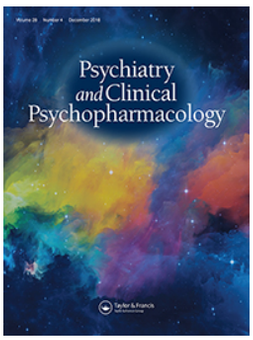

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Comparison of tidos with m-chat for screening autism spectrum disorder

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ABSTRACT

OBJECTIVES: Modified Checklist for Autism in Toddlers (M-CHAT) is widely used internationally to screen autism spectrum disorder (ASD). Three-item Direct Observation Screen (TIDOS) is a novel observational tool which may be used by physicians in a short time as a part of routine well-child visit. It includes the following: (a) Joint Attention, (b) Eye Contact, and (c) Response to Name. We aimed to compare the screening performance of TIDOS and M-CHAT for ASD.

MATERIAL AND METHODS: A total of 1345 children aged 16–38 months were examined during well-child care visits at Social Pediatrics Department of Ankara University between May 2015 and May 2016. Five hundred and eleven of 1345 children aged 16—38 months whose parents approved informed consent were enrolled in this study to evaluate the performance of two screening tests: TIDOS and M-CHAT for ASD. The children whose screening tests were positive and controls whose tests were negative had undergone clinical evaluation for the diagnosis of ASD. Clinical evaluation was performed within 2 weeks of the initial M-CHAT, M-CHAT/F, or TIDOS screenings for screening positive children and within 3–9 months for screening randomly selected negative children. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of those tests were determined.

RESULTS: ASD was diagnosed in 5 of the 511 children in a healthy child clinic of a university hospital with the prevalence of approximately 1%. All the children with ASD were boys. The growth parameters (including body weight, height, head circumference) did not have any properties. There were no consanguineous marriages among the parents of children with ASD. The ages of mothers and fathers of the children with ASD were in a range between 31–39 years and 31–46 years, respectively. The sensitivity for diagnosis of ASD was found to be 0.60 for both M-CHAT and M-CHAT/F tests. The specificity of M-CHAT and M-CHAT/F tests for diagnosis of ASD was found to be 0.96 and 0.97, respectively. PPV were found to be 0.14 and 0.18, respectively. The sensitivity for diagnosis of ASD was found to be 0.80 for TIDOS. Specificity and PPV in the diagnosis of ASD were found to be 0.99 and 0.80, respectively. NPV for all tests were above 0.99.

CONCLUSION: The current study has demonstrated that TIDOS was more sensitive and had higher PPV than M-CHAT. TIDOS has required little time and might be easily combined to routine physical examination of toddlers attending 18- to 36-month well-child clinic visits.

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KEYWORDS
Autism; screening; M-CHAT; TIDOS

Introduction

Autism spectrum disorder (ASD) is defined as a lifelong, neurodevelopmental disability and includes significant impairments in social interactions, communication, patterns of interests, and stereotyped patterns of behaviours. It requires extensive educational, vocational, and community support [1,2]. The prevalence of ASD is estimated to be around 0.5–1% [3,4]; this ratio was estimated to be higher (2.64 to 1.47%) in recent studies with the increased awareness of ASD [5,6].

Early diagnosis and interventions were critically important for young children with ASD [7]; so screening tools for ASD carry quite importance to improve the outcome of ASD. However, there were not any perfect screening tools for ASD. M-CHAT is a screening tool for ASD which is used worldwide.

There are many developmental screening tools available to practitioners [8]. Those screening tests are appropriate for young children with ASD who had language and cognitive delays. However, those became problematic for children with other developmental problems and are associated with high false-positive screening results. Parent-report tools often have the advantage of being easy, inexpensive, and practical in the office setting. Modified Checklist for Autism in Toddlers (M-CHAT) is one of those parent-report tools and widely used internationally for screening ASD. It was firstly modified from Checklist for Autism in Toddlers in 2001 [9] and revised with additional follow-up test in 2014 [10]. However, M-CHAT has high false-positive screening results for screening ASD and it leads to increase the concerns of the parents. In different countries, by the validation

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of M-CHAT, the outcomes for the M-CHAT for screening ASD were reported; Baduel et al. [11] from France and Yıkgeç [12] from Turkey reported that the use of as a screening tool of M-CHAT for ASD was not appropriate because of the high false-positive results of the test.

Similar to other developmental screening measures, most of the screening tools for ASD depend entirely on parent report. Parent-report tools often have the advantage of being easy, inexpensive, and practical in the office setting. However, some screening tools may require a direct observation or intervention of the clinicians. As regret to the recommendations of the American Academy of Pediatrics Council (AACP) [13], to add simple, easy-to-apply tests to the routine paediatrics examinations for younger children may support to early diagnose of ASD. Three-item Direct Observation Screen (TIDOS) is a simple observational test and it may be applied in any office settings. It may also be arranged to normal healthy child care visits. All trained health professionals easily may apply these direct observational items that included the following: (a) Joint Attention (following examiner's cues in observing an object with direct gaze or pointing gesture), (b) Eye Contact, and (c) Responsiveness to Name (called by examiner on four occasions). Its performance was firstly evaluated in 2014 [14] and the first reports had encouraged outcomes for its using for a screening tool [14].

An overarching goal of this innovative approach that has not been previously used [14] was to lower the likelihood of false-positive results and make screening otherwise more meaningful for public health authorities. Therefore, in the current study, we aimed to compare TIDOS with M-CHAT for ASD screening performance.

Material and methods

This study was conducted to evaluate the screening performance of two tests for ASD. A total of 1345 children aged 16–38 months were examined for healthy child care at Social Pediatrics Department of Ankara University between May 2015 and May 2016. Five hundred and eleven of 1345 children aged 16–38 months whose parents approved informed consent were enrolled to this study to evaluate the performance of two screening tests: TIDOS and M-CHAT for ASD. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of those tests were determined. This project received ethical approval from the Ankara University Institutional Review Board and the Ethics Committee and written informed consent was obtained from the parents of each participants.

The TIDOS measures were Joint Attention (following the examiner's verbal cues and pointing), Eye Contact, and Response to Name [14]. It can be combined to routine well-child clinic visits. It does not add any additional time to this routine visits. Joint Attention and Response to Name were scored as 0 if the response was normal, 1 if the response was not optimal, and 2 if the response was absent. Eye Contact was scored as normal (0) and abnormal (1). The first author (S.T) scored the observation items for all children. The TIDOS was accepted positive in the case of one of those three parameters had ≥ 1point. Children screened positive were invited to Child Psychiatry Clinic for clinical evaluation. Randomly selected screen-negative 25 children consisted of the controls and those children were also invited to Child Psychiatry Clinic for clinical evaluation.

The M-CHAT was designed as a self-administered, parent questionnaire for regular paediatric visits to screen for autism in toddlers [9]. The M-CHAT includes 23 "yes" or "no" items. The "yes" response is normal for 19 items, but is abnormal for item numbers 11, 18, 20, and 22. A child is considered as screen positive at the initial screening if he or she has abnormal answers for 2 of the 6 critical items or 3 of any 23 items. The critical items on the M-CHAT are as follows: item 2 (interest in other children), item 7 (proto-declarative pointing), item 9 (bringing objects to show the parent), item 13 (imitating), item 14 (responding to name), and item 15 (following a point). If the child screens positive, it does not constitute a diagnosis but indicates significant risk of autism, suggesting the need for evaluation with a gold standard test to diagnose autism.

The M-CHAT was originally validated for children between 16 and 30 months of age, but many studies have used an upper age limit of 36 months or more [12,15,16]. The M-CHAT was administered and scored by using previously published cut-offs. A positive screen was accepted if ≥2 of 6 critical items or ≥3 of 23 items were positive [9]. In the Turkish validation study, the item 6 (Does your child ever use his/her index finger to point, to ask for something?) was added to increase the sensitivity of the M-CHAT (12) and a positive screen was accepted if ≥2 of 7 critical items or ≥3 of 23 items were positive. M-CHAT/F screening test is made of asking the positive items to the parents with giving examples to increase the accuracy and to decrease the false-positive rate of M-CHAT. In the current study, M-CHAT/F screening test was performed immediately by the first author (S.T.). The filling up the M-CHAT test took approximately 10 min for parents and sequentially for the M-CHAT-positive subjects; it took approximately 5–10 min to complete the M-CHAT/F test. The time to complete the test was found similar as a previous study from Turkey [17]. The children whose both M-CHAT and M-CHAT/F screening tests positive were invited to Child Psychiatry Clinic for clinical

evaluation. Randomly selected screen-negative 25 children consisted of the controls and those children were also invited to Child Psychiatry Clinic for clinical evaluation. Diagnostic evaluation for both screen-positive and randomly selected screen-negative children was conducted by the same child psychiatrist according to Diagnostic and Statistical Manual of Mental Disorders, 5th Edition, (DSM-V) criteria for ASD [18]. The child psychiatrist, third author (O.O.) had known the screen-positive children; however, he was blind to which screening test was positive.

Clinical evaluation was performed within 2 weeks of the initial M-CHAT, M-CHAT/F, or TIDOS screening for screen-positive children and within 3–9 months for randomly selected screen-negative children.

Results

ASD was diagnosed in 5 of 511 children in a well-child clinic of a university hospital with the prevalence of approximately 1%. All the children with ASD were boys. The growth parameters (including body weight, height, and head circumference) did not have any properties. There were no consanguineous marriages among the parents of children with ASD. The ages of mothers and fathers of the children with ASD were in a range between 31–39 years and 31–46 years, respectively (Table 1).

The M-CHAT and TIDOS tests were applied to all 511 children. The time required for M-CHAT and M-CHAT/F tests were approximately 10 and 15 min, respectively. However, TIDOS measures were performed in the routine well-child clinic visits and did not require any additional time. M-CHAT results were positive in 46 of 511 children. M-CHAT/F was performed to all M-CHAT-positive children and M-CHAT/F was found positive in 18 of 46 M-CHAT-positive cases. The parents of 16 of 18 M-CHAT/F positive children and 5 of 28 M-CHAT-positive but M-CHAT/F negative children had accepted the clinical evaluation for diagnosis of ASD. Twenty-three children with positive M-CHAT and two children with positive M-CHAT/F screening tests did not approve clinical evaluation by child psychiatry. There were five TIDOS positive children and the parents of all those positive children had accepted the clinical evaluation for diagnosis of ASD by child psychiatry (Figure 1).

Three children who were M-CHAT and M-CHAT/F positive were diagnosed as ASD (Table 2). However, two children with ASD had negative M-CHAT and M-CHAT/F screening test results (Table 2). There were 5 of 511 children who had positive TIDOS test results. Four of five children with TIDOS positive test were diagnosed as ASD (Table 2). Fifty-one of 511 children had M-CHAT or TIDOS positive results. Five of those 51 children had diagnosed as ASD (Table 2).

The sensitivity for diagnosis ASD was found to be 60% for both M-CHAT and M-CHAT/F tests. The specificity of M-CHAT and M-CHAT/F tests for diagnosis of ASD was found to be 96% and 97%, respectively. Three of 21 M-CHAT-positive children and 3 of 16 M-CHAT/F-positive children were diagnosed as ASD (Table 2). PPV were found to be 14% and 18%, respectively (Table 3). The sensitivity for diagnosis of ASD was found to be 80% for TIDOS. Specificity and PPV in the diagnosis of ASD were found to be 99.8% and 80%, respectively (Table 3). NPV for all tests were above 99% (Table 3). The using of those tests together (M-CHAT or TIDOS positive) had 100% sensitivity with very low PPV 10% (Table 3).

One children (Case 3) with ASD had negative result for TIDOS; however, he had positive M-CHAT and M-CHAT/F tests. When we further evaluate the items of M-CHAT by one, we detected that he had taken positive results for item 2, 8, 20, and 22.

Discussion

In the present study, we aimed to examine whether direct observation items that consisted of measure of social interaction could provide a more sensitive and specific means of screening for ASD compared to the use of parent-based rating scales such as M-CHAT. The current study has demonstrated that TIDOS measures were more sensitive and had higher PPV than M-CHAT measures. Also, TIDOS has required little time and might be easily combined to routine physical examination of toddlers attending 18- to 36-month well-child clinic visits.

ASD is not a rare disease; its prevalence in Europe and North America was estimated approximately 6 per 1000 [19–21]. The Autism and Developmental Disabilities Monitoring (ADDM) Network reported ASD rates for 8-year-old children ranging from 1 in 303 to 1 in 94 in 2000 and in 2002 [22,23]. In Spain, 2055 children aged 18–36 months were screened and autism frequency was detected as 3/1000 [15]. In a previous community-based study in Turkey, ASD frequency was detected as 2 in 2021 [17]. The current hospital-based study screened 511 children aged 18–36 months in a well-child clinic and five male children were diagnosed as ASD. The prevalence of ASD was approximately 1/100 in current hospital-based study. We could not mention this rate (1/100) to all population; however, it was similar with ADDM Network report published in 2016, which found ASD prevalence 14.6 per 1000 (1/68) children aged 8 years [5].

The heightened awareness of ASD may result in early diagnosis and a tendency to increase the prevalence in recent studies. The admission of the parents to the professionals for ASD has increased due to the raised concern of the parents about ASD [24,25]. Early diagnosis and interventions were critically

Table 1. Characteristics of the children who were diagnosed as ASD.

Variables	Case 1	Case 2	Case 3	Case 4	Case 5
Age (months)	30	33	30	29	17
Gender	Boy	Boy	Boy	Boy	Boy
Birth weight (gr)	3000	3350	4000	3280	3180
Delivery route	C-section	C-section	C-section	C-section	C-section
Gestational age at birth (weeks)	39	39	40	38	36
Postnatal medical history	NS	NS	[a]Intracranial haemorrhage	NS	[b]Pneumonia
The order between the siblings	Second	Second	First	First	First
Body weight (kg)	13.6	21.5	14.5	14	13
Weight percentile (%)	25–50	>97	50–75	50–75	75–90
Height (cm)	98	102	92	94	88
Height percentile (%)	90–97	>97	25–50	50–75	90–97
Head circumference (cm)	50	51.1	49.5	50.9	51
Head Circumference (%)	50–75	75–90	25–50	75–90	90–97
Age of mother (years)	39	32	31	37	38
Education level of mother	University	University	High school	University	High school
Age of father (years)	46	34	31	34	43
Education level of mother	University	University	University	University	University
Are parents related?	No	No	No	No	No

Note: ASD: Autism Spectrum disorder, C-section: Caesarean section, NS: not significant.
[a]Intracranial haemorrhage due to falling down from height when he was 24-months aged.
[b]He had taken respiratory support due to pneumonia at the newborn period.

important for young children with ASD [7] because intensive early interventions may lead to the best long-term prognosis [26]. The median age at the diagnosis of ASD is child's fourth birthday; however, the median age at the diagnosis of ASD may delay more in children with low socio-economic status [27]. With the evaluation which was performed in an appropriate manner, ASD may be diagnosed before child's third birthday; AAP has already recommended screening at 18 and 24 months in routine well-child clinic visits [13]. In the current study, we diagnosed ASD in children aged 18–36 months.

Severe impairments in social interactions, communication, and restricted, repetitive, stereotyped patterns of behaviours, interests are typical features of ASD [18]. The diagnosis of ASD becomes difficult due to those wide heterogeneity of features. A few of the early social deficits are more associated with ASD [13]. One of those social deficits is joint attention. Impairment in joint attention arises very early among children with ASD [28,29]. Eye contact should begin in 5- to 6-months-aged children. Lack of eye contact is another feature which arises in the early period of life [13]. The other developmental feature which the children have quite early (8–10 months of age) is orientation to social stimuli, especially turning to respond his or her name and often deficit in children with ASD [30,31]. In a recent study, third author (O.O.) of the current study and his colleagues reported that the relevance to social interaction domain, ease of administration particularly with young children, and early developmental nature of the observational tasks not influenced by child's education and early environmental opportunity were the factors that why they had chosen these items [14]. In the first study that compares TIDOS with Social Communication Questionnaire for ASD screening, Oner et al. [14] found that the screening power of TIDOS was reassurance. The sensitivity, specificity, PPV, and NPV were 0.95, 0.91, 0.85, and 0.98 for any item positive TIDOS, respectively [14]. In the present study, we detected the sensitivity, specificity, PPV, and NPV as 0.80, 0.99, 0.80, and 0.99 for any item positive TIDOS,

Table 2. Evaluation of the results of M-CHAT, M-CHAT/F and TIDOS screening tests.

Variables	ASD positive *n* (%)	ASD negative *n* (%)
M-CHAT positive[a]	3 (60)	18 (3.7)
M-CHAT negative[a]	2 (40)	463 (96.3)
M-CHAT/F positive[b]	3 (60)	13 (2.7)
M-CHAT/F negative[b]	2 (40)	466 (97.3)
TIDOS positive	4 (80)	1 (0.1)
TIDOS negative	1 (20)	505 (99.9)
M-CHAT or TIDOS positive[c]	5 (100)	46 (19.8)
M-CHAT and TIDOS negative[d]	0 (0)	460 (80.2)

Note: M-CHAT: Modified Checklist for Autism in Toddlers; M-CHAT/F: Modified Checklist for Autism in Toddlers with Follow-up; TIDOS: Three-item Direct Observation Screen.
[a]Twenty-five children with positive M-CHAT screening test were excluded from statistical evaluation due to parents' not approving clinical evaluation for diagnosis of ASD by child psychiatry.
[b]Twenty-five children with positive M-CHAT and two children with positive M-CHAT/F screening tests were excluded from statistical evaluation due to parents' not approving clinical evaluation for diagnosis of ASD by child psychiatry.
[c]M-CHAT or TIDOS positive.
[d]M-CHAT and TIDOS negative.

Table 3. Comparison of the sensitivity, specificity, PPV, NPV of the M-CHAT, M-CHAT/F, and TIDOS[a].

Variables	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
M-CHAT ($n = 486$)	60	96	14	99.5
M-CHAT/F ($n = 484$)	60	97	18	99.5
TIDOS ($n = 511$)	80	99.8	80	99.8
M-CHAT or TIDOS[b]	100	90.1	10	100

Note: PPV: positive predictive value; NPV: negative predictive value; M-CHAT: Modified Checklist for Autism in Toddlers; M-CHAT/F: Modified Checklist for Autism in Toddlers with Follow-up; TIDOS: Three-item Direct Observation Screen.
[a]Twenty-five children with positive M-CHAT and two children with positive M-CHAT/F screening tests were excluded from statistical evaluation due to parents' not approving clinical evaluation for diagnosis of ASD by child psychiatry.
[b]M-CHAT or TIDOS positive.

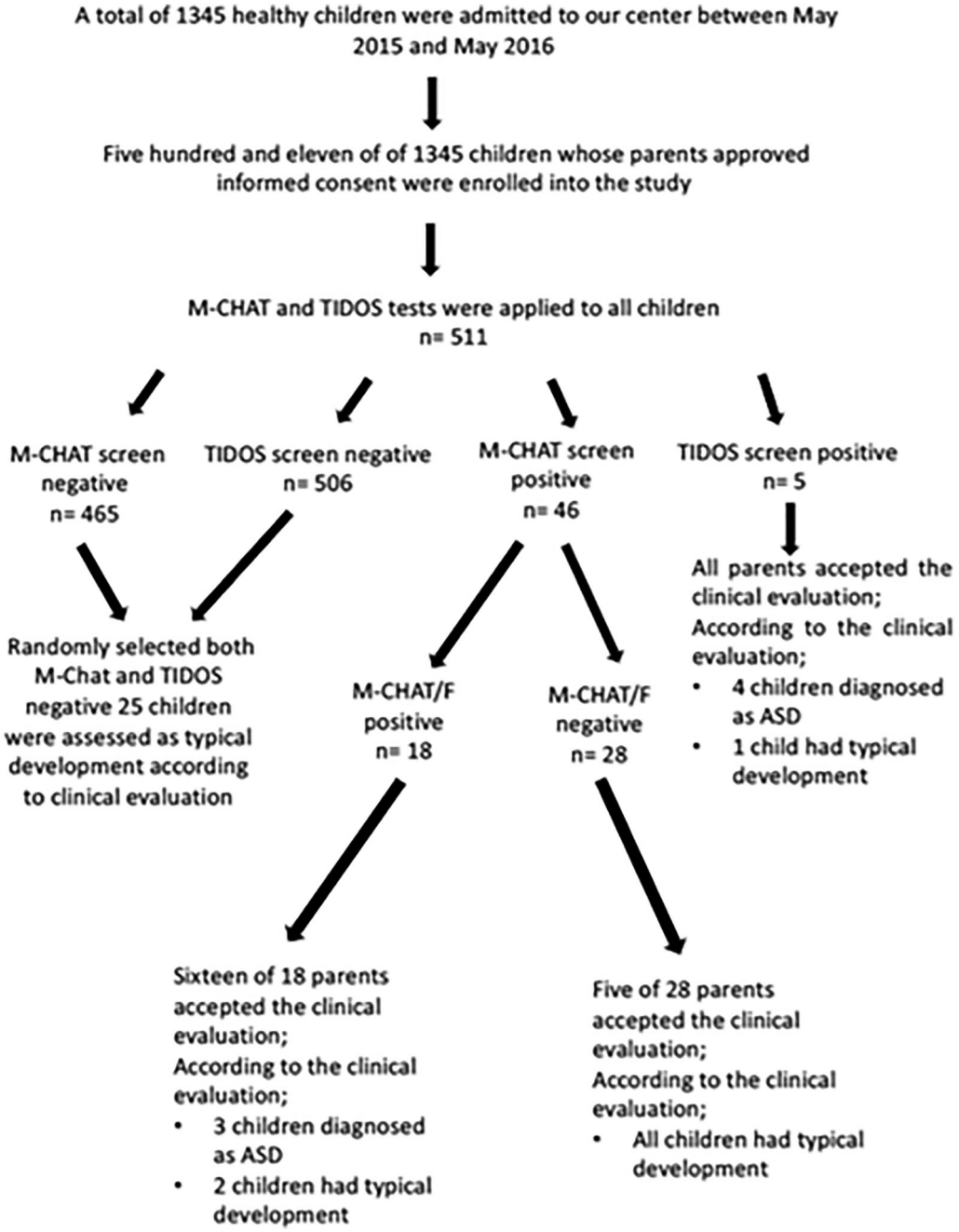

Figure 1. Flowchart of the screening.

respectively. The compliance of parents for clinical evaluation after TIDOS was 100%. This ratio was 19.2% in parents whose children had positive M-CHAT but negative results and was 88.8% in parents whose children had positive M-CHAT and M-CHAT/F results.

The purpose of using M-CHAT and TIDOS as screening tests is to identify children at risk for ASD. A screening test has a number of test characteristics, including sensitivity, specificity, PPV, and NPV. Sensitivity and specificity are two measures of test validity and powerful screening tests have validity. A valid test correctly categorizes persons who have disease as test positive and those without disease as test negative. In the validated tests, some corrections should be made because of likely affecting of social–cultural factors to the test results. We used validated Turkish form of M-CHAT in the current study. Item 6 has added to increase the power of M-CHAT for Turkish-speaking population [12]. Changing the cut-offs points may optimize sensitivity and minimize the number of false negatives but increase false-positive test results. However, in Turkish validated study of M-CHAT, changing cut-offs points of original M-CHAT was not needed. The M-CHAT test was administered and scored by using previously published cut-offs [9,12]. A positive screen was accepted if ≥2 of 7 critical items or ≥3 of 23 items were positive. For the clinician, a screening test with high PPV helps avoid excessive concern of the parents. PPV and NPV are screening test characteristics that change with the prevalence of disease (ASD) in the population. The

PPV is the probability that a child who tests positive truly has ASD. The NPV is the probability that a child who tests negative has typical development. The use of a screening test which has low PPV for ASD in low-risk population poses several problems. Most importantly, many children will be categorized as having ASD who in fact have a typical development.

M-CHAT is a parent-report tool widely used internationally for screening ASD [9]. However, its PPV (0.36 ± 0.05 for initial screening) was found to be low for a screening test; the follow-up questions are needed to increase the PPV [32]. In the current study, we detected the sensitivity, specificity, PPV, and NPV as 0.60, 0.96, 0.14, and 0.99, respectively. In original study of M-CHAT by Robins et al., they found a sensitivity of 0.87; a specificity of 0.99; a PPV of 0.80; and a NPV of 0.99. The population of the current study consisted of low-risk children for ASD; however, Robins et al. [9] included high-risk population in their study. There are some methodological differences in these studies that can influence these results. Firstly, Robins et al. [9] included high-risk sample in their study, whereas in this study high-risk children were not included. We know that AAP has already recommended screening at 18 and 24 months in routine well-child clinic visits [13]. Therefore, a good screening test should be used in low-risk population for any diseases. In a recent study from Turkey, despite they used different methodologies from original M-CHAT; they asked items of M-CHAT face to face with interview, they had lower PPV (0.12). This ratio was similar to that obtained in the current study. In different studies including low-risk children for ASD, they found low PPV; 0.19 and 0.06, respectively [15,33]. When follow-up was added, PPV increase to 0.54 from 0.06 (33); in the current study, follow-up measures increased PPV from 0.14 to 0.18.

There are some limitations in the current study. Firstly, this was a hospital-based study. The results of this study should not reflect all the population. Also, 21 parents whose children had positive M-CHAT but negative M-CHAT/F results and 2 parents whose children had positive M-CHAT and M-CHAT/F results did not approve the clinical evaluation. We had opportunity to follow up all those children at our well-child clinic whose parents did not approve psychiatric evaluation. In the follow-up period, we did not detect any abnormal development of those children. If we accept those children as typical development, in the current study, PPVs for M-CHAT and M-CHAT/F should be 0.07 and 0.16, respectively.

In conclusion, the current study showed that TIDOS measures could provide a more sensitive and specific means of screening for ASD and had a higher PPV than compared to the M-CHAT without requiring any additional time. TIDOS could be easily added to screening programme children aged 18–36 months at well-child clinic visits.

Disclosure statement

No potential conflict of interest was reported by the authors.

Compliance with ethical standards

This project received institutional review board approval from Ankara University Institutional Review Board and the Ethics Committee and written informed consent was obtained from the parents of each participants.

Statement of Human and Animal Rights: The authors undersign, certificate that the procedures and the experiments. The authors have done respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2000, as well as the national law.

References

[1] American Psychiatric Association. Diagnostic and statistical manual of mental disorders. V ed. Washington (DC): American Psychiatric Association; 2013.
[2] Ganz ML. The lifetime distribution of the incremental societal costs of autism. Arch Pediatr Adolesc Med. 2007;161(4):343–349.
[3] Baird G, Charman T, Baron-Cohen S, et al. A screening instrument for autism at 18 months of age: a 6-year follow-up study. J Am Acad Child Adolesc Psychiatry. 2000;39(6):694–702.
[4] Tidmarsh L, Volkmar FR. Diagnosis and epidemiology of autism spectrum disorders. Can J Psychiatry. 2003;48(8):517–525.
[5] Christensen DL, Baio J, Van Naarden Braun K, et al. Prevalence and characteristics of autism spectrum disorder Among children aged 8 years--autism and developmental disabilities monitoring network, 11 sites, United States, 2012. MMWR Surveill Summ. 2016;65(3):1–23.
[6] Kim YS, Leventhal BL, Koh YJ, et al. Prevalence of autism spectrum disorders in a total population sample. Am J Psychiatry. 2011;168(9):904–912.
[7] Dawson G, Burner K. Behavioral interventions in children and adolescents with autism spectrum disorder: a review of recent findings. Curr Opin Pediatr. 2011;23(6):616–620.
[8] Council on Children With D, Section on Developmental Behavioral P, Bright Futures Steering C, Medical Home Initiatives for Children With Special Needs Project Advisory C. Identifying infants and young children with developmental disorders in the medical home: an algorithm for developmental surveillance and screening. Pediatrics. 2006;118(1):405–420.
[9] Robins DL, Fein D, Barton ML, et al. The modified checklist for autism in toddlers: an initial study investigating the early detection of autism and pervasive developmental disorders. J Autism Dev Disord. 2001;31(2):131–144.
[10] Robins DL, Casagrande K, Barton M, et al. Validation of the modified checklist for autism in toddlers, revised

with follow-up (M-CHAT-R/F). Pediatrics. 2014;133 (1):37–45.
[11] Baduel S, Guillon Q, Afzali MH, et al. The French version of the modified-checklist for autism in toddlers (M-CHAT): a validation study on a French sample of 24 month-old children. J Autism Dev Disord. 2017;47(2):297–304.
[12] Yıkgeç A. Değiştirilmiş erken çocukluk dönemi otizm tarama ölçeğinin Türk örneklemi üzerine geçerlik çalışması. Yayınlanmamış Yüksek Lisans Tezi. Boğaziçi Üniversitesi, Sosyal Bilimler Enstitüsü, 2015, İstanbul.
[13] Johnson CP, Myers SM, American Academy of Pediatrics Council on Children With D. Identification and evaluation of children with autism spectrum disorders. Pediatrics. 2007;120(5):1183–1215.
[14] Oner P, Oner O, Munir K. Three-item direct observation screen (TIDOS) for autism spectrum disorder. Autism. 2014;18(6):733–742.
[15] Canal-Bedia R, Garcia-Primo P, Martin-Cilleros MV, et al. Modified checklist for autism in toddlers: cross-cultural adaptation and validation in Spain. J Autism Dev Disord. 2011;41(10):1342–1351.
[16] Snow AV, Lecavalier L. Sensitivity and specificity of the modified checklist for autism in toddlers and the social communication questionnaire in preschoolers suspected of having pervasive developmental disorders. Autism. 2008;12(6):627–644.
[17] Kondolot M, Özmert EN, Öztop DB, et al. The modified checklist for autism in Turkish toddlers: a different cultural adaptation sample. Res Autism Spectr Disord. 2016;21:121–127.
[18] American Psychiatric Association. Diagnostic and statistical manual of mental disorders (DSM-V). Washington (DC): American Psychiatric Association; 2013.
[19] Chakrabarti S, Fombonne E. Pervasive developmental disorders in preschool children. JAMA. 2001;285 (24):3093–3099.
[20] Bertrand J, Mars A, Boyle C, et al. Prevalence of autism in a United States population: the brick township, New Jersey, investigation. Pediatrics. 2001;108(5):1155–1161.
[21] Autism, Developmental Disabilities Monitoring Network Surveillance Year Principal I, Centers for Disease C, Prevention. Prevalence of autism spectrum disorders – autism and developmental disabilities monitoring network, six sites, United States, 2000. MMWR Surveill Summ. 2007;56(1):1–11.
[22] Autism, Developmental Disabilities Monitoring Network Surveillance Year Principal I, Centers for Disease C, Prevention. Prevalence of autism spectrum disorders – autism and developmental disabilities monitoring network, 14 sites, United States, 2002. MMWR Surveill Summ. 2007;56(1):12–28.
[23] Wiggins LD, Baio J, Rice C. Examination of the time between first evaluation and first autism spectrum diagnosis in a population-based sample. J Dev Behav Pediatr. 2006;27(2 Suppl):S79–S87.
[24] Gernsbacher MA, Dissanayake C, Goldsmith HH, et al. Autism and deficits in attachment behavior. Science. 2005;307(5713):1201–1203. author reply – 3.
[25] Myers SM, Johnson CP, American Academy of Pediatrics Council on Children With D. Management of children with autism spectrum disorders. Pediatrics. 2007;120(5):1162–1182.
[26] Mandell DS, Listerud J, Levy SE, et al. Race differences in the age at diagnosis among medicaid-eligible children with autism. J Am Acad Child Adolesc Psychiatry. 2002;41(12):1447–1453.
[27] Charman T. Why is joint attention a pivotal skill in autism? Philos Trans R Soc Lond B Biol Sci. 2003;358(1430):315–324.
[28] Chawarska K, Klin A, Volkmar F. Automatic attention cueing through eye movement in 2-year-old children with autism. Child Dev. 2003;74(4):1108–1122.
[29] Leekam SR, Ramsden CA. Dyadic orienting and joint attention in preschool children with autism. J Autism Dev Disord. 2006;36(2):185–197.
[30] Mundy P. Joint attention and social-emotional approach behavior in children with autism. Dev Psychopathol. 1995;7:63–82.
[31] Chlebowski C, Robins DL, Barton ML, et al. Large-scale use of the modified checklist for autism in low-risk toddlers. Pediatrics. 2013;131(4):e1121–7.
[32] Chakrabarti S, Fombonne E. Pervasive developmental disorders in preschool children: confirmation of high prevalence. Am J Psychiatry. 2005;162(6):1133–1141.
[33] Kleinman JM, Robins DL, Ventola PE, et al. The modified checklist for autism in toddlers: a follow-up study investigating the early detection of autism spectrum disorders. J Autism Dev Disord. 2008;38 (5):827–839.