



# Cognitive control and cognitive flexibility predict severity of depressive symptoms in parents of toddlers with autism spectrum disorder

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## Abstract

Having a toddler with autism spectrum disorder (ASD) can be challenging for parents and may negatively impact on parents' mental health. This study examined the relationship between parental depressive symptoms and their cognitive control and cognitive flexibility, and toddlers' ASD symptoms. A total of 68 parents with toddlers with ASD participated in this cross-sectional study. Parents completed a series of questionnaires covering the toddlers' symptoms of ASD (Gilliam Autism Rating Scale (GARS-2)), and their symptoms of depression (Beck Depression Inventory (BDI-II)) and their cognitive control and cognitive flexibility (Cognitive Control and Flexibility Questionnaire (CCFQ)). Pearson correlation coefficient and linear regression were used to analyze the data. Toddlers' greater severity of ASD symptoms ( $r=0.33$ ;  $p<05$ ), parents' a lower ability of cognitive control ( $r=-0.62$ ;  $p<01$ ) and cognitive flexibility ( $r=-0.33$ ;  $p<05$ ) were associated with parents' greater severity of depressive symptoms. Toddlers' severity of ASD (11%) and parents' cognitive control (39%) and cognitive flexibility (11%) explained significant changes of the variance of parents' depressive symptoms. Parents' cognitive control, but less so toddlers' severity of ASD, predicted the severity of their depressive symptoms. Interventions to improve cognitive control among parents of toddlers with ASD might favorably impact on parents' symptoms of depression.

**Keywords** Autism spectrum disorder · Parent · Depression · Cognitive control · Cognitive flexibility

## Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder. Typically, children, adolescents and adults with ASD show deficits in social interaction and communication skills, and restricted, repetitive, and stereotyped behaviors, interests, and activities (American Psychiatric Association, 2013). The behavior of a child with ASD affects the quality of life of the family and increases parental stress. Not surprising, a child's ASD may unfavorably impact on parents' mental health (Kütük et al., 2021; Sadeghi et al., 2021a). Indeed, parents of children with ASD reported higher levels of stress, compared to parents of children with other developmental disorders such as down syndrome (Miranda et al., 2019; Pisula, 2007), specific learning disorders, and language disorders (Craig et al., 2016). A meta-analysis comprising 31 studies with 9208 parents of children with ASD (Schnabel et al., 2020) showed that 33% of parents reported to suffer from symptoms of anxiety, and 31% reported to suffer from symptoms of depression.

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In general, to explain the degree of mental health impairment of a parent with a child with ASD, the following factors were identified: Being a sole parent/caregiver, caregiving burden, duration of care, unemployment, lack of social support, ASD symptom severity, and internalized stigma (American Psychiatric Association, 2013; Carter et al., 2009; Rodriguez et al., 2019). Internalized stigma is the process by which someone accepts the negative stereotypes associated with ASD as true (Dubreucq et al., 2020). In specific, to explain the occurrence of symptoms of depression in parents with a child with ASD, three core predictors were identified: A child's greater symptom severity of ASD, a child's greater externalizing behaviors, and the parents' lower social support (Falk et al., 2014).

Further, about one third of parents with a child with ASD reported symptoms of depression (Schnabel et al., 2020); this is problematic in that higher symptoms of depression were associated with higher suicidal ideation, in general, including also a higher search of specific information in Google® (Baldessarini et al., 2017; Solano et al., 2016), and with higher suicidal ideation among parents with children with ASD, in specific (Akram et al., 2019; Bal et al., 2021; Jahan et al., 2020). However, while thus one third of parents with a child with ASD reported symptoms of depression, about two thirds did not. This pattern of results deserves additional attention, and one line of research focused on the cognitive processes underlying the coping strategies and their relation to the symptoms of depression. More specifically, the psychological process to cope with stress consists of four cognitive components, including a causal event, a cognitive appraisal of the event, coping mechanisms, and stress reactions (Lazarus, 1993). As such, it appears plausible that parents of toddlers with ASD may experience anxiety and depression not as a linear cause of the child's symptom severity, but rather as a result of their cognitive elaboration of a child's severity of ASD symptoms.

In regard to the cognitive processes underlying stress and symptoms of depression, research focused on both cognitive control (Grahek et al., 2018, 2019; Harvey et al., 2005; Paulus, 2015; Wolkenstein & Plewnia, 2013) and cognitive flexibility (Maramis et al., 2021; Mills et al., 2014; Soltani et al., 2013; Yu et al., 2020). Cognitive control is understood as the intentional selection of cognitive, emotional, and behavioral responses based on a situational context and the suppression of inappropriate habitual actions (Dixon, 2015). Cognitive flexibility is defined as the ability to adapt to changing external or internal situations (e.g., stressful events or changes in emotions) (Dajani & Uddin, 2015). Poor cognitive control and poor cognitive flexibility were strongly associated with depressive symptoms, in that for instance individuals with symptoms of depression also showed lower scores for cognitive control such as poor concentration and greater memory deficits (De Lissnyder et al., 2012; Disner et al., 2011).

Similarly, a lower cognitive flexibility was associated with a higher vulnerability for symptoms of depression (Stange et al., 2017).

To summarize, parents with children with ASD were at increased risk to suffer from symptoms of depression, and symptoms of depression were associated with impaired cognitive functions (Grahek et al., 2019). Given this background, it appears plausible that symptoms of depression in parents of children with ASD might, at least in part, be associated with their cognitive control and cognitive flexibility. Accordingly, the following two hypotheses and one research question were formulated. First, based in previous results (Carter et al., 2009; Falk et al., 2014; Rodriguez et al., 2019) we assumed that a toddler's higher ASD severity was associated with the parents' higher symptoms of depression. Second, based on previous results observed outside the area of ASD, we assumed that parents' higher symptoms of depression were associated with their lower scores for cognitive control (Grahek et al., 2018, 2019; Harvey et al., 2005; Paulus, 2015; Wolkenstein & Plewnia, 2013) and for cognitive flexibility (Maramis et al., 2021; Mills et al., 2014; Soltani et al., 2013; Yu et al., 2020). The exploratory research question asked, if toddlers' ASD symptom severity, parents' cognitive control and flexibility, or their combination, could predict parents' symptoms of depression. The key outcome variable was thus the parents' symptom severity of depression.

We think that the identification of factors to predict symptoms of depression among parents of toddlers with ASD may help mental health professionals to develop evidence-based strategies and interventions to improve mental health of parents with toddlers with ASD. Such an investigation is further justified in that it appears that the prevalence rates of individuals with ASD is continuously increasing, with one out of 68 children showing symptoms of ASD (American Psychiatric Association, 2013).

## Materials and methods

### Participants and procedure

Using a multiple linear regression model, this study examined the effects of parental cognitive control, flexibility, and child's ASD symptoms severity on depression symptoms in parents. We selected our participants by convenience sampling method.

Parents with toddlers aged under 36 months diagnosed with an ASD participated in this study. The toddlers were referred to Tehran Autism Center (Tehran, Iran) for evaluation of ASD. Parents were fully informed about the purpose of the study and the confidential and anonymous data handling. Thereafter, they signed the written informed consent. Next, clinical psychologists

and experienced in ASD were responsible for the accurate diagnosis of a toddler's ASD. The assessment and diagnosis included a standardized testing, behavioral observation, and parent reports. Diagnoses were based on DSM-5 guidelines (American Psychiatric Association, 2013). Inclusion criteria for parents were as follows: 1. Aged 18 years and older; 2. Having a child with ASD, as thoroughly assessed and described above; 3. No psychiatric issues, as assessed by an experienced clinical psychologist and based on the DSM-5 criteria for psychiatric issues (American Psychiatric Association, 2013). 4. No self-reported neurological or medical issues. 5. Willing and able to comply with the study conditions; 6. Signed written informed consent. Exclusion criteria were: 1. Withdrawal from the study. 2. More than 5% of missing data while completing the questionnaires. Parents completed a series of self-rating questionnaires covering sociodemographic information, symptoms of depression, cognitive control and cognitive flexibility and the toddler's symptom severity of ASD (see details below). The Ethics Committee of the Shahid Beheshti University (Tehran, Iran) approved the study (SBU.ICBS 96/1020), which was performed in accordance with the seventh and current (World Medical Association, 2013) edition of the Declaration of Helsinki.

## Measures

### Sociodemographic information

Parents reported on their age (years), sex at birth (male; female), the highest educational degree (high school; undergraduate; master; doctoral degree), the number of children, and their current employment status (yes; no). Parents also reported on their toddlers' age (months) and sex at birth (male; female).

### Toddler's severity of autism spectrum disorder (ASD)

Parents completed the Farsi version (Ahmadi et al., 2011) of the Gilliam Autism Rating Scale (GARS-2) (Gilliam, 2006). The questionnaire consists of 42 items on a 4-point Likert scale that provides information about three areas: communication, stereotypes, and social interaction. A GARS-2 sum score is calculated by summing the scores of these three subscales. The GARS-2 sum score was used in this study. Higher sum scores reflect more severe symptoms of ASD. Parents fill out this questionnaire. The internal reliability of the GARS-2 ranges between 0.88 and 0.93 (Healy et al., 2008). Previous studies have also shown the reliability of this scale in measuring the severity of autism symptoms in Iranian children (Aqdassi et al., 2019; Pouretemad et al., 2016, 2017; Sadeghi & Pouretemad, 2022a, b; Sadeghi et al., 2017, 2019a, b, 2021a, b). The Cronbach's alpha of the internal consistency of the GARS-2 (sum score) in the present study was 0.82.

## Depression

Parents completed the Farsi version (Ghassemzadeh et al., 2005) of the Beck Depression Inventory-II (Beck et al., 1996). The BDI-II is a self-report questionnaire. This questionnaire consists of 21 items on a 4-point Likert scale, ranging from 0 to 3, to self-assess depression severity. Each item represents 1 of the symptoms of depression. It takes 5 to 10 min to complete and is suitable for people over 13 years old. Sum score was calculated by summing across all 21 items ( $\alpha=0.92$ ). A higher sum score reflects a depression severity. In a previous study (Hamidi et al., 2015), Beck-2 reliability (Cronbach's alpha = 0.92) has been well reported in Iranian population. The Cronbach's alpha of the internal consistency of the BDI-2 in the present study was 0.90.

### Cognitive control and flexibility questionnaire (CCFQ):

This questionnaire was developed by Gabrys et al. (2018) to assess a person's perceived ability to exercise control over intrusive thoughts and emotions, and their ability to adapt to stressful situations. CCFQ is a self-reporting questionnaire. In the CCFQ, there are 18 items on a 7-point Likert scale (ranging from 1 to 7) divided into two categories: "cognitive control" (9 items) and "flexibility" (9 items). A higher score on the CCFQ indicates better cognitive control and cognitive flexibility. Gabrys et al. (2018) reported a high level of reliability for cognitive control ( $\alpha=0.88$ ) and cognitive flexibility ( $\alpha=0.91$ ). In the present study, the Cronbach's alphas for the internal consistency of the CCFQ were  $\alpha=0.83$  for cognitive control and  $\alpha=0.86$  for cognitive flexibility subscales.

## Statistical procedure

Preliminary calculations: For testing normality of distribution, we used the Kolmogorov–Smirnov (K-S) test. According to a Kolmogorov–Smirnov (K-S) test, depression, symptoms of ASD, and cognitive control and flexibility scores follow a normal distribution ( $p > 0.05$ ).

To test the first (toddlers' ASD scores were associated with parents' symptoms of depression) and the second hypothesis (parents' scores for cognitive control and flexibility were associated with parents' symptoms of depression) we performed a series of Pearson's correlations. To answer the research question, and thus to predict parents' symptoms of depression, a multiple regression analysis was performed with parents' symptoms of depression as dependent variable and parents' scores for cognitive control and cognitive flexibility and toddlers' scores for ASD as predictors. Following others (Brosius, 2018; Hair et al., 2014), preliminary conditions to perform a multiple regression analysis were generally met: the number of predictors  $\times$  10 should not be greater than sample size (here:  $3 \times 10 = 30 < 68$ ); predictors should

sufficiently explain the dependent variable ( $R_s$  and  $R^2_s$ ); and the Durbin–Watson coefficient should be between 1.5 and 2.5, indicating that the residuals of the predictors were independent of each other. Last, the variance inflation factors (VIF) to test multicollinearity should be  $1 < VIF < 10$ .

The level of significance was set at  $\alpha < 0.05$ . All statistical computations were performed with SPSS® 28.0 (IBM Corporation, Armonk, NY, USA) for Windows®.

## Results

### General sociodemographic information and key variables

Table 1 provides the descriptive statistical overview of the sociodemographic information and the key values of toddlers' symptoms of ASD and parents' scores for depression, cognitive control and cognitive flexibility. A total of 49 mothers

and 19 fathers of 68 toddlers aged under 36 months diagnosed with an ASD (77.9% males) took part in the study.

### Correlations between toddlers' scores for ASD and parents' scores for depression, and cognitive control and cognitive flexibility

Table 2 provides the overview of the Pearson's correlation coefficients between toddlers' symptoms of ASD and parents' symptoms of depression, and cognitive control and cognitive flexibility.

Toddlers' higher symptoms of ASD were associated with parents' higher symptoms of depression. Parents' higher symptoms of depression were associated with their lower scores for cognitive control and cognitive flexibility.

### Predicting parents' symptoms of depression

To predict parents' symptoms of depression, a multiple regression analysis was performed with toddlers' symptoms

**Table 1** Participants' sociodemographic characteristics and the descriptive statistics of the study measures

Descriptive statistics of the study measures					
Variables		<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SD</i>
Toddlers	ASD symptoms severity	3	51	24.28	11.36
Parents	Cognitive control	11	63	31.72	11.82
	Cognitive flexibility	11	63	48.46	11.16
	Depression symptoms severity	0	43	17.15	10.11

  

Age of toddlers and parents						
Variable	Sex	Scale	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
Age of toddlers	Male (55)	Months	26.87	4.95	16	36
	Female (13)		28.00	4.71	20	36
Age of parents	Male	Years	33.46	4.95	24	43
	Female		38.10	4.09	30	47

  

Participants' sociodemographic characteristics					
Variable		Parent	Frequency	Percent	
Number of children in the family	One child	-	47	69.1	
	Two children	-	19	27.9	
	Three children	-	2	3	
Education	High School	Father	7	10.3	
		Mother	10	14.7	
	Undergraduate	Father	41	60.3	
		Mother	36	52.9	
	Master	Father	14	20.6	
		Mother	15	22.1	
Doctoral	Father	6	8.8		
	Mother	7	10.3		
Economically active	Do not Work	Father	0	0	
		Mother	59	86.8	
	Work	Father	68	100	
		Mother	9	13.2	

Abbreviations: *M*, Mean; *SD*, Standard deviation; *Min*, Minimum; *Max*, Maximum

**Table 2** Overview of correlational computations (Pearson's correlations) between toddlers' symptoms of ASD and parents' symptoms of depression and scores for cognitive control and cognitive flexibility ( $N=68$ )

Variables		Toddlers	Parents		
		ASD symptoms	Depression	Cognitive control	Cognitive flexibility
Toddlers	ASD symptoms	-	0.35*	-0.06	-0.03
Parents	Depression		-	-0.62**	-0.33*
	Cognitive control			-	0.36*
	Cognitive flexibility				-

\* =  $p < 0.05$ ; \*\* =  $p < 0.01$

of ASD and parents' cognitive control and cognitive flexibility as predictors. Table 3 provides the statistical overview.

A toddler's higher ASD scores, and a parent's lower cognitive control and cognitive flexibility predicted a parent's higher symptoms of depression. The severity of the child's ASD, the parents' cognitive control, and their cognitive flexibility abilities explained 11%, 39%, and 11% of the variance in parental depression scores, respectively.

**Discussion**

The aims of the present cross-sectional study among parents of toddlers with ASD were to investigate, if and to what extent parents' symptoms of depression were associated with toddlers' ASD symptom severity and parents' cognitive control and flexibility. The main findings of this study were that parents' higher symptoms of depression were associated with with toddlers' higher symptoms of ASD and with parents' lower cognitive control and cognitive flexibility. Importantly, relative to toddlers' symptoms of ADS and parents' cognitive flexibility, parents' lower cognitive control was the most powerful predictor for their higher symptoms of depression. The present results add to the current literature in an import way: Against lay and general opinion, parents' depressive symptoms were not mainly associated with their toddlers' severity of ASD, but with the parents' cognitive elaboration of the toddlers' ASD-related behavior. We claim that this result is of practical and clinical importance: First, the pattern of results emphasizes that parents with toddlers with ASD are not helpless towards their toddlers' behavior, but parents' cognitive (and emotional) processes contribute heavily to their well-being.

Second, specific. Psychotherapeutic and skill-oriented interventions should enable to improve dimensions of cognitive control and cognitive flexibility; as such, third, parents with toddlers with ASD can be encouraged to improve their well-being, in general, and their symptoms of depression, in specific.

Two hypotheses and one research question were formulated, and each of these is considered now in turn.

With the first hypothesis we assumed that toddlers' higher ASD severity was associated with the parents' higher symptoms of depression, and data did confirm this. Thus, the present findings corroborate what has been already observed before (Carter et al., 2009; Falk et al., 2014; Rodriguez et al., 2019). The present results expand upon the current literature in that such findings were also observed among parents belonging to a geographically, socially and culturally other area compared to previous observational studies (Carter et al, 2009; Rodriguez et al., 2019; US-American parents; Falk et al., 2014; Australian parents).

With the second hypothesis we assumed that that parents' higher symptoms of depression were associated with their lower scores for cognitive control and cognitive flexibility, and data did again confirm this assumption. While thus the present results were in line with previous findings (Grahek et al., 2018, 2019; Harvey et al., 2005; Paulus, 2015; Wolkenstein & Plewnia, 2013) and for cognitive flexibility (Maramis et al., 2021; Mills et al., 2014; Soltani et al., 2013; Yu et al., 2020), the novelty of the present study is that such associations were observed among parents of toddlers with ASD. To explain such an association we assume that that impairments in cognitive control act as important mechanism for the development and maintenance of depression (De

**Table 3** Linear regression for variables predicting parent's depression symptoms severity

Independent variable		Dependent variable				
		Parent's depression symptoms severity				
		$R^2$	$B$	$SE\ b$	$\beta$	$F$
Toddler's	ASD severity	0.11	0.30	1.38	0.33	4.67*
Parent's	Cognitive control	0.39	-0.53	0.11	-0.62	23.58***
	Cognitive flexibility	0.11	-0.30	0.14	-0.33	4.55*

\* $p \leq 0.05$ , \*\* $p < 0.01$ , \*\*\* $p \leq 0.001$

Lissnyder et al., 2012; Disner et al., 2011). More specifically, the present results also confirm the seminal work Lazarus and Folkman's model of stress and coping (Lazarus & Folkman, 1984), where not a stressor per se, but its cognitive elaboration, does increase the risk of being distressed. In this view, when dealing with stressors such as the challenging behavior of a toddler with ASD, cognitive control and cognitive flexibility appear to play a crucial role. Further, this pattern of results also offers excellent opportunities to parents with toddlers with ASD to improve their cognitive control and cognitive flexibility. Classically, an active agent of cognitive-behavioral therapy (CBT) interventions is the cognitive restructuring to dysfunctional thoughts and feelings (Grawe, 2004, 2007; Grawe & Bernauer, 1994; Kanfer & Hagerman, 1987; Kanfer et al., 2011). In line with this, parents of the toddlers with ASD experienced mental distress as well as less positive feelings toward their children. So, it can be concluded that parents of children with ASD who process a broad range of distressing emotions and negative information may experience depression symptoms. As such, depressive symptoms are likely to develop as a result of poor cognitive control, most probably due to ruminating on negative information about their toddlers' behavior. Further, cognitive control has been reported to be an effective intervention on depression (Hoorelbeke & Koster, 2017, 2018; Koster et al., 2017; Vervaeke et al., 2018), however no studies have been conducted on parents of children with ASD.

With the research question we asked, if and to which extent both parents' cognitive control and cognitive flexibility and a child's ASD severity could predict parents' severity of depression, and the answer was that the combination of lower cognitive control and cognitive flexibility and toddlers' higher symptoms of ASD were three independent factors (see Table 3). In our opinion, the present findings are consistent with previous studies which observed that parents' depressive symptoms were associated with the severity of their children's severity of ASD (American Psychiatric Association, 2013; Falk et al., 2014; Rodriguez et al., 2019). The present data also replicate the observation that having a child with ASD might be challenging for their parents and may thus negatively impact on their mental health (Carter et al., 2009). More specifically, caring for a child with ASD can have a negative impact on the parenting role, their way of living, and their social networks. In a further step, it appears plausible that parents of children with ASD might develop emotional distress; this is, what in fact has been summarized elsewhere (Lanyi et al., 2021; Schnabel et al., 2020; Yorke et al., 2018). However, the present data expand upon previous studies in that the role of parents' cognitive control and cognitive flexibility has been highlighted.

Despite the novelty of the combination of predictors the following limitations should be considered. First, only parents willing and able to participate in this present study were included; as such, a sample bias cannot be excluded. Second, the sample itself might be considered as small, though, as our

data convincingly showed, emotional (and most probably also family-related and logistic) distress for parents with toddlers with ASD was also particularly high; as such, a sample of 68 parents of toddlers with ASD appears to be considerable. Third, we fully relied on parents' self-reports; a thorough clinical and psychiatric assessment of parents and toddlers' psychiatric issues might have improved the quality of data. Fourth, it is conceivable that further unassessed and latent variables might have biased two or more dimensions in the same or opposite directions. Possible confounders could be: both parents' and toddlers' sleep disturbances; parents' marital relationship, parents' parenting style; parents' overall coping strategies, to name just but a few. More specifically, we did not assess social support of the family and parents, while social support seemed to be an important factor to decrease parents' burden and to improve positive growth (Feng et al., 2022). Thus, future studies might further assess the stress-buffering effect of social support. Fifth, future studies should also assess both state and trait anxiety scores, as symptoms of depression and anxiety are highly associated among parents with children with developmental disabilities (Scherer). Sixth, we thoroughly assessed parents' psychiatric status and included only those with no apparent signs of psychiatric issues. However, given that ASD is associated with a strong genetic component as well as other causes (Lord et al., 2018), it is highly conceivable that such a "pure" sample does rather not reflect clinical everyday reality.

## Conclusion

The present results provide further insight into the relationship between depression symptoms in parents of toddlers with ASD and their cognitive control, cognitive flexibility, and their toddler ASD symptoms severity. The findings indicate that rather than toddler's symptoms severity, parents' cognitive control ability is an important predictor of parents' depression symptoms severity. It would be helpful if future studies replicated these results across different cultures and countries (especially in countries with limited resources to treat children with ASD) to understand the differences in mental health of parents of children with ASD. We propose examining cognitive control training for reducing depressive symptoms in parents of toddlers with ASD in future studies.

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**Author contribution** The authors confirm contribution to the paper as follows: study conception and design: SS and HRP; data collection: SS; analysis and interpretation of results: SS; draft manuscript preparation: SS and SB.

**Data availability statement** All data are included in the article.

### Declarations

All study procedures were performed after the study was approved by the Ethics Committee of the Shahid Beheshti University (SBU.ICBS 96/1020).

**Conflict of interest** The authors declared no conflict of interest.

## References

- Ahmadi, S. J., Safari, T., Hemmatian, M., & Khalili, Z. (2011). The psychometric properties of Gilliam Autism Rating Scale (GARS). *Research in Cognitive and Behavioral Sciences*, 1(1), 87–104. [https://cbs.ui.ac.ir/article\\_17282\\_1a9454b924308ae195c549dd9fd2ab4b.pdf](https://cbs.ui.ac.ir/article_17282_1a9454b924308ae195c549dd9fd2ab4b.pdf). Accessed 24 Jan 2022
- Akram, B., Batool, M., & Bibi, A. (2019). Burden of care and suicidal ideation among mothers of children with autism spectrum disorder: perceived social support as a moderator. *JPMA*, 69(504).
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub. Author.
- Aqdassi, L., Pouretamad, H. R., Fathabadi, J., & Sadeghi, S. (2019). Family-based tele-intervention of SPARK program on motor proficiency and severity of autism symptoms in children with high functioning autism spectrum disorder: A pilot study [Research]. *Razi Journal of Medical Sciences*, 25(11), 61–71. <http://rjms.iums.ac.ir/article-1-5184-fa.html>
- Bal, V. H., Leventhal, B. L., Carter, G., Kim, H., Koh, Y.-J., Ha, M., Kwon, H.-J., Hong, P., & Kim, Y. S. (2021). Parent-reported suicidal ideation in three population-based samples of school-aged Korean children with autism spectrum disorder and autism spectrum screening questionnaire screen positivity. *Archives of Suicide Research*, 1–18.
- Baldessarini, R. J., Innamorati, M., Erbuto, D., Serafini, G., Fiorillo, A., Amore, M., Girardi, P., & Pompili, M. (2017). Differential associations of affective temperaments and diagnosis of major affective disorders with suicidal behavior. *Journal of Affective Disorders*, 210, 19–21.
- Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck depression inventory (BDI-II)* (Vol. 10). Pearson.
- Brosius, F. (2018). *SPSS; Umfassendes Handbuch zu Statistik und Datenanalyse - Comprehensive textbook for statistics and data analysis*. mitp Verlags GmbH & Co.
- Carter, A. S., Martínez-Pedraza, Fd. L., & Gray, S. A. (2009). Stability and individual change in depressive symptoms among mothers raising young children with ASD: Maternal and child correlates. *Journal of Clinical Psychology*, 65(12), 1270–1280.
- Craig, F., Operto, F. F., De Giacomo, A., Margari, L., Frolli, A., Conson, M., Ivagnes, S., Monaco, M., & Margari, F. (2016). Parenting stress among parents of children with neurodevelopmental disorders. *Psychiatry Research*, 242, 121–129.
- Dajani, D. R., & Uddin, L. Q. (2015). Demystifying cognitive flexibility: Implications for clinical and developmental neuroscience. *Trends in Neurosciences*, 38(9), 571–578.
- De Lissnyder, E., Koster, E. H., Everaert, J., Schacht, R., Van den Abeele, D., & De Raedt, R. (2012). Internal cognitive control in clinical depression: General but no emotion-specific impairments. *Psychiatry Research*, 199(2), 124–130.
- Disner, S. G., Beevers, C. G., Haigh, E. A., & Beck, A. T. (2011). Neural mechanisms of the cognitive model of depression. *Nature Reviews Neuroscience*, 12(8), 467–477.
- Dixon, M. L. (2015). Cognitive control, emotional value, and the lateral prefrontal cortex. *Frontiers in Psychology*, 6, 758.
- Dubreucq, J., Plasse, J., Gabayet, F., Faraldo, M., Blanc, O., Chereau, I., Cervello, S., Couhet, G., Demily, C., & Guillard-Bouhet, N. (2020). Self-stigma in serious mental illness and autism spectrum disorder: Results from the REHABase national psychiatric rehabilitation cohort. *European Psychiatry*, 63(1).
- Falk, N. H., Norris, K., & Quinn, M. G. (2014). The factors predicting stress, anxiety and depression in the parents of children with autism. *Journal of Autism and Developmental Disorders*, 44(12), 3185–3203.
- Feng, Y., Zhou, X., Liu, Q., Deng, T., Qin, X., Chen, B., & Zhang, L. (2022). Symptom severity and posttraumatic growth in parents of children with autism spectrum disorder: The moderating role of social support. *Autism Research*, 15(4), 602–613.
- Gabrys, R. L., Tabri, N., Anisman, H., & Matheson, K. (2018). Cognitive control and flexibility in the context of stress and depressive symptoms: The cognitive control and flexibility questionnaire. *Frontiers in Psychology*, 2219.
- Ghassemzadeh, H., Mojtabai, R., Karamghadiri, N., & Ebrahimkhani, N. (2005). Psychometric properties of a Persian-language version of the Beck Depression Inventory-Second edition: BDI-II-PERSIAN. *Depression and Anxiety*, 21(4), 185–192. <https://doi.org/10.1002/da.20070>
- Gilliam, J. E. (2006). *Gilliam autism rating scale: GARS 2*. Pro-ed.
- Grahek, I., Everaert, J., Krebs, R. M., & Koster, E. H. (2018). Cognitive control in depression: Toward clinical models informed by cognitive neuroscience. *Clinical Psychological Science*, 6(4), 464–480.
- Grahek, I., Shenhav, A., Musslick, S., Krebs, R. M., & Koster, E. H. (2019). Motivation and cognitive control in depression. *Neuroscience & Biobehavioral Reviews*, 102, 371–381.
- Grawe, K. (2004). *Psychological therapy*. Hogrefe Publishing.
- Grawe, K., & Bernauer, F. (1994). *Development of psychotherapy—from the confession to profession*. Hogrefe.
- Grawe, K. (2007). Counseling and psychotherapy investigating practice from scientific, historical, and cultural perspectives. *Neuropsychotherapy: How the neurosciences inform effective psychotherapy*. In: Lawrence Erlbaum Associates, Mahwah.
- Hair, J. F., Black, C. W., Babin, B. J., & Anderson, R. E. (2014). *Multivariate data analysis* (7th ed.). Pearson Education Limited.
- Hamidi, R., Fekrizadeh, Z., Azadbakht, M., Garmaroudi, G., Taheri Tanjani, P., Fathizadeh, S., & Ghisvandi, E. (2015). Validity and reliability Beck Depression Inventory-II among the Iranian elderly Population. *Journal of Sabzevar University of Medical Sciences*, 22(1), 189–198. [http://jsms.sinaweb.net/article\\_550\\_c326338d69b115a13f8996b01613b38f.pdf](http://jsms.sinaweb.net/article_550_c326338d69b115a13f8996b01613b38f.pdf). Accessed 23 Jan 2022
- Harvey, P.-O., Fossati, P., Pochon, J.-B., Levy, R., LeBastard, G., LeHérissey, S., Allilaire, J.-F., & Dubois, B. (2005). Cognitive control and brain resources in major depression: An fMRI study using the n-back task. *NeuroImage*, 26(3), 860–869.
- Healy, O., O'Connor, J., Leader, G., & Kenny, N. (2008). Three years of intensive applied behavior analysis: A case study. *Journal of Early and Intensive Behavior Intervention*, 5(1), 4.
- Hoorelbeke, K., & Koster, E. H. (2017). Internet-delivered cognitive control training as a preventive intervention for remitted depressed patients: Evidence from a double-blind randomized controlled trial study. *Journal of Consulting and Clinical Psychology*, 85(2), 135.
- Hoorelbeke, K., & Koster, E. (2018). Ten years of cognitive control training for depression: An overview of findings and challenges. *Tijdschrift Voor Psychiatrie*, 60(6), 403–410.
- Jahan, S., Araf, K., Gozal, D., Griffiths, M., & Mamun, M. A. (2020). Depression and suicidal behaviors among Bangladeshi mothers of children with Autistic Spectrum Disorder: a comparative study. *Asian Journal of Psychiatry*.
- Kanfer, F., Reinecker, H., & Schmelzer, D. (2011). *Selbstmanagement-therapie [Self-management therapy]*. Springer.

- Kanfer, F., & Hagerman, S. (1987). A model of self-regulation. In *Motivation, intention, and volition* (pp. 293–307). Springer.
- Koster, E. H., Hoorelbeke, K., Onraedt, T., Owens, M., & Derakshan, N. (2017). Cognitive control interventions for depression: A systematic review of findings from training studies. *Clinical Psychology Review, 53*, 79–92.
- Kütük, M. Ö., Tufan, A. E., Kılıçaslan, F., Güler, G., Çelik, F., Altıntaş, E., Gökçen, C., Karadağ, M., Yektaş, Ç., & Mutluer, T. (2021). High depression symptoms and burnout levels among parents of children with autism spectrum disorders: A multi-center, cross-sectional, case-control study. *Journal of Autism and Developmental Disorders, 51*(11), 4086–4099.
- Lanyi, J., Mannion, A., Chen, J. L., & Leader, G. (2021). Relationship between comorbid psychopathology in children and adolescents with autism spectrum disorder and parental well-being. *Developmental Neurorehabilitation, 1–11*.
- Lazarus, R. S. (1993). From psychological stress to the emotions: A history of changing outlooks. *Annual Review of Psychology, 44*(1), 1–22.
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer.
- Lord, C., Elsabbagh, M., Baird, G., & Veenstra-Vanderweele, J. (2018). Autism spectrum disorder. *The Lancet, 392*(10146), 508–520.
- Maramis, M. M., Mahajudin, M. S., & Khotib, J. (2021). Impaired cognitive flexibility and working memory precedes depression: A rat model to study depression. *Neuropsychobiology, 80*(3), 225–233.
- Mills, F., Bartlett, T. E., Dissing-Olesen, L., Wisniewska, M. B., Kuznicki, J., Macvicar, B. A., Wang, Y. T., & Bamji, S. X. (2014). Cognitive flexibility and long-term depression (LTD) are impaired following  $\beta$ -catenin stabilization in vivo. *Proceedings of the National Academy of Sciences, 111*(23), 8631–8636.
- Miranda, A., Mira, A., Berenguer, C., Rosello, B., & Baixauli, I. (2019). Parenting stress in mothers of children with autism without intellectual disability. Mediation of behavioral problems and coping strategies. *Frontiers in Psychology, 10*, 464.
- Paulus, M. P. (2015). Cognitive control in depression and anxiety: Out of control? *Current Opinion in Behavioral Sciences, 1*, 113–120.
- Pisula, E. (2007). A comparative study of stress profiles in mothers of children with autism and those of children with Down's syndrome. *Journal of Applied Research in Intellectual Disabilities, 20*(3), 274–278.
- Pouretamad, H. R., Fathabadi, J., Sadeghi, S., & Shalani, B. (2016). The effectiveness of social skills training on autism spectrum disorder symptoms in adolescents: A Quasi-experimental study. *Journal of Research In Rehabilitation Sciences, 12*(4), 216–220. <https://doi.org/10.22122/jrrs.v12i4.2751>
- Pouretamad, Fathabadi, J., Sadeghi, S., & Shalani, B. (2017). The effectiveness of social skills training on autism spectrum disorder symptoms in adolescents: A Quasi-experimental study. *Journal of Research in Rehabilitation Sciences, 12*(4), 216–220.
- Rodriguez, G., Hartley, S. L., & Bolt, D. (2019). Transactional relations between parenting stress and child autism symptoms and behavior problems. *Journal of Autism and Developmental Disorders, 49*(5), 1887–1898.
- Sadeghi, S., & Pouretamad, H. R. (2022a). Cognitive predictors of behavioral inflexibility in young children with autism spectrum disorder symptoms [Research]. *Advances in Cognitive Sciences, 23*(4), 117–129. <https://doi.org/10.30514/icss.23.4.117>
- Sadeghi, S., & Pouretamad, H. R. (2022b). Executive functions predict restricted and repetitive behaviors in toddlers under 36 months old with autism spectrum disorder. *Infant Behavior and Development, 67*, 101721. <https://doi.org/10.1016/j.infbeh.2022.101721>
- Sadeghi, S., Pouretamad, H. R., & Fathabadi, J. (2017). Effectiveness of social skills training on behavioral problems and social skills in high-functioning adolescents with autism spectrum disorder (ASD). *Quarterly of Applied Psychology, 10*(4), 477–499.
- Sadeghi, S., Pouretamad, H., Khosrowabadi, R., Fathabadi, J., & Nikbakht, S. (2019a). Behavioral and electrophysiological evidence for parent training in young children with autism symptoms and excessive screen-time. *Asian Journal of Psychiatry, 45*, 7–12.
- Sadeghi, S., Pouretamad, H. R., Khosrowabadi, R., Fathabadi, J., & Nikbakht, S. (2019b). Effects of parent–child interaction training on children who are excessively exposed to digital devices: A pilot study. *The International Journal of Psychiatry in Medicine, 54*(6), 408–423. <https://doi.org/10.1177/0091217419837070>
- Sadeghi, S., Pouretamad, H. R., Khosrowabadi, R., Fathabadi, J., & Nikbakht, S. (2021a). Parent–child interaction effects on autism symptoms and EEG relative power in young children with excessive screen-time. *Early Child Development and Care, 191*(6), 827–836.
- Sadeghi, S., Pouretamad, H. R., & Shalani, B. (2021b). Internet-based versus face-to-face intervention training for parents of young children with excessive screen-time and autism spectrum disorder–like symptoms: a comparative study. *International Journal of Developmental Disabilities, 1–12*.
- Schnabel, A., Youssef, G. J., Hallford, D. J., Hartley, E. J., McGilivray, J. A., Stewart, M., Forbes, D., & Austin, D. W. (2020). Psychopathology in parents of children with autism spectrum disorder: A systematic review and meta-analysis of prevalence. *Autism, 24*(1), 26–40.
- Solano, P., Ustulin, M., Pizzorno, E., Vichi, M., Pompili, M., Serafini, G., & Amore, M. (2016). A Google-based approach for monitoring suicide risk. *Psychiatry Research, 246*, 581–586.
- Soltani, E., Shareh, H., Bahrainian, S. A., & Farmani, A. (2013). The mediating role of cognitive flexibility in correlation of coping styles and resilience with depression. *Pajoohandeh Journal, 18*(2), 88–96.
- Stange, J. P., Alloy, L. B., & Fresco, D. M. (2017). Inflexibility as a vulnerability to depression: A systematic qualitative review. *Clinical Psychology : A Publication of the Division of Clinical Psychology of the American Psychological Association, 24*(3), 245–276. <https://doi.org/10.1111/cpsp.12201>
- Vervaeke, J., Van Looy, J., Hoorelbeke, K., Baeken, C., & Koster, E. H. (2018). Gamified cognitive control training for remitted depressed individuals: User requirements analysis. *JMIR Serious Games, 6*(2), e8609.
- Wolkenstein, L., & Plewnia, C. (2013). Amelioration of cognitive control in depression by transcranial direct current stimulation. *Biological Psychiatry, 73*(7), 646–651.
- World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA, 310*(20), 2191–2194. <https://doi.org/10.1001/jama.2013.281053>
- Yorke, I., White, P., Weston, A., Rafla, M., Charman, T., & Simonoff, E. (2018). The association between emotional and behavioral problems in children with autism spectrum disorder and psychological distress in their parents: A systematic review and meta-analysis. *Journal of Autism and Developmental Disorders, 48*(10), 3393–3415.
- Yu, Y., Yu, Y., & Lin, Y. (2020). Anxiety and depression aggravate impulsiveness: The mediating and moderating role of cognitive flexibility. *Psychology, Health & Medicine, 25*(1), 25–36.

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