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Comparison of Ophthalmic Findings Between Obese and Healthy Children

Obez ve Sağlıklı Çocuklarda Oftalmik Bulguların Karşılaştırılması

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ABSTRACT Objective: Obesity is becoming a serious health problem in pediatric population. There is limited information about ophthalmic findings in childhood obesity. We aimed to investigate the ophthalmic findings in obese children and compare them with healthy ones. **Material and Methods:** Patients were divided into 2 groups according to their body mass index (BMI) percentiles; 49 obese children (BMI >95th percentile), 33 control subjects (BMI <85th percentile). Demographic features and ophthalmological examination including tear break up time, Schirmer 1 test with topical anesthesia, intraocular pressure (IOP), central corneal thickness (CCT), and biometric measurements were compared between the groups. **Results:** IOP, CCT, and anterior chamber depth (ACD) values were significantly lower in obese group than control group. The mean tear break up time and median Schirmer test values were similar between the groups [9.5±2.7 sc and 16 mm (interquartile range 8.5-23.5) in obese group, 9.6±2.1 sc and 10 mm (interquartile range 6.5-18) in control group; p=0.83 and p=0.093, respectively]. **Conclusions:** Our study demonstrated that IOP, CCT, and ACD values seemed to be lower in obese children. However, dry eye findings did not accompany obesity in these children.

Keywords: Dry eye syndromes; obesity; child; intraocular pressure

ÖZET Amaç: Pediatrik popülasyonda obezite ciddi bir sağlık sorunu haline gelmiştir. Çocukluk çağı obezitesinde oftalmik bulgular hakkında sınırlı bilgi mevcuttur. Bu çalışmada, obez çocuklarda oftalmik bulguların araştırılması ve sağlıklılarla karşılaştırılması amaçlandı. **Gereç ve Yöntemler:** Hastalar beden kütle indeksi (BKİ) yüzdeliklere göre 2 gruba ayrıldı; 49 obez çocuk (BKİ>% 95 persentil), 33 kontrol (BKİ <85 persentil). Demografik özellikler, gözyaşı kırılma zamanı (GKZ), topikal anestezi ile Schirmer 1 testi, göz içi basıncı (GİB), santral kornea kalınlığı (SKK) ve biyometrik ölçümleri içeren oftalmolojik muayene bulguları gruplar arasında karşılaştırıldı. **Bulgular:** Obez grupta GİB, SKK ve ön kamara derinliği (ÖKD) değerleri kontrol grubuna göre anlamlı olarak düşük bulundu. Ortalama GKZ ve medyan Schirmer test değerleri gruplar arasında benzerdi [obez grupta 9.5 ± 2.7 sn ve 16 mm (interkuartil aralık 8.5-23.5), kontrol grubunda 9.6 ± 2.1 sn ve 10 mm (interkuartil aralık 6.5-18); sırasıyla p = 0.83 ve p = 0.093]. **Sonuç:** Çalışmamız, obez çocuklarda GİB, SKK ve ÖKD değerlerinin daha düşük izlendiğini ortaya koymuştur. Ancak, kuru göz bulguları bu çocuklarda obeziteye eşlik etmemiştir.

Anahtar Kelimeler: Kuru göz sendromları; obezite; çocuk; intraoküler basınç

Childhood obesity (CO) has become epidemic over the world. In terms of estimates, 200 million school-age children are overweight /obese and 40-50 million of them are obese.[1] Worldwide, there is a progressive increase in CO, reaching approximately 13-21% in Turkey, and 16.5% in European countries (WHO, 2012). Because of obesity leads hypertension, dyslipidemia, diabetes, insulin resistance, cardiovascular disease at an early age, deterioration in bone health, skin problems and psychological stress, it is a major cause of morbidity.[1]

We are interested in ocular manifestations in CO. CO is characterized by a low-grade inflammation status depending on the multicellular release of cytokines, adipokines, and reactive oxygen species.[1,2] We have hypothesized that dry eye, as an inflammatory disease, may be correlated with obese children based on the role of this inflammation in CO. We have realized that there is no data about Schirmer test and tear break up time (TBUT) values and limited information about biometric findings in obese children in literature. In addition, there is not a consensus on intraocular pressure (IOP) of obese children. Some authors argue that obesity increases due to an excessive intraorbital adipose tissue deposit, leading to a rise in blood viscosity and episcleral venous pressure, and a consequent decrease in the facility of aqueous outflow.[3] But some studies have shown no correlation among body mass index (BMI), IOP and central corneal thicknesses (CCT) in children.[4,5]

Thus, we aimed to investigate the ophthalmic findings including ocular surface clinical parameters, biometric measurements together with IOP and CCT in CO and compare them with healthy ones.

MATERIAL AND METHODS

This study was undertaken as a prospective analysis from January 2016 through March 2016. Eighty two patients who referred by our pediatric endocrinology department and department of pediatrics to our ophthalmology outpatient clinic, were enrolled consecutively in this study. The inclusion criteria for the study groups were primary obesity (BMI > 95th percentile for sex and age) and control subjects (BMI < 85th percentile for sex and age) aged 7 to 17 years, without recent or chronic illnesses. Exclusion criteria included over-weight children (85th-95th percentiles for BMI), previous glaucoma, orbital masses, severe myopia (>6D), diseases of the ocular surface, contact lens wearers, or the presence of diabetes mellitus, cardiovascular, renal, neurological, thyroid, mental or metabolic disorders and genetic syndromes.

Each patient underwent full ophthalmologic examination including best-corrected visual acuity, biomicroscopic anterior segment and fundus examination, and IOP measurement by noncontact tonometer (Reichert 7 CR Corneal Response Technology, USA). Three consecutive IOP measurements were taken for each eye and the mean value was recorded. Visual acuity test results, detection of significant refractive errors following cycloplegia, and ocular alignment findings based on cover-uncover, alternate cover, and Hirschberg testing were recorded for each patient. Snellen testing was used to determine visual acuity. Cycloplegic retinoscopy and fundus examination following dilation of the pupils with cyclopentolate 1% were also performed. The refractive status of each patient was assessed using a hand-held automated refractometer (SureSightTM autorefractor, Welch Allyn, Skaneateles Falls, NY). The ultrasonic pachymeter and A-mode biometry probe (Nidek US-4000 Echoscan, Japan) were used to determine CCT and biometric parameters (anterior chamber depth, lens thickness, vitreous depth and axial length), respectively. After administering topical proparacaine hydrochloride 0.5% (Alcaine ophthalmic solution, Alcon, Turkey), measurements were taken with the tip of the probe targeting the center of the pupil and perpendicular to the cornea while the subject was looking at a fixed target. The probe was sterilized with alcohol after each subject was examined. At least 5 consecutive measurements were obtained for each eye and the mean value was recorded. TBUT and Schirmer 1 test with topical anesthesia were performed to all patients 30 minutes after full ophthalmologic examination. The TBUT was measured after fluorescein staining. Subjects were instructed to blink, and the tear film was examined using the cobalt blue filter of a slit-lamp biomicroscope. The time interval in seconds between the instilment of fluorescein and the appearance of the first randomly distributed dry spot was enrolled as the TBUT. This method was repeated three times for each eye, and the average of the results was registered as the mean TBUT. TBUT of less than 10 seconds was accepted as abnormal. [6] Corneal fluorescein staining was evaluated using cobalt blue illumination following the 15-point NEI/Industry scale (grades of 0-3 for five regions of the ocular surface), after TBUT measurements.[6] The Schirmer 1 test was applied by placing a standardized strip of filter paper in the 1/3 lateral tarsal conjunctiva away from the cornea. Outcomes were expressed in millimeters after 5 minutes of wetting.[6]

Prevalence of obesity was defined using BMI percentiles for age and sex. Obesity in children was defined as a BMI greater than the 95th percentile for age and sex according to the reference values for the Turkish pediatric population.[7] BMI was calculated based on the formula: BMI=[weight/ height ^{2} (kg/m^{2})].[8]

This study was carried out with the Institutional Review Board/Ethics Committee approval. The research adhered to the tenets of the Declaration of Helsinki. Informed consent was obtained from all parents after explaining the nature and purpose of the study.

STATISTICAL ANALYSIS

All analyses were performed using the Statistical Package for the Social Sciences (SPSS) for Windows (version 18.0, SPSS, Chicago, IL). Continuous variables are presented as mean ± standard deviation (SD) for normally distributed data or as medians and interquartile ranges for non-normally distributed data. Continuous variables were compared using Student's unpaired t tests or Mann-Whitney nonparametric U tests. Categorical variables were compared using chi-square statistics. A two-tailed p value<0.05 was considered as significant.

RESULTS

The mean ages were 11.09±2.83 years in obese group, and 12.3±2.45 years in control group (p=0.17). Twenty eight of 49 patients (57%) in obese group and 16 of 33 patients (48%) in control group were boy (p=0.44). The baseline demographic features of study subjects were shown in Table 1. The mean IOP, CCT, and anterior chamber depth (ACD) values were significantly lower in obese group than the control group (p= 0.02, p=0.049 and p=0.006, respectively). The baseline ophthalmic measurements of study subjects were shown in Table 1. The mean TBUT and the median Schirmer test values were similar between the groups [9.5±2.7 sc and 16 mm (interquartile range 8.5-23.5) in obese group, 9.6±2.1 sc and 10 mm (interquartile range 6.5-18) in control group; p=0.83 and p=0.093, respectively]. None of the patients had corneal staining in either group. The 20% of patients in obese group and %15 of patients in non obese group have complained dry eye symptoms as; irritation, foreign body sensation, burning, presence of stringy mucus discharge and transient blurring of vision. But the difference between groups

TABLE 1: Baseline demographic features and ophthalmic measurements of study subjects

Variable	Obese Group (n =49)	Control Group (n = 33)	p
Age (years)	11.09±2.83	12.3±2.45	0.17
Gender (boy)	28	16	0.44
Body mass index (kg/m2)	27.90±5.34	23.58±3.23	<0.01
Hypertension	6	0	0.03
Central corneal thickness (µm)	542.5±33.6	560±38.0	0.049
Intraocular pressure (mmHg)	14.63±1.68	15.71±2.49	0.02
Schirmer test (mm) median (interquartile range)	16 (8.5-23.5)	10 (6.5-18)	0.093
Tear break-up time (sc)	9.5±2.7	9.6±2.1	0.83
Axial length (mm)	23.16±1.1	23.56±1.26	0.20
Lens thickness (mm)	3.56±0.2	3.56±0.3	0.98
Anterior chamber depth (mm)	3.5±0.25	3.7±0.28	0.006
Vitreous chamber depth (mm)	15.87±2.1	16.4±0.7	0.20

was not significant (p=ns). Thirty three of patients were emmetropic and 4 patients had anisometropia in obese group, 17 patients were emmetropic and 3 patients had anisometropia in control group. Spherical values were between -4.25 and +3.0 D in obese group, -0.75 and -3.0 in control group. All astigmatism values were recorded in plus cylinder; cylindrical values were between +0.50 and +3.00 D in both groups. Refractive errors of study subjects were shown in Table 2. Only 1 patient had strabismus (esodeviation) in obese group. Ophthalmic pathologies of study subjects were also shown in Table 2.

DISCUSSION

To the best of our knowledge, this is the first study that demonstrates and compares the Schirmer test and TBUT values of obese children with non-obese pairs. We have not found significant differences in terms of these parameters between the groups.

Obesity is associated to a condition of both systemic inflammation and impaired immunity.[1,2] The increased inflammatory state that accompanies obesity, insulin resistance and endothelial dysfunction is considered to be a chronic low-grade inflammation, generally associated with high concentrations of leukocytes, fibrinogen and other inflammatory biomarkers, such as high-sensitivity C-reactive protein.[9,10] Dry eye involves a localized immune-inflammatory response. However, in a recently online published study, it has been shown that neutrophil-to-lymphocyte ratio, as a systemic inflammatory marker, is associated with non-Sjögren dry eye patients.[11] Given the role of the inflammation in obesity, we have hypothesized that dry eye, as an inflammatory disease, might be correlated with obesity in these children. However, we have noticed no correlation between the ocular surface clinical parameters in our study population groups.

Some epidemiological studies have described an association between obesity and IOP in adults.[12,13] Association between higher BMI and higher IOP in adults was concluded in a recent review.[14] Excessive intraorbital adipose tissue deposits may lead to elevated IOP by increasing the episcleral venous pressure. Akinci et al. found that CO was an independent risk factor for increased IOP.[3] In contrast to this study, Albuquerque et al. did not show a correlation between BMI and IOP in children.[4] In the study of Koçak et al., there were no significant differences in IOP measurements, central corneal thicknesses, cup/disc ratios and visual field parameters between obese and normal children. No significant correlation was found between obesity and glaucoma or elevated IOP in children. [5] Obesity was not associated with a larger vertical cup-disc ratio in another study.[15] Higher IOP was associated with the nonocular parameters of female sex, higher BMI, younger age, maternal myopia and with the ocular parameters of longer axial and smaller corneal horizontal diameter.[16] And we have found significantly decreased IOP

TABLE 2: Ophthalmic pathologies and refractive errors of study subjects.

Variable	Obese Group (n =49)	Control Group (n = 33)	p
Strabismus	1 (2.04%)	0 (0%)	0.41
Lens opacities	1 (2.04%)	1 (3.03%)	0.79
Eryblepharon	1 (2.04%)	0 (0%)	0.40
Refractive errors			
Myopia	5 (10.2%)	7 (21.2%)	0.19
Hypermetropia	2 (4.08%)	0 (0%)	0.23
Simple myopic astigmatism	3 (6.12%)	4 (12.12%)	0.37
Compound myopic astigmatism	3 (6.12%)	4 (12.12%)	0.37
Mix astigmatism	3 (6.12%)	1 (3.03%)	0.49
Amblyopia	4 (8.16%)	3 (9.09%)	0.92

and CCT values in obese children. This may be due to the small size of our study population. In the study of Saw et al. has mentioned heavier children had more hyperopic refraction and shorter vitreous chambers in their study population similar to the findings of our study.[17] Shorter ACD and vitreous chamber depth can be related to this higher frequency of hyperopic refraction in obese children. In our study, ACD values were significantly lower in obese children, too. These children seem to have higher frequency of hyperopic refraction in our study. However, there was not a significant difference in terms of refraction measurements, axial length, lens thickness, and vitreous chamber depth between our study groups.

In adolescents, greater body fat deposition is related to narrower retinal arterioles and wider retinal venules.[18] Even during childhood, body composition might have an association with systemic microvasculature.[18] A strong and independent association between adiposity and blood pressure was present during early childhood. These data have important public health implications because elevated blood pressure at a young age may be associated with increased cardiovascular risk in later life.[19] In our study; 6 patients in obese group had hypertension, and 1 of them had hypertensive retinopathy.

Our study has several limitations. First, the study was a single center study. Second, we assessed a relatively small number of subjects. Third, we were unable to detect inflammatory markers such as high-sensitivity C-reactive protein and interleukin-6 of patients which would support inflammation in CO.

In conclusion, we have demonstrated that IOP, CCT, and ACD values seem to be lower in obese children; however, dry eye findings do not accompany obesity in this population. Since the association of CO with ocular findings has not been fully understood, the role of CO on ocular findings can be further investigated in extended series.

Conflict of Interest

Authors declared no conflict of interest or financial support.

Authorship Contributions

Study conception and design: *Bengi Ece Kurtul, Zehra Aycan, Pinar Altiaylik Ozer, Emrah Utku Kabatas, Ayla Akca Çağlar;* ***Acquisition of data:*** *Bengi Ece Kurtul, Pinar Altiaylik Ozer, Emrah Utku Kabatas, Ayla Akca Çağlar, Erdal Kurnaz, Elvan Bayramoğlu;* ***Analysis and interpretation of data:*** *Bengi Ece Kurtul, Zehra Aycan;* ***Drafting of manuscript:*** *Bengi Ece Kurtul, Pinar Altiaylik Ozer, Emrah Utku Kabatas, Zehra Aycan.*

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