# ASSESSMENT OF THE INTERNAL CONSISTENCY AND CONCURRENT VALIDITY OF THE MEDICATION ADHERENCE REASONS SCALE (MAR-SCALE) IN AN ATTENTION-DEFICIT/HYPERACTIVITY DISORDER POPULATION-BASED SAMPLE

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## Abstract

**OBJECTIVES:** To validate the Medication Adherence Reasons Scale (MAR-Scale) in an adult attention-deficit/hyperactivity disorder (ADHD) population and to describe reasons for non-adherence to oral stimulants among adults with ADHD.

**METHODS:** Adults (aged ≥18 years) who self-reported being diagnosed with ADHD and were currently being treated with oral stimulants (for ≥3 months) participated in this cross-sectional observational survey. The survey included questions regarding sociodemographic characteristics, ADHD symptom level (Adult ADHD Self-Report Scale Version 1.1 Symptom Checklist [ASRS-v1.1]), medication adherence (MAR-Scale and Morisky Green Levine Medication Adherence Scale [MGLS]), and work productivity loss and non-work activity impairment (Work Productivity and Activity Impairment-General Health [WPAI-GH] questionnaire). MAR-Scale reliability was evaluated using Cronbach's α, with an α >0.70 being considered acceptable. Pearson correlations assessed MAR-Scale validity versus the MGLS, ASRS-v1.1, and WPAI-GH. Reasons for non-adherence, based on the 19-item MAR-Scale, are reported descriptively using percentages.

**RESULTS:** A total of 602 respondents completed the survey. The mean ± SD age of respondents was 40.26±14.51 years. Most respondents were female (77.1%), white (89.5%), and employed (65.0%). MAR-Scale overall score demonstrated acceptable reliability when its items were treated as 4 separate domains (Cronbach's α=0.79) and when all 19 items were considered as one scale (Cronbach's α=0.80). MAR-Scale and MGLS overall scores were significantly correlated (r=0.65; P<0.001), with both scales classifying approximately 65% of respondents as non-adherent. The most frequently reported reason for non-adherence was "I would have taken it but simply missed it" (33.72%). The MAR-Scale overall score was significantly and positively correlated (all P<0.001) with overall work productivity impairment (r=0.32), activity impairment (r=0.19), and ADHD symptom level (r=0.25).

**CONCLUSIONS:** The MAR-Scale demonstrated acceptable validity in adults with ADHD. MAR-Scale overall score was significantly and positively correlated with the MGLS overall score, ADHD symptom level, work productivity loss, and non-work activity impairment.

## Introduction

- Adult attention-deficit/hyperactivity disorder (ADHD) is associated with impaired function across multiple domains and with increased healthcare resource utilization and costs.[1,2]
- ADHD pharmacotherapy improves functioning in adults with ADHD, but medication adherence is poor in some adults with ADHD.[3-5]
  - Depending on the measure of adherence, studies in adults diagnosed with ADHD have suggested that 22% to 44% of adults with ADHD do not adequately adhere to their prescribed ADHD pharmacotherapy.[4]
- It is important to better understand why patients with ADHD may not adhere to their prescribed pharmacotherapy because poor adherence to medication reduces the efficacy of ADHD treatment and increases work productivity loss and related indirect costs.[6,7]
  - However, there are relatively limited data describing the reasons for non-adherence to oral ADHD pharmacotherapy among US adults with ADHD.
- The Medication Adherence Reasons Scale (MAR-Scale) is a validated self-report measure that has been used to assess medication non-adherence across different disease conditions, but it has not yet been used to examine adherence in adults diagnosed with ADHD.[8]

## Objectives

- To validate the MAR-Scale in adults diagnosed with ADHD and to describe reasons for non-adherence to oral stimulant medication among adults with ADHD.

## Methods

### Study Design and Procedures

- This cross-sectional, observational online survey was conducted between May 8, 2018 and July 27, 2018 among adults who self-reported an ADHD diagnosis by a healthcare provider.
- Potential participants were e-mailed an internet link to the survey, which took approximately 20 minutes to complete and included questions related to medication adherence, work productivity, ADHD symptoms, demographics, and health characteristics.
- The protocol and questionnaire were reviewed and approved by the Sterling Institutional Review Board (Atlanta, GA, USA).

### Participants

- Participants were recruited from the US National Health and Wellness Survey (n=73) and additional healthcare ailment panels (n=529; Lightspeed Health, Research Now, Survey Sampling International, and Toluna).
- Participants were required to meet the following criteria:
  - ≥18 years of age
  - Diagnosed with ADHD
  - Currently treated for ≥3 months with oral psychostimulants
  - Access to a computer and ability to access the survey website
  - Willing and able to provide informed consent

### Measures

- The MAR-Scale is a self-report measure assessing 19 reasons for medication non-adherence that encompass 4 domains (logistics [8 items], beliefs [4 items], forgetfulness [4 items], and long-term concerns [3 items]); the scale also includes a question assessing the self-reported frequency of non-adherence in the past 7 days.[8]
  - Items are initially scored in a "yes/no" format; a "yes" response to any reason is scored with a value of 1 (total score range: 0–19; higher values indicate more complex non-adherence) and is followed up with a query about the number of days medication was missed in the past week due to that reason (range: 0–7 days).
  - Participants with scores ≥1 were considered non-adherent and participants with scores of 0 were considered adherent.
- The Morisky Green Levine Medication Adherence Scale (MGLS) is a 4-item self-report measure of medication-taking behavior or adherence among prescription medication users.[9]
  - In this study, participants with MGLS scores ≥1 were considered non-adherent and those with scores of 0 were considered adherent.
- The Work Productivity and Activity Impairment Questionnaire–General Health (WPAI-GH) is a 6-item validated self-report that assesses the impact of health on work productivity (absenteeism [absence from work], presenteeism [time unproductive at work due to sickness], and overall work productivity loss [absenteeism plus presenteeism]) and daily activities (activity impairment) over the past 7 days.[11]
  - Scores are expressed as percentages (range, 0–100), with higher values indicating greater levels of absenteeism, presenteeism, overall work productivity loss, or activity impairment.
  - Only employed respondents provide data for absenteeism, presenteeism, and overall work productivity loss; employed respondents who reported working 0 hours in the past week were excluded from analyses of presenteeism. Activity impairment was assessed in all respondents.
- The 18-item Adult ADHD Self-Report Scale version 1.1 (ASRS-v1.1) Symptom Checklist assesses ADHD symptom levels in adults based on Diagnostic and Statistical Manual of Mental Disorders, 4th Edition criteria.[12]
  - Items are rated based on the frequency of ADHD symptoms over the past 6 months on a 5-point scale (0 = never to 4 = very often); total scores range from 0–18, with higher scores representing more severe symptoms.

### Data Presentation and Analysis

- Descriptive statistics were calculated for sociodemographic characteristics, with the mean and standard deviation (SD) reported for continuous variables, and frequencies and percentages reported for categorical variables.
- Bivariate comparisons between MAR-Scale categories (adherent vs non-adherent) were conducted using 2-sided independent sample t tests for continuous variables and chi-square tests for categorical variables; statistical significance was set at P<0.05.
- The reliability of the MAR-Scale was assessed using Cronbach's α, with values ≥0.70 being considered acceptable.[13]
- Pearson correlations were used to assess convergent validity between the MAR-Scale and MGLS and to assess criterion-related validity between the MAR-Scale and the ASRS-v1.1 Symptom Checklist and WPAI-GH.

## Results

### Respondent Characteristics

- A total of 602 respondents participated (Table 1), with 395 categorized as non-adherent and 207 as adherent based on MAR-Scale total score.
  - Compared with the adherent group, the non-adherent group was significantly younger and had a lower annual income (both P<0.05).

**Table 1. Respondent Sociodemographic Characteristics**

| | Adherent* (n=207) | Non-adherent* (n=395) | Total sample (N=602) | P Value |
|---|---|---|---|---|
| Mean ± SD age, y | 44.97±14.64 | 37.80±13.83 | 40.26±14.51 | <0.001 |
| Sex, n (%) | | | | 0.040 |
| Male | 50 (24.2) | 85 (21.5) | 135 (22.4) | |
| Female | 154 (74.4) | 310 (78.5) | 464 (77.1) | |
| Prefer not to answer | 3 (1.4) | 0 | 3 (0.5) | |
| Region, n (%) | | | | 0.670 |
| Northeast | 30 (14.5) | 64 (16.2) | 94 (15.6) | |
| Midwest | 51 (24.6) | 92 (23.3) | 143 (23.8) | |
| South | 97 (46.9) | 171 (43.3) | 268 (44.5) | |
| West | 29 (14.0) | 68 (17.2) | 97 (16.1) | |
| Employment, n (%) | | | | 0.246 |
| Unemployed | 79 (38.2) | 132 (33.4) | 211 (35.0) | |
| Employed | 128 (61.8) | 263 (66.6) | 391 (65.0) | |
| Self-identified race/ethnicity, n (%)‡ | | | | 0.455‡ |
| White | 188 (90.8) | 351 (88.9) | 539 (89.5) | |
| Black or African American | 7 (3.4) | 17 (4.3) | 24 (4.0) | |
| American Indian or Alaska Native | 3 (1.4) | 8 (2.0) | 11 (1.8) | |
| Asian | 5 (2.4) | 15 (3.8) | 20 (3.3) | |
| Hispanic or Latino | 7 (3.4) | 25 (6.3) | 32 (5.3) | |
| Other | 1 (0.5) | 3 (0.8) | 4 (0.7) | |
| Health insurance, n (%) | | | | 0.221 |
| No insurance | 9 (4.3) | 27 (6.8) | 36 (6.0) | |
| Any insurance | 198 (95.7) | 368 (93.2) | 566 (94.0) | |
| Education, n (%) | | | | 0.411 |
| Less than a college degree | 92 (44.4) | 194 (49.1) | 286 (47.5) | |
| College degree or greater | 115 (55.6) | 200 (50.6) | 315 (52.3) | |
| Do not know | 0 | 1 (0.3) | 1 (0.2) | |
| Annual household income, n (%) | | | | 0.006 |
| <$50,000 | 84 (40.6) | 210 (53.2) | 294 (48.8) | |
| ≥$50,000 | 114 (55.1) | 165 (41.8) | 279 (46.3) | |
| Do not know | 4 (1.9) | 3 (0.8) | 7 (1.2) | |
| Prefer not to answer | 5 (2.4) | 17 (4.3) | 22 (3.7) | |

MAR-Scale=Medication Adherence Reasons Scale; SD=standard deviation.
*Adherent (MAR-Scale score = 0); non-adherent (MAR-Scale total score ≥1).
‡Respondents could select multiple options.
§Based on comparison of those self-identifying as white vs the sum of all who did not self-identify as white.

### Reliability of the MAR-Scale

- MAR-Scale total and domain scores are reported in Figure 1.
- MAR-Scale total score demonstrated an acceptable level of reliability when the domain scores were treated as 4 separate items (Cronbach's α=0.79) and when all of the 19 items were considered (Cronbach's α=0.80; Table 2).
  - Table 2 summarizes the correlations of each MAR-Scale item with MAR-Scale total score.

**Figure 1. MAR-Scale Total and Domain Scores in the Total Sample (N=602)**
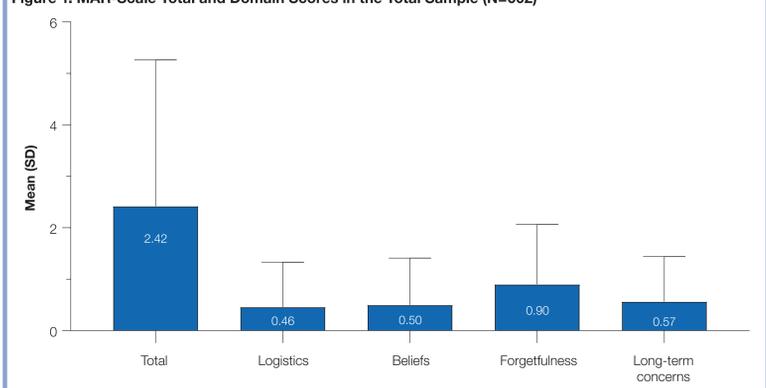


MAR-Scale=Medication Adherence Reasons Scale; SD=standard deviations.
Score ranges (total: 0–19; logistics: 0–8; beliefs: 0–4; forgetfulness: 0–4; long-term consequences: 0–3).

**Table 2. Reliability for MAR-Scale Items Relative to Total Score in the Total Sample (N=602)**

| | r* | Cronbach's α |
|---|---|---|
| **Logistics domain items** | | |
| Trouble managing medicines taken | 0.36 | 0.79 |
| Uncomfortable taking medicine for social reasons | 0.36 | 0.79 |
| Uncomfortable taking medicine for personal reasons | 0.44 | 0.79 |
| Pharmacy/provider out of medicine, out of refills, order did not arrive in time | 0.21 | 0.80 |
| Could not get to the pharmacy/provider | 0.28 | 0.80 |
| Difficulty opening container | 0.16 | 0.80 |
| Difficulty swallowing medicine | 0.23 | 0.80 |
| Unsure how to take medicine | 0.27 | 0.80 |
| **Beliefs domain items** | | |
| Had side effects | 0.48 | 0.78 |
| Thought medicine was not working | 0.44 | 0.79 |
| Sometimes skip medicine to see if still needed | 0.55 | 0.78 |
| Do not need the medicine anymore | 0.45 | 0.79 |
| **Forgetfulness domain items** | | |
| Difficulty remembering things in my daily life | 0.49 | 0.78 |
| Busy schedule/change in routine | 0.46 | 0.78 |
| Simply missed it | 0.41 | 0.79 |
| Taking medicine not a high priority | 0.39 | 0.79 |
| **Long-term concerns** | | |
| Cannot afford medicine | 0.25 | 0.80 |
| Concerned about possible side effects | 0.46 | 0.78 |
| Concerned about long-term effects | 0.42 | 0.79 |
| **Overall Cronbach's α for total score** | | 0.80 |

MAR-Scale=Medication Adherence Reasons Scale.
*Pearson correlation coefficient for items with total score.

### Reasons for Non-adherence

- The highest mean domain score on the MAR-Scale was observed for the forgetfulness domain (Figure 1).
  - When considering reasons for non-adherence by MAR-Scale domain, the most frequently reported reasons for non-adherence in the non-adherent group were forgetfulness 68.1% [269/395], followed by long-term concerns (52.4% [207/395], logistics (47.3% [187/395], and beliefs (44.8% [177/395]).
- Among non-adherent respondents, the most frequently reported reasons for non-adherence were "simply missed it" and "busy schedule/change in routine" (Figure 2A).
- The mean ± SD number of days respondents took their medication as prescribed in the past week was 5.35±2.04 in the total sample, with number of days medication was taken being statistically lower in non-adherent versus adherent respondents (4.56±2.07 vs 6.86±0.70, P<0.001).
  - In the non-adherent group, the mean ± SD number of days medication was missed in the past week was greatest for "unsure how to take medicine" and "cannot afford medicine" (Figure 2B).

**Figure 2. Percentage of Respondents (A) and Number of Days Medication Was Missed (B) by Reason in the Non-adherent Group (n=395)†‡**
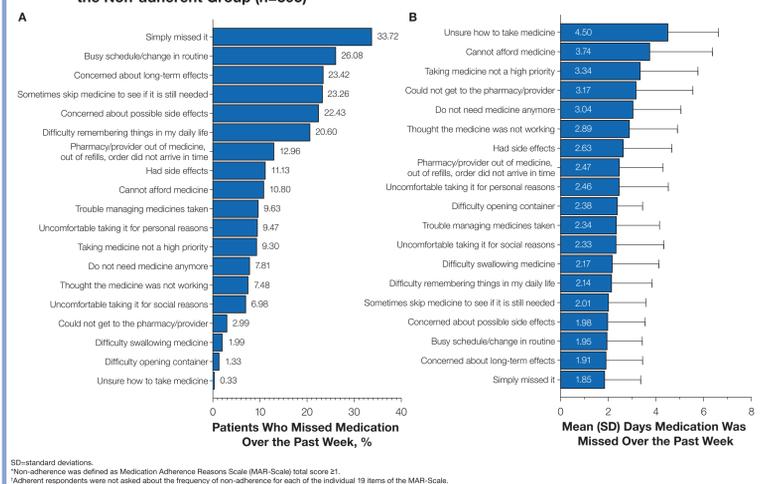


SD=standard deviations.
†Non-adherence was defined as Medication Adherence Reasons Scale (MAR-Scale) total score ≥1.
‡Adherent respondents were not asked about the frequency of non-adherence for each of the individual 19 items of the MAR-Scale.

### Convergent Validity of the MAR-Scale

- The MAR-Scale and MGLS demonstrated convergent validity (Table 3).
  - Statistically significant positive correlations of MAR-Scale total and domain scores with MGLS scores (all P<0.001) indicated that non-adherence on the MAR-Scale was associated with non-adherence on the MGLS.
- Both the MAR-Scale and MGLS classified approximately 35% of respondents as adherent and 65% as non-adherent.
  - Of the 209 respondents categorized as adherent based on MGLS scores, 71.3% (149/209) were categorized as adherent based on MAR-Scale total score.
  - Of the 393 respondents categorized as non-adherent based on MGLS scores, 85.2% (335/393) were categorized as non-adherent based on MAR-Scale total score.

### Criterion-Related Validity of the MAR-Scale

- The MAR-Scale demonstrated criterion-related validity regarding ADHD symptom level and impairment to work productivity and non-work activities (Table 3).
  - Statistically significant (all P<0.05, except for activity impairment on the beliefs domain) positive correlations of MAR-Scale total and domain scores indicated that non-adherence was associated with higher ADHD symptom levels (based on ASRS-v1.1 Symptom Checklist scores) and higher levels of absenteeism, presenteeism, overall work productivity, and activity impairment (based on the WPAI-GH).

**Table 3. Convergent and Criterion-Related Validity with MAR-Scale Score in the Total Sample**

| | Logistics Domain | | Beliefs Domain | | Forgetfulness Domain | | Long-Term Concerns Domain | | Total Score | |
|---|---|---|---|---|---|---|---|---|---|---|
| | r* | P value | r* | P value | r* | P value | r* | P value | r* | P value |
| **Convergent validity** | | | | | | | | | | |
| MGLS score (n=602) | 0.40 | <0.001 | 0.54 | <0.001 | 0.58 | <0.001 | 0.37 | <0.001 | 0.65 | <0.001 |
| **Criterion-related validity** | | | | | | | | | | |
| ASRS-v1.1 Symptom Checklist score (n=602) | 0.16 | <0.001 | 0.17 | <0.001 | 0.26 | <0.001 | 0.11 | 0.006 | 0.25 | <0.001 |
| Absenteeism† (n=366) | 0.29 | <0.001 | 0.18 | <0.001 | 0.10 | 0.045 | 0.16 | 0.003 | 0.24 | <0.001 |
| Presenteeism† (n=358) | 0.23 | <0.001 | 0.16 | 0.002 | 0.20 | <0.001 | 0.24 | <0.001 | 0.28 | <0.001 |
| Overall work productivity impairment† (n=366) | 0.28 | <0.001 | 0.21 | <0.001 | 0.21 | <0.001 | 0.27 | <0.001 | 0.32 | <0.001 |
| Activity impairment† (n=602) | 0.19 | <0.001 | 0.06 | 0.144 | 0.18 | <0.001 | 0.10 | 0.012 | 0.19 | <0.001 |

ASRS-v1.1=Adult ADHD Self-Report version 1.1; MAR-Scale=Medication Adherence Reasons Scale; MGLS=Morisky Green Levine Adherence Scale.
*Pearson correlation coefficient relative to MAR-Scale total score.
†Based on the Work Productivity and Activity Impairment Questionnaire–General Health; only employed respondents provided data for absenteeism, presenteeism, and overall work productivity loss; employed respondents who reported working 0 hours in the past week were excluded from analyses of presenteeism.

## Limitations

- All study data were self-reported without independent or clinical verification.
- The results may not generalize to a heterogeneous adult ADHD population because respondents were recruited based on their membership in an online market research panel.
- The inclusion of respondents who were healthy enough to participate and interested in research may have introduced selection bias.
- The method used to define non-adherence in this study (ie, dichotomization of MAR-Scale or MGLS scores) may have influenced the study results.

## Conclusions

- In adults who self-reported being diagnosed with ADHD and currently treated with oral stimulants, the MAR-Scale demonstrated acceptable internal reliability and good convergent validity with the MGLS.
- The MAR-Scale demonstrated good criterion-related validity, with non-adherence being associated with high ADHD symptom level (as measured by correlations with ASRS-v1.1 Symptom Checklist scores) and with increased levels of impaired work productivity and non-work activity impairment (as measured by correlations with WPAI-GH-related outcomes).
  - The highest correlation of ADHD symptom level with the MAR-Scale was for the forgetfulness domain. Furthermore, among non-adherent respondents, the most frequently reported reasons for non-adherence were associated with the forgetfulness domain. These findings align with the nature of ADHD symptoms, especially the inattention dimension.
  - For work productivity and activity impairment, the highest correlations with the MAR-Scale were with the logistics domain, which demonstrates the difficulties of being productive during work and non-work–related activities when faced with procuring and taking medication as prescribed.
- Of note, the most frequently reported reasons for non-adherence did not always align with the number of days non-adherent for a specific reason. Thus, multiple reasons may be at play and should be taken into consideration when assessing non-adherence in an individual with ADHD.
- Approximately 65% of participants were categorized as non-adherent based on MAR-Scale total score.
  - This percentage exceeds that of previous reports,[4,5] which may in part be related to differences in the methods used to define non-adherence. The MAR-Scale includes 19 reasons for medication non-adherence, which is more comprehensive than previously published assessments.[4,5]

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