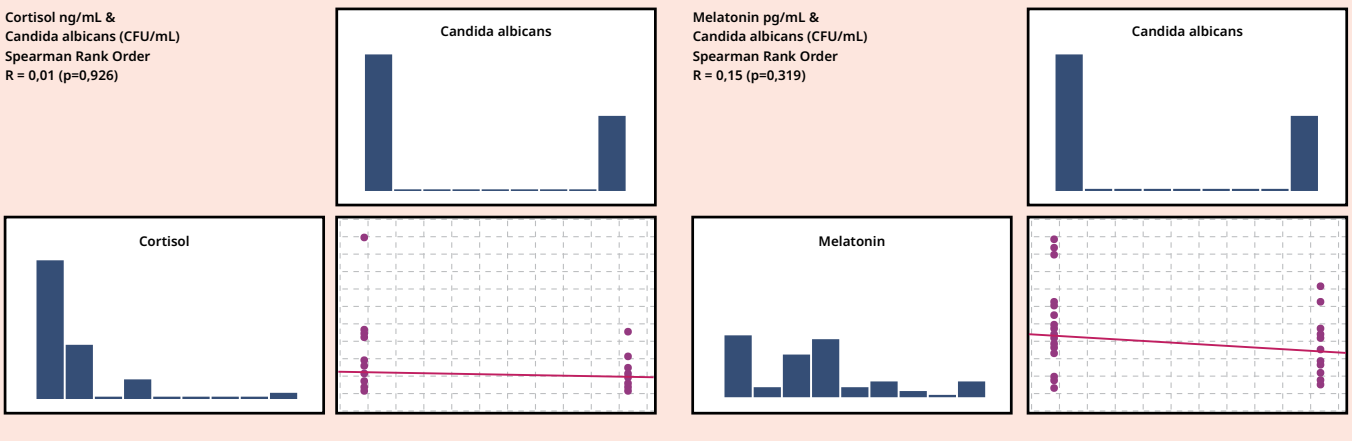


FIGURE 4. Correlation between melatonin and cortisol levels with *C. albicans* in the ASD group

presence of *C. albicans* was associated with a 0.850-unit increase in cortisol (B = 0.850) compared to its absence, but this was not significant when other variables were held constant. Each one-year increase in age was associated with a 0.208-unit decrease in cortisol, also non-significant when other variables were held constant. A one-unit increase in melatonin was associated with a 0.013-unit increase in cortisol, again non-significant when other variables were held constant (Table 2).

In the ASD group, age had the greatest influence on cortisol, followed by *C. albicans* presence and melatonin. Each one-year increase in age was associated with a 1.971-unit increase in cortisol, which was significant ($P = 0.032$) when other variables were held constant. The presence of *C. albicans*

Table 2: Multiple regression analysis of studied parameters in the ASD and control groups

Group	Model	Unstandardized coefficients		Standardized coefficients	t	*P* value	95.0% Confidence interval for B	
		B	Std. error	Beta			Lower bound	Upper bound
Control	(Constant)	2.208	1.333		1.656	.106	(.487)	4.902
	Age	(.208)	.229	(.141)	(.910)	.369	(.671)	.255
	C. albicans	.850	.523	.253	1.626	.112	(.206)	1.907
	Melatonin	.013	.016	.120	.802	.427	(.019)	.045
ASD	(Constant)	-5.947	4.654		-1.278	.209	-15.353	3.458
	Age	1.971	.886	.333	2.225	**.032**	.181	3.760
	C. albicans	-1.288	1.446	(.137)	(.890)	.379	-4.211	1.635
	Melatonin	.002	.079	.005	.031	.976	(.157)	.162

a. Dependent Variable: cortisol

Table 3. Binary logistic regression of studied parameters for *Candida albicans* presence in the ASD and control group

Group			B	S.E.	Wald	df	*P* value	Exp(B)	95% CI for EXP(B)	
									Lower	Upper
Control	Step 1[a]	Sex (1)	-1.788	1.693	1.115	1	.291	.167	.006	4.622
		Age	(.743)	.881	.711	1	.399	.476	.085	2.676
		Cortisol	.962	.537	3.204	1	.073	2.616	.913	7.495
		Melatonin	.002	.062	.001	1	.976	1.002	.887	1.132
		Constant	-1.534	4.795	.102	1	.749	.216		
ASD	Step 1[a]	Sex (1)	(.701)	.735	.909	1	.340	.496	.118	2.095
		Age	.292	.479	.372	1	.542	1.339	.524	3.422
		Cortisol	(.040)	.089	.199	1	.656	.961	.806	1.145
		Melatonin	(.055)	.045	1.452	1	.228	.947	.866	1.035
		Constant	-1.672	2.203	.576	1	.448	.188		

a. Variable(s) entered in step 1: sex, age, cortisol, melatonin.

was associated with a 1.228-unit decrease in cortisol compared to its absence, but this was not significant when other variables were held constant. A one-unit increase in melatonin was associated with a 0.002-unit increase in cortisol, which was not significant when other variables were held constant (Table 2).

Binary logistic regression

To determine the predictive values of sex (boy = 1; girl = 0), age, cortisol, and melatonin for the presence of *C. albicans*, binary logistic regression (Enter model) was applied.

In the control group, when assessing the significance of each factor in predicting the presence of *C. albicans*, cortisol had the greatest impact (Wald = 3.204, $P = 0.073$), followed by sex (1), age and melatonin (Table 3). Thus, a one-unit (1 ng/mL) increase in cortisol increased the risk of *C. albicans* presence by 161.6% (Exp(B) = 2.616, 95% CI 0.913–7.495), though this result was not statistically significant ($P = 0.073$, > 0.05). Boys had a 0.167 times lower risk of *C. albicans* presence compared to girls, which was also not statistically significant. A one-unit increase in age reduced the risk of *C. albicans* presence by 52.4%, but this was not statistically significant. A one-unit (1 pg/mL) increase in melatonin increased the risk of *C. albicans* presence by 0.2%, but this result was not significant ($P = 0.976$, > 0.05).

In the ASD group, melatonin had the greatest impact, followed by sex (1), age, and cortisol (Table 3). Thus, a one-unit increase in melatonin reduced the risk of *C. albicans* presence by 5.3%, which was not statistically significant. Boys (sex = 1) had a 0.496 times lower risk of *C. albicans* presence compared to girls, but this was not significant. A one-unit increase in age increased the risk of *C. albicans* presence by 33.9%, but this was not statistically significant. A one-unit increase in cortisol reduced the risk of *C. albicans* by 3.9%, which was not significant.

Discussion

The increased *C. albicans* presence in children with ASD compared to typically developing peers observed in our study aligned with the results reported in previous case-control studies. Similar findings have been reported, demonstrating a significantly higher prevalence of *C. albicans* in individuals with ASD, accompanied by an increased susceptibility to oral health problems[22,23]. Our findings extended this knowledge to preschool-aged children, implying that dysbiosis may be evident before school age. Higher cortisol and lower melatonin levels in our ASD cohort mirrored the endocrine profiles reported in systematic reviews of circadian and autonomic dysfunction in ASD[24]. Recent cross-sectional evidence in preschool and school-aged children with ASD further supports this observation, demonstrating that specific sleep characteristics are associated with alterations in salivary cortisol and melatonin levels, while these hormones do not act as independent predictors of clinical outcomes[25]. We also noted a threefold higher cortisol concentration and a threefold increase in *Candida* positivity in ASD participants, supporting the hypothesis that stress-related hormonal dysregulation may foster fungal overgrowth.

Experimental studies have shown that melatonin possesses antifungal properties, including direct inhibitory effects on *C. albicans* in vitro[26]. In addition to its species-specific activity, melatonin has been reported to modulate fungal community structure and influence the balance of bacterial and fungal populations under abiotic stress conditions[27]. Furthermore, recent evidence highlights melatonin's broader roles in fungal morphogenesis, stress tolerance, and cellular homeostasis, supporting its potential relevance in fungal biology and pathogenesis[28]. Thumb-sucking children with lower salivary melatonin had more *C. albicans* and caries lesions[29]. Our observation of reduced melatonin in ASD children with higher fungal loads is consistent with these reports and

suggests a potential protective role of melatonin in oral mucosal immunity. In addition, clinical reports emphasize that factors such as drooling, which is common among children with developmental disorders, may contribute to perioral skin breakdown and increase susceptibility to *candidal* infections, underscoring the importance of structured oral care and early clinical assessment in this population[30]. Conversely, elevated cortisol has been associated with decreased salivary flow and buffering capacity, as well as with increased counts of cariogenic bacteria and *C. albicans* in saliva[31,32]. The combination of high cortisol and low melatonin in ASD children may therefore create an oral environment conducive to fungal proliferation and biofilm formation with cariogenic bacteria[33].

Notably, our regression analyses did not identify melatonin or cortisol as independent predictors of *Candida* colonization. This finding is consistent with evidence from studies in children with neurodevelopmental disorders showing no significant differences in salivary cortisol levels when comparing subgroups with and without gastrointestinal symptoms, suggesting that cortisol variability may be influenced by comorbidities rather than diagnostic category alone[34].

This suggests that hormonal dysregulation alone may not drive fungal overgrowth, but might act in concert with diet, oral hygiene, immune status, and the bacterial community.

Increased oral colonization by *C. albicans* in children with ASD may also be influenced by clinical and treatment-related factors. Review-based evidence suggests that commonly prescribed medications in this population can induce chronic xerostomia, thereby reducing the protective antimicrobial function of saliva and increasing susceptibility to oral infections such as oral candidiasis[35]. Dietary patterns high in fermentable carbohydrates, selective eating behaviors, and exposure to antibiotics or anticonvulsants in ASD may facilitate fungal persistence[23,36]. Future studies incorporating dietary records, oral hygiene practices, and microbial profiling may help clarify the pathways linking hormones and oral dysbiosis.

Several mechanisms could underpin the observed associations. Elevated cortisol reflects the activation of the hypothalamic-pituitary-adrenal axis and may result from chronic stress, anxiety, or sleep disturbances common in ASD. Cortisol reduces salivary secretion, and suppresses the innate immune defense, thereby facilitating fungal and bacterial growth. Melatonin, which is produced by the pineal gland, regulates circadian rhythms, and has antioxidant and immunomodulatory properties. Decreased melatonin could impair mucosal immunity and disrupt the balance of the oral microbiota. Experimental studies showed that melatonin can inhibit *C. albicans* growth[26], and broader ecological research has indicated that melatonin modulates fungal communities under stress[27]. Thus, the combination of low melatonin and high cortisol may create a permissive niche for *C. albicans* colonization and caries development.

Study limitations

The study's cross-sectional design limited causal inference, and the single evening sampling may not have captured diurnal variations in hormone levels. Our sample size, although comparable with those in prior studies, may not have been large enough to detect subtle associations. Saliva was collected unstimulated, and stimulated flow rates might provide additional insights. Future longitudinal studies should assess the temporal relationship between hormonal fluctuations, microbiota dynamics, and oral health in ASD, ideally integrating multi-omics approaches to characterize the bacterial and fungal communities. Interventions targeting diet, stress management, and/or melatonin supplementation could then be evaluated.

Conclusion

Preschool children with ASD exhibited significantly higher oral colonization by *C. albicans*, elevated salivary cortisol levels, and reduced melatonin concentrations compared to typically developing peers. Although these hormonal parameters did not independently predict fungal presence, their co-occurrence may reflect a salivary environment more favorable to fungal overgrowth, particularly in the context of behavioral and immunological vulnerabilities associated with ASD. Early monitoring of oral microbiota and stress-related hormones may support preventive strategies aimed at preserving both oral and systemic health in children with ASD.

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SAŽETAK

Kolonizacija usne šupljine *Candidom albicans* te biomarkeri stresa i spavanja u slini kod predškolske djece s poremećajem autističnog spektra: presječno istraživanje

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Poremećaj iz autističnog spektra (PAS) neurološki je razvojni poremećaj povezan s mikrobnim i neuroendokrinim promjenama. Naš je cilj bio procijeniti prevalenciju *Candide albicans* (*C. albicans*) u usnoj šupljini, kao i razine hormona u slini kod predškolske djece s dijagnozom PAS-a, kako bismo istražili potencijalnu vezu između količine gljivica i neuroendokrinih markera. Presječno istraživanje obuhvatilo je 90 djece u dobi od četiri do šest godina (45 s PAS-om i 45 vršnjaka u tipičnom razvoju). U obje skupine prikupili smo oralne uzorke i uzorke sline. Oralni uzorci prikupljeni su za otkrivanje kolonija *C. albicans*, dok se u uzorcima sline analizirala razina kortizola i melatonina pomoću ELISA tehnike. *Candida albicans* imala je značajno veći broj kolonija u skupini s PAS-om. Otkrivena je kod 35,6 % djece s PAS-om u usporedbi s 11,1 % kontrolne skupine ($P = 0,006$). Osim toga, djeca s PAS-om pokazivala su povišene razine kortizola u slini ($P < 0,001$) i smanjene koncentracije melatonina ($P = 0,04$). Međutim, nisu pronađene značajne korelacije između opterećenja *C. albicans* i razine hormona. Dob je bila jedini značajan prediktor kortizola u skupini s PAS-om, dok je logistička regresija otkrila neznačajne trendove. Djeca s PAS-om pokazala su povećanu kolonizaciju *C. albicans*, povišen kortizol i smanjene razine melatonina u usporedbi s kontrolnom skupinom. Iako nisu utvrđene izravne veze između razine hormona i prisutnosti gljivica, ovi rezultati naglašavaju potencijalnu neuroendokrino-mikrobnu neravnotežu u PAS-u, što opravdava daljnja istraživanja s većim uzorcima i longitudinalnim tipom istraživanja.

KLJUČNE RIJEČI

Poremećaj iz autističnog spektra; *Candida albicans*; *Biomarkeri u slini*; *Kortizol*; *Melatonin*; *Oralna mikrobiota*