Validating instruments to screen intelligence in a setting for individuals with a substance use disorder

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Abstract

Background: The awareness of a mild to borderline intellectual disability (MBID) increases among patients who are in treatment for substance use disorders (SUD). Having a MBID is a risk factor for developing a SUD. The group of people with MBID is very heterogeneous, this makes it more difficult to recognize MBID. It is important to detect MBID, in order to not overcharge these individuals, and to account for the specific features of individuals with a MBID during treatment and diagnostic research. However, diagnostic instruments validated for the MBID population are scarce.

Purpose: Currently, the Wechsler Adult Intelligence Scale (WAIS-IV) is the preferred questionnaire within Tactus to analyze a patients intellectual functioning. The WAIS-IV is an extensive instrument and is validated among MBID individuals. However, because of its long and complex character, this instrument does not meet the specific features of patients with MBID symptoms, making this instrument less suitable. The purpose of this study is to validate screeners for intellectual functioning among this target group, which seem to meet the specific features of patients with MBID symptoms.

Method: Twelve patients who are in clinical treatment within one of the MBID departments of Tactus are included in this study by convenience sampling. The construct validity of the Montreal Cognitive Assesment (MoCA) and the Screener voor Intelligentie en Licht Verstandelijke Beperking (Screener for Intelligence and Mild Intellectual Disability; SCIL) is examined by a regression analysis between the scores on these tests and the corresponding scales of the WAIS-IV. Besides this, the sensitivity and specificity for detecting MBID of different cut-off scores of these screeners is considered by use of crosstabs, and is supported by a receiver operating characteristic analyse (ROC-analyse).

Results: The results of the regression analysis show a strong relationship, and a strong, significant correlation between the WAIS-IV and the MoCA, and an even stronger relationship and stronger significant correlation between the WAIS-IV and the SCIL. The relationship between indexes of the WAIS-IV and scales of the MoCA is questionable. Utilizing a cut-off score of 26 for the MoCA results in 100% sensitivity, and 50% specificity. Utilizing a cut-off score of 19 for the SCIL results in 70% sensitivity, and 100% specificity. A sensitivity of 100% is achieved when using a cut-off score of 23.

Conclusion: The MoCA and the SCIL are both valide instruments to screen intellectual functioning. It is suggested that the SCIL will be used as an screener for intellectual functioning, because of the strong, positive relationship with the WAIS-IV, with the assumption that the cut-off point for detecting MBID will be enhanced from 19 to 23.

Samenvatting

Achtergrond: De aandacht voor een licht verstandelijk beperkt of laag begaafd niveau (LVB) neemt toe onder patiënten die worden behandeld voor een stoornis in het gebruik van middelen. Het hebben van een LVB een risicofactor voor het ontwikkeling van een aan middelen gebonden stoornis. De groep mensen met LVB is heterogeen, dit maakt het moeilijk om LVB te herkennen. Het is van groot belang om LVB vast te stellen, om deze persoon niet te overvragen, en de behandeling en diagnostisch onderzoek aan te passen aan de specifieke kenmerken van de LVB-patiënten. Diagnostische instrumenten die gevalideerd zijn voor de LVB-populatie zijn echter schaars.

Doel: Momenteel is de Wechsler Adult Intelligence Scale (WAIS-IV) het favoriete instrument binnen Tactus Verslavingszorg om het intellectuele functioneren van een patiënt te analyseren. De WAIS-IV is uitgebreid en is gevalideerd onder personen met LVB. Vanwege zijn lange en complexe karakter sluit dit instrument echter niet aan bij de specifieke kenmerken van patiënten met LVB-symptomen, wat dit instrument minder geschikt maakt voor deze doelgroep. Het doel van deze studie is om screeners voor intellectueel functioneren onder deze doelgroep te valideren, die lijken aan te sluiten bij de specifieke kenmerken van patiënten met LVB-symptomen.

Methode: Twaalf patiënten die een klinische behandeling volgen binnen één van de LVB-afdelingen van Tactus, worden in dit onderzoek opgenomen middels gemakssteekproef. De constructvaliditeit van de Montreal Cognitive Assesment (MoCA) en de Screener voor Intelligentie en Licht Verstandelijke Beperking (SCIL) wordt onderzocht door een regressieanalyse tussen de scores op deze tests en de overeenkomende schalen van de WAIS-IV. Daarnaast wordt de sensitiviteit en specificiteit voor het detecteren van LVB van verschillende cut-off scores van deze screeners bekeken met behulp van kruistabellen, en wordt dit ondersteund door een receiver operating characteristic analyse (ROC-analyse).

Resultaten: De resultaten van de regressieanalyse tonen een sterke relatie en een sterke, significante correlatie tussen de WAIS-IV en de MoCA, en een nog sterkere relatie en een sterkere significante correlatie tussen de WAIS-IV en de SCIL. De relatie tussen indices van de WAIS-IV en schalen van de MoCA is in twijfel te trekken. Het gebruik van een cut-off score van 26 voor de MoCA resulteert in 100% sensitiviteit en 50% specificiteit. Een cut-off score van 19 voor de SCIL resulteert in een sensitiviteit van 70% en een specificiteit van 100%. Bij gebruik van een cut-off score van 23 wordt een sensitiviteit van 100% bereikt.

Conclusie: De MoCA en de SCIL zijn valide instrumenten om het intellectueel functioneren te screenen. Er wordt gesuggereerd dat de SCIL wordt gebruikt als screener voor intellectueel functioneren, vanwege de sterke, positieve relatie met de WAIS-IV, met de veronderstelling dat het cut-off-punt voor het detecteren van MBID zal worden verhoogd van 19 naar 23.

Validating instruments to screen intelligence in a setting for individuals with a substance use disorder

The abuse and misuse of drugs has become one of society's biggest problems: substance abusers often pay a high personal cost for their dependency, in terms of poor physical & mental health and premature death (Volksgezondheidszorg, 2019; Van Laar et al., 2017; Davey, 2014). Besides that, society pays a high cost in terms of lost productivity, traffic accidents, violence, crime, and the strain such abuse puts on national health resources (Goossens, 2012; Davey, 2014). The National Drug Monitor by van Laar et al. (2017) states that in the period of 2007 to 2009 there are 29.300 people with cannabis dependency and 40.200 cannabis abusers, 82.400 people with alcohol dependency and 395.000 alcohol abusers, 22.000 people with sedatives dependency and 35.000 sedative-abusers. In 2012, there were approximately 14.000 problematic users of opiates (van Laar et al., 2017). According to the fifth edition of the Diagnostic Manual for Mental Disorders (the DSM-5), a substance use disorder (SUD) can be determined when, besides using a substance, "there is a problematic pattern of using alcohol or another substance that results in impairment in daily life or noticeable distress" (American Psychiatric Association [APA], 2013).

Nowadays, the awareness of SUD among individuals with a mild to borderline intellectual disability (MBID) increases (Hammink & Schrijvers, 2012). MBID individuals have an IQ level between 50 and 85, limited social adaptability and a permanent need for help (Wechsler, 2012; Moonen & Verstegen, 2006). Bransen, Schipper & Blekman (2009) found in a exploratory research among 760 adolescents with a MBID, that 21% of the participants regularly used drugs, and 66% regularly used alcohol. Another study revealed that among 9.484 individuals with a MBID, 2.6 % abuses substances (Slayter, 2010). Taggart, McLaughlin, Quinn & Milligan (2006) found among 67 substance users with intellectual disabilities, that alcohol is the main substance to be misused. 20% of these individuals also poly-drug use prescribed medication and/or illicit drugs. Taggert et al. (2006) states that having a MBID is a risk factor for developing a SUD. Through difficulties with cognitive inhibition of behavior, experimenting with substances easily can turn into excessive use (Dijkstra, Bransen, & Leeman, 2011).

MBID individuals' level of intellectual functioning is lower than individuals without MBID. In everyday life, this means that these individuals have difficulties with e.g. self-insight, problem solving, reasoning and planning (APA, 2013). They mostly have a low self-esteem and are strongly impressionable (Clerkx & Trentelman, 2007). The deficits in adaptive

functioning results in deficits in communication, in social skills, in personal independence and in school or work functioning (APA, 2013). The group of people with MBID is very heterogeneous: each person has their own strengths and weaknesses, this makes it more difficult to recognize MBID. Among patients from addiction care, there appears to be a large number of people with an intellectual disability who have never been diagnosed as MBID before (Van der Nagel, Kiewik, Didden, 2017). Consequently, individuals with a MBID regularly will be 'overcharged': way too much is expected and asked from them for their level of abilities (Clerkx & Trentelman, 2007). Therefore, it is important to analyze whether a patient has a MBID or not, in order to not overcharge these patients in their daily lives, as well during their treatment, and to connect treatment and care to their abilities and needs. Analyzing MBID should be done by use of an instrument with sufficient psychometric quality among this population, in order to obtain useful and reliable test results. In practice, diagnostic instruments that are developed for individuals with MBID are scarce (Douma, Moonen, Noordhof & Ponsioen, 2014). Consequently, a lot of instruments are used for individuals with MBID, while they are only validated for individuals without MBID. With respect to the usefulness and reliability of the test results, it is important to take the specific features of individuals with MBID into account (Douma et al., 2014). Examples of these specific features are: difficulties with processing information, reduced ability to maintain attention and concentration, difficulties with self-reflection and abstraction, and a limited reading and linguistic level (Douma, 2018). Not only during diagnostic research the specific features of individuals with a MBID should be taken into account, also treatment interventions need to be adapted to these features (Douma, 2018). Individuals with a MBID benefit from a more intensive treatment which is characterized by one-to-one, practical guidance (Hammink & Schrijvers, 2012).

Tactus Verslavingszorg is an organization focused on treating, guiding and caring for people with a substance use disorder or behavioral addiction, and has three locations that are specialized in treating patients with the double diagnoses SUD & MBID. Patients who are presumed to have a MBID will be placed in one of these clinical departments. Within Tactus, 6,5% of the patients has a MBID (De Jong, van der Nagel, Kiewik, Kemna, 2009). In favour to analyze a patients level of intellectual functioning and hereby diagnose whether a patient has a MBID or not, the Wechsler Adult Intelligence Scale (WAIS-IV; Wechsler, 2012) will be used after 6 weeks of abstinence. The level of neuropsychological abilities improve by an increasing time of abstinence. Due to the period of 6 weeks of abstinence, the brain can regenerate and, consequently, blur around a patients intellectual functioning is prevented

(Walvoort, Wester & Egger, 2013). An advantage of the WAIS-IV is that it is extensive and provides a lot of information. Besides that, the WAIS-IV is validated among individuals who are MBID (Wechsler, 2012). On the other hand, the WAIS-IV is time-consuming, and the length of the test and the complexity of the questions seem to constitute a substantial threshold for individuals who are MBID (Van der Nagel, Kemna, Berenregt & Wits, 2017). In conclusion, it is recommended that the level of intellectual functioning will be analyzed by use of the WAIS-IV because of its good psychometric qualities and extensive character, but this instrument does not meet the abilities of the individuals with a MBID because of its complex and time-consuming character, just like a lot other diagnostic instruments which are used within Tactus.

Therefore, Tactus started a so called MBID-ROM study, with the purpose to validate suitable diagnostic instruments among individuals with SUD and symptoms of a MBID. The ultimate goal of the MBID-ROM study is to compile a test battery, appropriate to use as a Routine Outcome Monitoring (ROM) among these patients. The final MBID-proof ROM can be used as an indication for care and treatment and the evaluation of the provided treatment. This study also includes instruments that analyze intellectual functioning. In the MBID-ROM study, two screeners for intellectual functioning are included: the Montreal Cognitive Assesment (MoCA; Nasreddine et al., 1996) and the Screener voor Intelligentie en Licht Verstandelijke Beperking (Screener for Intelligence and Mild Intellectual Disability) (SCIL; Kaal, Nijman & Moonen, 2015).

The MoCa has an cut-off point of 26: a score of 26 points or higher is considered as ‘normal’, a score of 25 points or lower is considered as ‘signs for cognitive impairment’ (Nasreddine et al,, 1996). In a study by Van Dijk et al. (2016), it was investigated whether the MoCa is a suitable screening instrument for MBID, compared with the outcome of the WAIS-III-R (TIQ). It emerged that the MoCA is a suitable screener, compared with the TIQ from the WAIS-III-R. It is unknown how the correlation is with the more recent version of the WAIS, the WAIS-IV. The user manual of the WAIS-IV states that the results of the WAIS-III-R are on average 3.3 points higher than on the WAIS-IV (Wechsler, 2012).

The SCIL has an cut-off point of 19: a score of 18 or lower is classified as ‘probably MBID’. This is based on a research with 318 participants: 122 with a MBID and 196 without a MBID (Kaal, Nijman & Moonen, 2015).

The purpose of this research is to validate these screeners for intellectual functioning among individuals who suffer from SUD and have symptoms of a MBID. A big advantage of these screeners in comparison with the WAIS-IV is that the duration and the length of the test

is much shorter, with less complex questions, which makes this screeners more suitable among individuals with SUD and symptoms of a MBID.

Because the WAIS-IV is validated among the population with MBID, this is currently seen as the golden standard for analyzing a patients intellectual functioning. Research is necessary to examine whether the more suitable SCIL and the MoCA correlate with the WAIS-IV, in order to validate these screeners. The test results of the screeners will be compared to the results of the WAIS-IV.

Thereby, cut-off scores are prescribed from the literature to detect MBID. For the MoCA, this cut-off score is 26, and for the SCIL, this cut-off score is 19. It is valuable to analyze whether these cut-off scores also are applicable to this research group.

Therefore, the following research question is formulated:

"Are the MoCA and the SCIL valid instruments to use as a screener for intellectual functioning, used among the SUD population, who have symptoms of a MBID?"

The following sub-questions are formulated to answer the main research question:

1. "Do the patients scores on the WAIS-IV, correlate significantly with their results on the MoCA and the SCIL?"
2. "What are suitable cut-off points for detecting MBID?"

Method

Participants

The participants were collected by a convenience sampling method on voluntary basis. The data of the patients that started their clinical treatment in one of the MBID-departments of the Johannes Wierhuis in Rekken after September 1st 2018 is included in this study. These participants meet the criteria for SUD, and are placed in one of the MBID-departments on estimation, which means in some cases it is not (yet) estimated that a patient has a MBID. Given the fact that one of the instruments which is used in this study will be used after a abstinence-period of six weeks, a minimal clinical hospitalization of the duration of six weeks is required. Generally, an hospitalization has a duration of eight to ten weeks. Another inclusion criteria is that participants should agree with the informed consent by which they

authorize the use of their data, have an age of eighteen years or older, and master the Dutch language. After selecting participants who meet the inclusion criteria, the study contains a sample of 12. The characteristics of the participants can be found in table 1.

Apparatus

Wechsler Adult Intelligence Scale IV (WAIS-IV)

The WAIS-IV is an individually applicable clinical instrument which determines the intellectual capacity of adolescents and adults between the ages of 16 and 85 years old, and needs to be administered individually by a trained psychologist (Wechsler, 2008). Completing the test will take approximately two hours. Preferably, this test will be done in the morning and will be completed the same day, with a break between the subtests when necessary. As mentioned before, it is advisable to do the test when a person is at least six weeks abstinent from substances, because one's neuropsychological functioning improves by increasing the time of abstinence (Walvoort, Wester & Egger, 2013).

This instrument consists of 10 core-subtests and five optional subtests. These optional subtests can be used when there is a solid reason to assume that the performance on a core subtests is disturbed. In that case, the result on the core subtest will be replaced by the result of the optional subtest. The sum of the scaled scores of the 10 subtests provides an estimate of one's general intelligence level; expressed in the Total IQ (TIQ). Besides the TIQ, four underlying indexes can be calculated, namely the Verbal Comprehension Index (VCI), the Perceptual Reasoning Index (PRI), the Working Memory Index (WmI) and the Processing Speed Index (PsI). An overview of the indexes and corresponding core- and optional subtests can be found in appendix 1. The VCI is a measure for verbal concept formation, verbal reasoning and knowledge gained from the environment. The PRI is a measure for perceptual reasoning and fluid reasoning, spatial awareness and visual-motoric integration. In appeals to analyse, synthesis and non-verbal reasoning. The WmI is a measure for working memory, the capacity to temporarily hold information in the memory, perform some mental actions and produce a result. Attention, concentration, mental control and reasoning are of great importance for the results on the WmI. The PsI involves the patient's ability to quickly and accurately scan simple visual information, order it or make a distinction in this information. The visual short-term memory, attention and visual-motor coordination are important here.

The internal consistency of the WAIS-IV-NL can be classified as good. The values of the internal consistency between the subtests are predominantly above .80, between the indexes around or above 0.90, and the internal consistency of the TIQ is 0.97. The stability of the

WAIS-IV-NL can also be classified as good, analysed by the use of a test-retest-correlation. The correlation between the two test-retest-groups is 0.95. The criterion validity was analysed by calculating the correlations between educational level and the results of the WAIS-IV-NL. As expected, the IQ increases when the level of education increases, this is support for the predictive qualities of the WAIS-IV-NL (Wechsler, 2012).

A validity study is conducted among people with an mild intellectual disability (MID) (n = 30), which confirmed the validity of the WAIS-IV among MID individuals. It appears that a number of subtests has a floor effect, which means that there is insufficiently easy items to accurately measure one's functioning. Furthermore, a number of instructions are too difficult for this target group, but after practice items and start items, the assignment of the subtest is understood. Besides that, a quarter of the respondents in this study indicate that they have difficulty with the time pressure in certain subtests (Wechsler, 2012).

Montreal Cognitive Assessment (MoCA)

The Montreal Cognitive Assessment (MoCA; Nasreddine et al., 1996) was designed to detect mild cognitive impairment. The MoCA consists of 11 items assessing six multiple cognitive domains: executive functioning (EF), visuospatial abilities (VA), attention, concentration and working memory (ACW), language (L), short-term memory (STM) and orientation (O). The maximum score that can be achieved is 30, whereby a score of 26 points or higher is considered as 'normal'. The MoCA needs to be individually administered by a psychologist, and completing the MoCA takes approximately 10 minutes (Nasreddine et al., 1996). In this research, the MoCA will be administered in week one, six, and in the last week of a patients hospitalization, whereby there will be no learning effect because of the three parallelversions of the Dutch MoCA (7.1, 7.2 and 7.3). These versions will be randomly assigned to the three measurement moments.

In practice, the MoCA is a frequently used screening tool for the detection of cognitive impairment. Ozer, Young, Champ and Burke (2016) indicated that the MoCA has been analyzed most extensively with respect to other neurological screeners. The validation study of Nasreddine et al. (1996) implicates that the MoCA has a sensitivity of 90% detecting a mild cognitive impairment (MCI), and a 100% sensitivity for detecting mild Alzheimer's disease. The validation study of Smith, Gildeh and Holmes (2007) also implicates that the MoCA is a useful brief screening tool, with a sensitivity of 83% for detecting MCI and a 94% sensitivity for detecting dementia.

A study that assessed the validity, accuracy and clinical utility of the MoCA for identifying cognitive impairment among SUD patients states that the MoCA is a time-efficient and resource-conscious way to identify neuropsychological impairment in SUDS patients, with a sensitivity of 83.3% and a specificity of 72.9% (Copersino et al., 2009).

Summarizing, in practice the MoCA is a useful screening tool for detecting cognitive impairment. As mentioned earlier, in a study by Van Dijk et al. (2016) was emerged that the MoCA is also a suitable screener for detecting MBID with a cut-off point of 26. The sensitivity in the population with a SUD is 83% and the specificity is 59%, compared with the results of the WAIS-III (TIQ).

Screener voor Intelligentie en Licht Verstandelijke Beperking

The Screener voor Intelligentie en Licht Verstandelijke Beperking (Screener for Intelligence and Mild Intellectual Disability) (SCIL; Kaal, Nijman & Moonen, 2015) was designed to detect an IQ lower than 85 in a more easy way. The SCIL is a list with questions and assignments which need to be administered individually, which will take approximately five to ten minutes. The questions are about education, contact with organisations especially for MBID and contacts with family. The assignments are aimed at mathematics, understanding proverbs, reading and writing. The maximum score that can achieved is 28 (Kaal, Nijman & Moonen, 2015). In this research the SCIL will be administered in week one of a patients hospitalization.

The internal consistence of the SCIL has a value of a = 0.83 for the respondents of 18 years and older (n = 318). This finding confirms a high internal consistency between the 14 items of the SCIL, because a chronbach's alpha of $\alpha = 0.80$ is considered 'optimal' (Kaal, Nijman & Moonen, 2015). The test-retestreliability of the SCIL is r = 0.92, which confirms a high test-retestreliability. In this research population (n = 138) with a cut-off point of 19.5, the sensitivity for detecting MBID is 82% and the specificity is 89% (Kaal, Nijman & Moonen, 2015).

Analyses

Statistical Package for Social Sciences (SPSS) is used to analyse the data (version 23). The data consists of some general variables e.g. gender and age, five variables which consists of the WAIS-IV scores (TIQ, VCI, PRI, WmI and PsI), seven variables which consists of the MoCA scores (EF, VA, ACW, L, STM, O and the total score (TOT)) and one variable which

consists of the total score of the SCIL. To get insight in the respondent characteristics, frequency tables are used. These can be found in table 1.

Table 1

Characteristics of participants (n = 12)

Variable	
Gender	
- Male, n (%)	11 (91,7 %)
- Female, n (%)	1 (8,3 %)
Age	
- Mean (SD)	31,92 (8,99)
- Range (min – max)	22 – 53
IQ	
- MID (IQ 50-70), n (%)	7 (58,3 %)
- BIF (IQ 71-85), n (%)	3 (25 %)
- Other (IQ > 85), n (%)	2 (16,6 %)

To examine the construct validity and hereby answer the first sub-question if the patients scores on the WAIS-IV correlate significantly with their results on the MoCA and the SCIL, a quantitative correlation study is conducted by use of a simple linear regression analysis. All the variables involved are measured on interval level. The scores of the WAIS-IV will be selected as the independent variable, the results of the MoCA and the SCIL will be selected as the dependent variable.

First of all, a scatter chart will be carried out for the TIQ of the WAIS-IV (X-as) and the total score of the MoCA (Y-as), and for the TIQ of the WAIS-IV (X-as) and the total score of the SCIL (Y-as). Additionally, the subscales of the MoCA will also be added to this validation study. For the combinations of WAIS-IV-scores (X-as) and MoCA-scores (Y-as) which are likely to measure the same construct based on their descriptions, a scatter chart will be carried out. An overview of the combinations can be found in table 2.

Table 2

Combinations of variables for which a scatter chart is carried out

	X-as	Y-as
1	Total IQ (WAIS-IV)	Total score (MoCA)
2	Total IQ (WAIS-IV)	Total score (SCIL)
3	Verbal Comprehension Index (WAIS-IV)	Language (MoCA)
4	Perceptual Reasoning Index (WAIS-IV)	Visuospatial abilities (MoCA)
5	Working Memory Index (WAIS-IV)	Attention, Concentration and Working Memory (MoCA)
6	Processing Speed Index (WAIS-IV)	Visuospatial abilities (MoCA)

Carrying out a scatter chart will provide insight whether two variables are related, whether it is reasonable to assume that the relation between them is linear and the possible presence of outliers (Stern, 2014). A best fitting regression line will be added to the plot. Extreme scores can confound the test results because of a small sample size (< 30) (Baarda, de Goede, & van Dijkum, 2007). Outliers in the scatter chart will be analyzed by use of the Cook's distance, whereby a Cook's distance (D_i) of $D_{i =} .05$ or higher means that the data point may be influential and is worthy further investigation. A Cook's distance of $D_i = 1$ or higher means that the data point is quite likely to be influential (Pensylvania State University, 2018). The cut-off point for indicating a relationship between two variables or not is $R^2 = .35$. R^2 gives the value of the response variable variation that is explained by a linear model, so the higher the R^2, the better the linear model fits the data (The Minitab Blog, 2013). The combinations of which the scatter chart indicates a relationship are selected to the sequel of the simple linear regression analysis.

Secondly, the correlation coefficient (r) will be analyzed by use of the simple linear regression analysis for the selected combinations. The degree of coherence between the two variables is indicated by use of Pearon's correlation coefficient (r). The correlation coefficient (r) can be seen as an index of the distribution of the data points around the regression line (Howit & Cremer, 2007). The correlation is significant if $p < .05$ and the correlation is high if $r \geq .50$ (Cohen, 1988). High correlation ($r \geq .50$; $p < .05$) between the WAIS-IV and the MoCA and between the WAIS-IV and the SCIL is an indication for the construct validity of the MoCA and the SCIL. Because of the small sample size ($n < 30$), a non parametric analysis is executed to examine the relationship between the selected combinations of variables, by use of a Spearman correlation analysis. The findings of the Spearman correlation analysis can

confirm or contradict the findings of the Pearson correlation analysis.

For answering the second sub-question what suitable cut-off point for detecting MBID in this research population are, crosstabs are conducted. The TIQ scores of the WAIS-IV indicate mild or borderline intellectual disability (MBID: IQ 50-85). TIQ scores that outreach this ranges are specified as 'normal' (IQ > 85). At first, new variables are created: WAIS_CAT with the categories 1 = MBID (IQ 50-85) and 2 = no MBID (IQ > 85), MOCA_CAT with the categories 1 = signs for cognitive impairment (total score $\leq$ 25) and 2 = normal (total score $\geq$ 26), and SCIL_CAT with the categories 1 = probably MBID (total score $\leq$ 18), and 2 = probably no MBID ($\geq$ 19). The raw scores of the respondents are assigned to the corresponding category. The variable WAIS_CAT is selected as row variable in the crosstab analysis, and the variables MOCA_CAT and SCIL_CAT are selected as column variables.

Additionally, a receiver operating characteristic analyse (ROC-analyse) will be carried out to analyse the predictive value in terms of the area under the curve value (AUC-value), over the different possible cut-off points of the SCIL & MoCA with regard to determine whether a individual has a MBID or not. The ROC-analyse is a useful way to interpret the sensitivity (right positive test results among the individuals with MBID) and specificity (right negative test results among individuals without MBID) of diagnostic tests. An AUC-value of over 0.75 is considered to be qualified as high or large by authors who are involved in the development of instruments for recidivism risk in forensic psychiatric patients (Douglas et al., as cited in Kaal, Nijman & Moonen, 2015).

Procedure

The patients who started their hospitalization in one of the MBID-departments of Tactus after September 1st 2018 were analyzed by a desk study whether they meet the inclusion criteria for being included as respondents. As mentioned before, this research is part of an comprehensive study in Tactus, the so called 'MBID-ROM study', which is approved by the scientific committee of Tactus. A part of the data-collection is done by psychologists, and a part is done by socio-therapists. The required data for current research is selected out of the data which is obtained by use of the compiled test battery for the MID-ROM study.

Results

Scattercharts of the relevant combinations of variables are appended as figures ($R^2 \geq .35$). Also the scatterchart of the TIQ of the WAIS and the total score of the SCIL is appended as a figure. When analysing outliers in these scattercharts on individual level by use of the Cook's distance, no noticeable deviations occur.

In table 3 the results of the simple linear regression analysis can be found. Within this sample, there is clearly a positive relationship (WAIS x SCIL: $R^2 = .66$; WAIS x MoCA: $R^2 = .48$) between the total scores of the two screening instruments and the Total IQ of the WAIS-IV. The correlation is strong and significant (WAIS x SCIL: $r = .81$; $p = .001$; WAIS x MoCA: $r = .68$; $p = .02$).

As mentioned earlier, not only the total score but also the subscales of the MoCA are part of this validation study. In table 2, the combinations of variables are presented which measure approximately the same construct, so of which is expected that there is a relationship. Between the Working memory Index of the WAIS-IV and the Attention, Concentration and Working Memory-scale of the MoCA consists a positive relationship ($R^2 = .58$), and a strong, significant correlation ($r = .76$; $p = .004$). Also between the Processing speed Index of the WAIS-IV and the Visuospatial Abilities-scale of the MoCA consists a positive relationship ($R^2 = .39$), and a strong, significant correlation ($r = .62$; $p = .03$).

Despite the similarities in description, there seems no relationship and/or correlation between the Verbal Comprehension Index of the WAIS-IV and the Language-scale of the MoCA, and no relationship and/or correlation between the Perceptual Reasoning Index of the WAIS-IV and the Visuospatial Abilites-scale of the MoCA.

Table 3

Overview of the parametric and non-parametric results of relationship between the WAIS-IV and the SCIL, and between the WAIS-IV and the MoCA

Figure	Variables	R^2	F (P)	r (P)	rs (P)	B	95% CI
3	TIQ (WAIS-IV) x Total score (SCIL)	.66	19.10 (.001)	.81 (.001)	.84 (.001)	.37	.18 - .56
4	TIQ (WAIS-IV) x Total score (MoCA)	.48	9.04 (.01)	.68 (.02)	.69 (.01)	.16	.03 - .286
5	WmI (WAIS-IV) x ACW (MoCA)	.58	14.03 (.004)	.76 (.004)	.67 (.02)	.05	.02 - .07
6	PsI (WAIS-IV) x VA (MoCA)	.39	6.34 (.03)	.62 (.03)	67 (.02)	.03	.004 - .062

Non-parametric correlation

Regarding the small sample size, it is difficult to determine whether the data meets the assumptions for a parametric test, e.g. whether the data is normally distributed. Consequently, a Spearman correlation analysis is conducted to confirm the findings of the Pearson correlation analysis. Also these findings can be found in table 3. The Spearman correlation (rs) shows a strong, positive relationship between all the presented combinations of variables. The p-values are smaller than the significance level (α =.05), this means there is statistical evidence for these positive relationships. The findings of the Spearman correlation analysis confirm the findings of the Pearson correlation analysis.

Sensitivity and specificity

To analyze the sensitivity and specificity of the suggested cut-off points, and to analyse the most suitable cut-off point of the screeners for detecting a Mild to Borderline Intellectual Disability, crosstabs are made and a ROC analysis is carried out for the SCIL and the MoCA.

SCIL

In table 4, the sensitivity and specificity for different cut-off points of the SCIL for detecting MBID can be found. The designers of the SCIL advises a cut-off score of 19, whereby a score of 19 or higher indicates that a individual probably has no MBID, and a score of 18 or lower indicates that a individual probably has a MBID (Kaal, Nijman, & Moonen, 2015). In this sample, that cut-off score of the SCIL is 70% sensitive and 100% specific.

Table 4

Sensitivity and specificity for different cut-off points of the SCIL for detecting MBID (n= 12)

Cut-off score	**TP**	**FP**	**TN**	**FN**	**Sensitivity % (95% CI)**	**Specificity % (95% CI)**
23	10	1	1	0	100% (69.15% - 100%)	50% (1.26% - 98.74%)
22	8	1	1	2	80% (44.39% - 97.48%)	50% (1.26% - 98.74%)
21	8	1	1	2	80% (44.39% - 97.48%)	50% (1.26% - 98.74%)
20	7	1	1	3	70% (34.75% - 93.33%)	50% (1.26% - 98.74%)
19	**7**	**0**	**2**	**3**	**70% (34.75% - 93.33%)**	**100% (15.81% - 100%)**

Note. TP = True Positive, FP = False Positive, TN = True Negative, FN = False Negative

Additionally, a ROC-analyse is carried out. In figure 1, the corresponding figure can be found. The area under the curve value is .85 which indicates a good balance between sensitivity and specificity. The 95% confidence interval lies between .58 and 1.

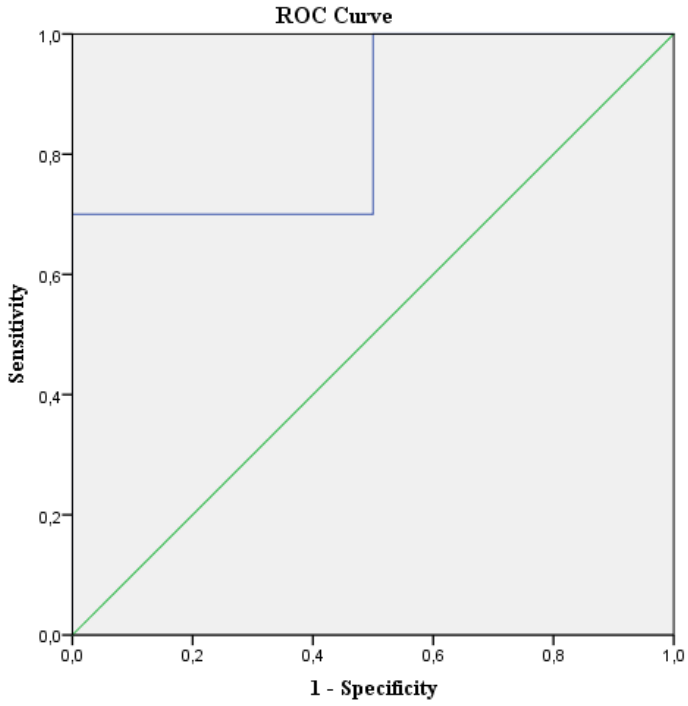

Figure 1. Receiver operating characteristic-curve of the SCIL

MoCA

In table 5, the sensitivity and specificity for different cut-off points of the MoCA for detecting MBID can be found. The designers of the MoCA advises a cut-off score of 26, whereby a score of 26 or higher indicates 'normal', and a score of 25 or lower indicates signs for cognitive impairment (Nasreddine et al., 1996). In this sample, this cut-off score of the MoCA is 100 % sensitive and 50 % specific.

Table 5

Sensitivity and specificity for different cut-off points of the MoCA (n = 12)

Cut-off score	TP	FP	TN	FN	Sensitivity % (95% CI)	Specificity % (95% CI)
26	**10**	**1**	**1**	**0**	**100% (69.15% - 100%)**	**50% (1.26% - 98.74%)**
25	7	1	1	3	70% (34.75% - 93.33%)	50% (1.26% - 98.74%)
24	7	1	1	3	70% (34.75% - 93.33%)	50% (1.26% - 98.74%)
23	5	0	2	5	50% (18.71% - 81.29%)	100% (15.81% - 100%)

Note. TP = True Positive, FP = False Positive, TN = True Negative, FN = False Negative

Additionally, a ROC-analyse is carried out. In figure 2, the corresponding figure can be found. The area under the curve value is .8, which indicates a good balance between sensitivity and specificity. The 95% confidence interval lies between .46 and 1.

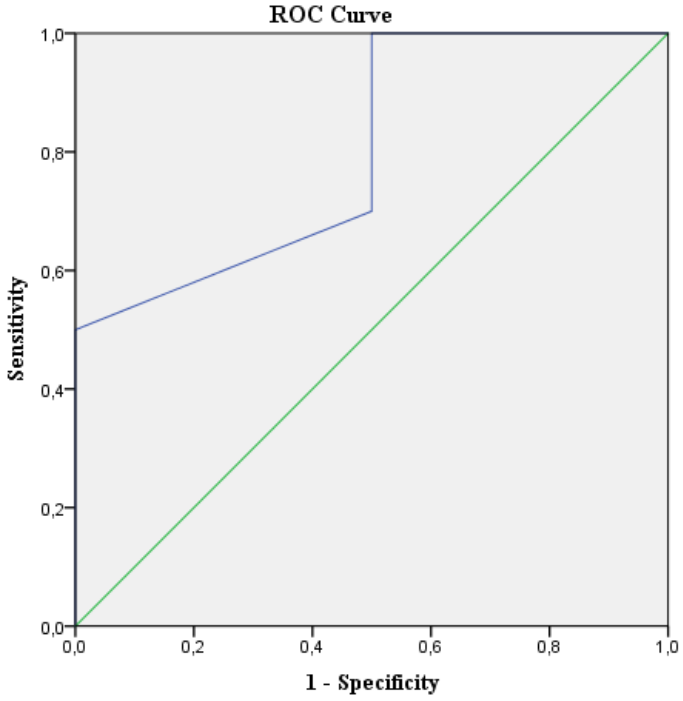

Figure 2. Receiver operating characteristic-curve of the MoCA

Discussion

Main results

In addiction care, the double diagnosis with MBID is frequently overlooked, making the treatment suboptimal. The WAIS-IV is an extensive and valid instrument to analyze someone's intellectual functioning, but is also very stressful for this target group due to its

time-consuming and complex character. To burden these clients as little as possible, screeners for intellectual functioning are needed. In this validation study, the purpose was to validate two screeners to detect a mild intellectual disability or borderline intellectual functioning (MBID) among individuals who meet the criteria for a substance use disorder (SUD): the Montreal Cognitive Assessment (MoCA) and the Screener voor Intelligentie en Licht Verstandelijke Beperking (SCIL). Twelve patients who are in clinical treatment within one of the MBID departments of Tactus are included in this study by convenience sampling. The results of the parametric and non-parametric analyses tentatively suggest that the SCIL and the MoCA are valid screeners to detect MBID among this research population. The correlation coefficients with the WAIS-IV TIQ ranges from .81 for the SCIL to .68 for the MoCA. Also the underlying scales of the MoCA took part of this validation study, but the corresponding results show a questionable validity: between indexes and scales which are supposed to measure approximately the same construct, relationships were expected, but did not occur in all cases.

Additionally, the sensitivity and specificity of the prescribed cut-off scores of the SCIL (19) and the MoCA (26) for detecting a MBID were examined by crosstabs and ROC-analyses. A cut-off score of 26 for the MoCA results in an excellent sensitivity (100%), and a moderate specificity (50%). A cut-off score of 19 for the SCIL results in a moderate sensitivity (70%), and excellent specificity (100%). In order to prevent overlooking MBID among individuals who have a MBID , the optimal cut-off point preferably ensures zero false negatives, so the sensitivity is preferably 100%, with in addition the highest possible specificity. The results suggest that a higher cut-off score for the SCIL should be considered, because this would result in a higher sensitivity. Using a cut-off score of 23 results in an excellent sensitivity.

Discussion, limitations and suggestions for future research

Although results are found that support the construct validity of the MoCA and the SCIL, there should be paid attention to the fact that the analyses and corresponding results are based on scores of 12 participants. This small sample size is one of the biggest limitations of this research: it reduces statistical power, which might ensure that the results are less reliable. Interpreting the results should be done thoughtfully.

Besides a reduction in statistical power, the small sample size makes it impossible to ensure that the data is normally distributed, which is an assumption for parametric tests. The regression analysis could display biased results. In this research, non-parametric analyses

‘Spearman’ are executed, to support the found correlations of the regression analyses, and to reduce the chance to draw a false conclusion. The Spearman correlation shows a strong, significant and positive relationship between the variables, so the findings of the non-parametric tests confirm the findings of the parametric tests, regarding the strong, significant and positive correlation that is found between the WAIS-IV and the SCIL and between the WAIS-IV and the MoCA.

The primary goal of statistics is to generalize results from a research sample to a population, in this case to the patient population of Tactus Verslavingszorg with MBID. Because of the small sample size of this research, the generalizability of the found results is questionable. Selection bias might occur in a small sample size, which can cause homogeneity of the sample, which consequently might cause a lower generalizability. The sample remained small by two reasons: there was a lower inflow than expected and there were drop-outs because the duration of their treatment was too short to collect the required data. Because of the practical nature of these reasons, the presence of selection bias seems unlikely. Besides that, no noticeable deviations occur when analysing outliers in the scattercharts, which implies no observations might have influenced the regression line. The probability that the research sample represents the patient population of Tactus who are MBID increases by these findings.

When analysing the characteristics of the respondents, it is noticeable that the sample largely consists of men (n = 11), and only one woman is represented. According to Wisselink, Kuijpers & Mol (2016), the male-female ratio remained constant over the past 10 years among patients in addiction care, whereby 25% of the requests for help comes from a female and 75% from a male. In this study, females seem underrepresented when compared by these findings, which makes the results less generalizable.

As mentioned earlier, the small sample size seems a big limitation of this study, but this does not imply that the found results are meaningless. The small sample size can be seen as a strength, because despite the small sample, strong, positive and significant correlations are found. The results of the regression analysis confirms preliminary a good construct validity of the SCIL and the MoCA among the population with the double diagnoses MBID and SUD.

Future research with a larger amount of participants is advisable. A bigger sample size will probably increase the statistical power and thereby the reliability of the results, and also the generalizability of the results will probably increase. Another advise for future research is to append qualitative research to analyze the user-friendliness of the SCIL and the MoCA among the MBID-individuals, for example with an interview after completing the screeners. The

questions of the interview should consist of questions which take the specific features of MBID individuals into account, such as limited reading and linguistic level, reduced concentration arc and difficulties with abstraction and with self-reflection (Douma, 2018). The obtained information can contribute to the evaluation of the user-friendliness of the MoCA and the SCIL among these research population.

With regard to the reliability of this study, the time lag of four weeks between the measures of the SCIL and the WAIS-IV and between the MoCA and the WAIS-IV could have a negative influence. This time lag might ensure a reduction of the reliability of the results because of a greater chance on variety in the scores on the SCIL and the MoCA, and the WAIS-IV, possibly caused by detoxifying from the substance or by treatment effects. The fact that the level of neuropsychological abilities improve by an increasing time of abstinence (Walvoort, Wester & Egger, 2013), implicates that the substances could possibly have a negative effect on the results of these tasks, and would occur more often by use of the SCIL and the MoCA (measured after one week of abstinence) in comparison by use of the WAIS-IV (measured after six weeks of abstinence). This limitation possibly could ensure a less strong relationship between the MoCA and the WAIS-IV and between the SCIL and the WAIS-IV. Where overestimation individuals with a MBID is a recurring theme, the negative effects of the substances on the neuropsychological functioning of the individuals during the first week of abstinence will be more likely to ensure an underestimation of the individuals. The assumption to measure cognitive functions after six weeks of abstinence (Walvoort, Wester & Egger, 2013), does not match with the screening character of the MoCA and the SCIL.

In this research, the results from the WAIS-IV are used as the reflection of a person's intelligence. By use of this reflection, it is important to bear some factors in mind. Firstly, in the majority of the analyzes, the TIQ of the WAIS-IV is used as a reflection of a person's intelligence, while the WAIS-IV manual indicates that the TIQ should not be seen as a representative reflection of a person's intelligence when there is a significant difference between the underlying indices. If there is a suspicion that the Working Memory Index and/or the Processing Speed Index presses the TIQ down, the General Skill Index (GSI) can be calculated as an alternative. In such case, the use of the GSI is preferable to the use of the TIQ (Kooij, 2012). Additionally, in further research there should be paid attention to a possible floor effect of the WAIS-IV. The manual indicates that possibly the amount of easy items is too low to measure one's intelligence when an individual's intelligence is located at the bottom of the range for an intellectual disability. In this research, the result of one participant

is located at the bottom of the range, namely TIQ = 50, so the result of one participant might have a floor effect.

Final statement

In favour of the validation of the SCIL and the MoCA among MBID individuals with SUD, significant effects are found, which support the construct validity of these screeners. However, future research with a larger sample size is necessary to draw more certain, more in-depth and more reliable conclusions. Despite that, the findings of this research enables to give suggestions for using a intelligence screener. Firstly, it is suggested that the SCIL will be used as an intelligence screener, because of the strong, positive relationship with the WAIS-IV, with the assumption that the cut-off point for detecting MBID will be enhanced from 19 to 23. Finally, the third suggestion is to append qualitative future research to analyze the user-friendliness of the SCIL among this population.

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Figures

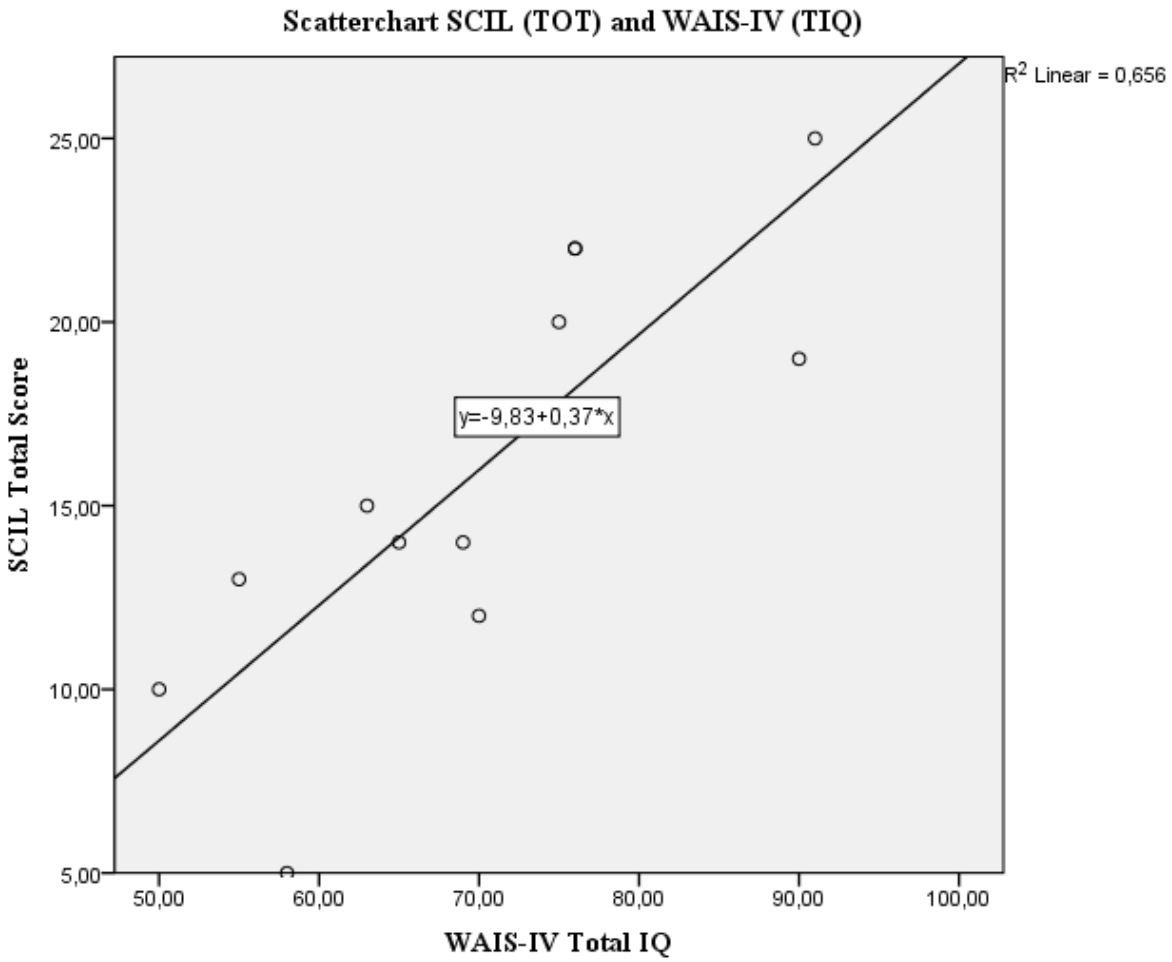

Figure 3. Scatterchart of the TIQ's (WAIS-IV) and the total scores (SCIL)

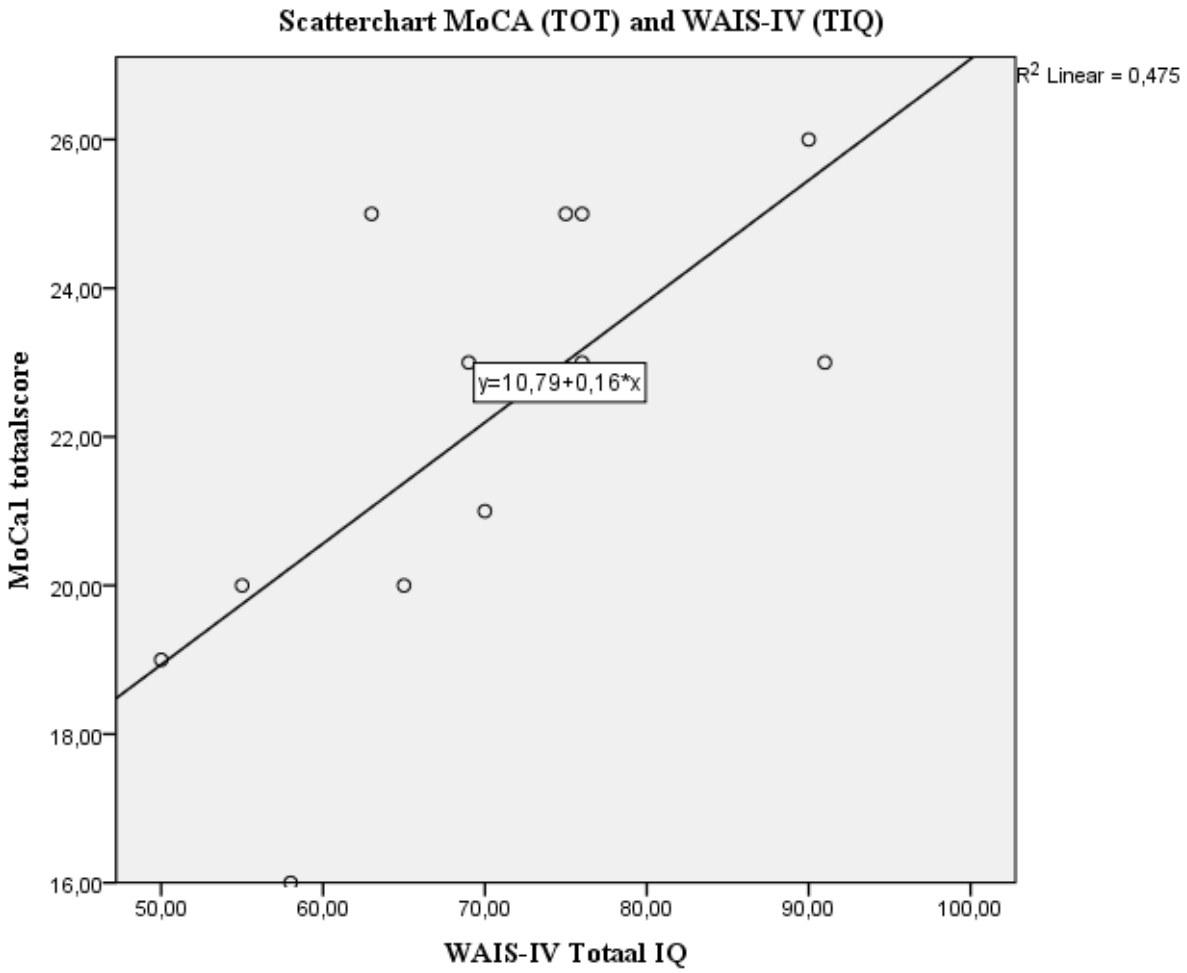

Figure 4. Scatterchart of the TIQ's (WAIS-IV) and the total scores of the MoCA

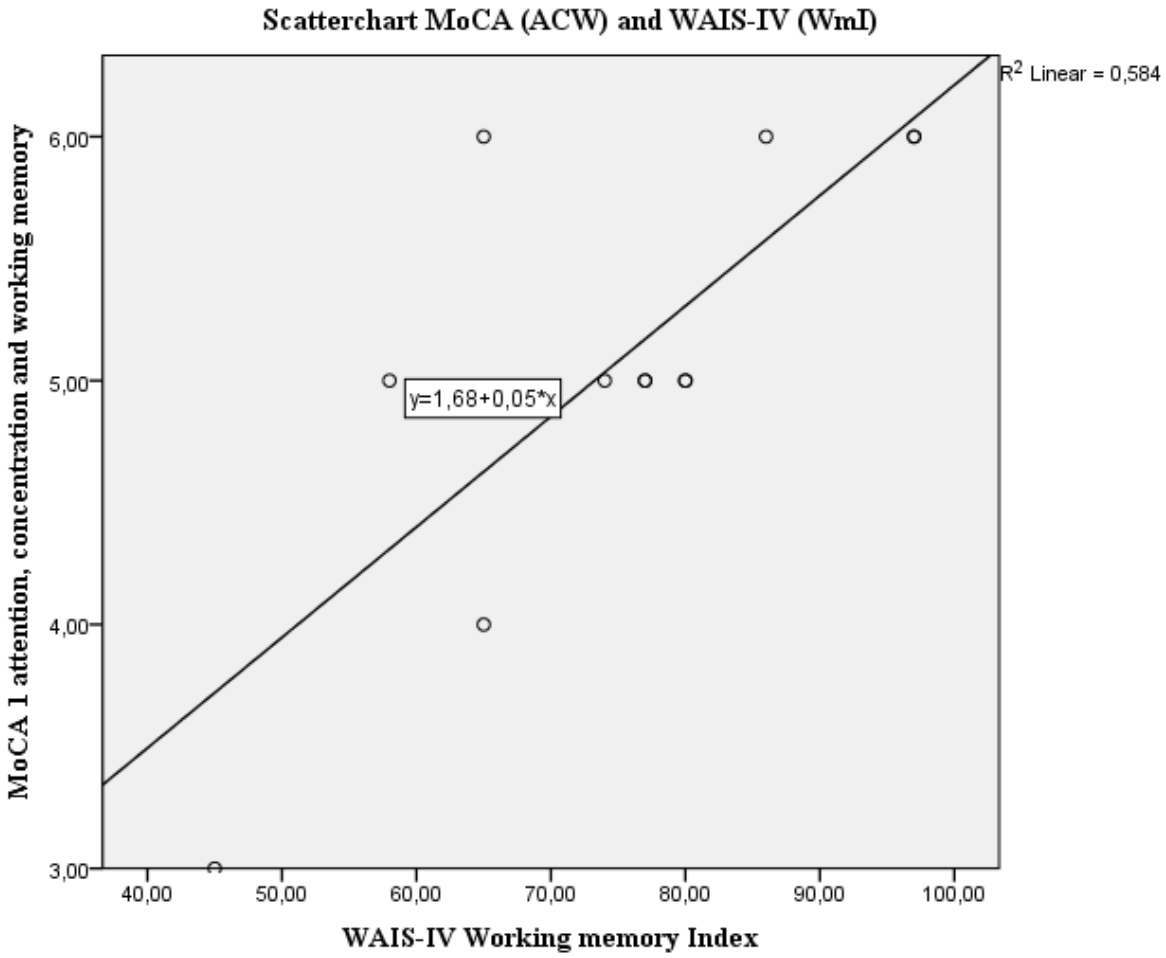

Figure 5. Scatterchart of the scores on the WmI (WAIS-IV) and on ACW (MoCA)

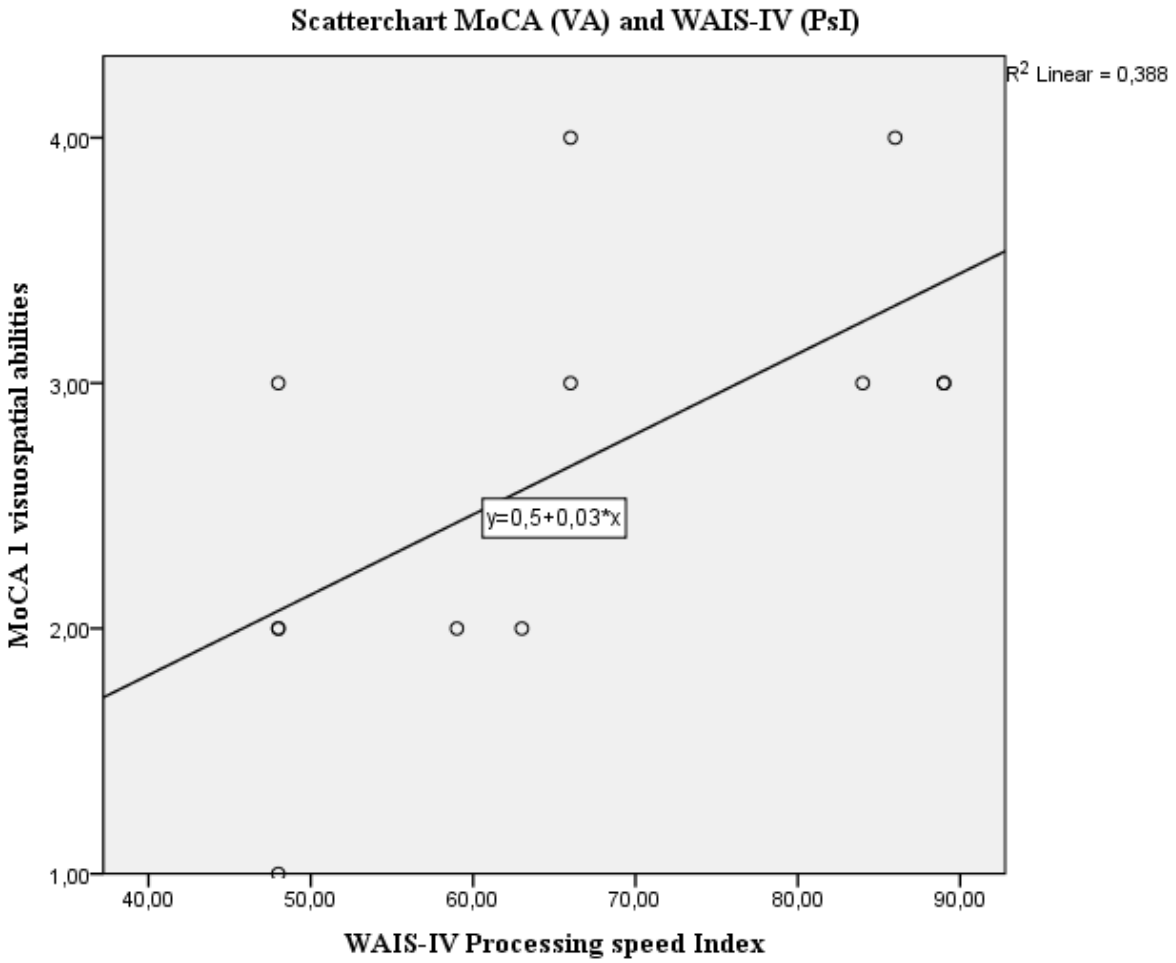

Figure 6. Scatterchart of the scores on PsI (WAIS-IV) and on VA (MoCA)