Chapter

14

Attention-Deficit Hyperactivity Disorder

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Introduction

Although most epidemiological studies of the prevalence and correlates of childhood and adult Attention-Deficit Hyperactivity Disorder (ADHD) have taken place in the United States (US), Australia, and Western Europe, there has been a recent increase in comparable studies in other parts of the world and the publication of several comprehensive reviews (Polanczyk *et al.* 2007, 2014; Polanczyk & Jensen 2008; Alhraiwil *et al.* 2015; Thomas *et al.* 2015). Taken together, these reports make it clear that ADHD is an important disorder throughout the world given its early age-of-onset, strong associations with the subsequent onset and persistence of secondary disorders, persistence into adulthood, and strong associations with impaired role functioning throughout the lifespan. A challenge in comparing cross-national results, though, is that existing epidemiological studies vary widely in measures, classification systems, and data collection procedures. The World Mental Health (WMH) Surveys Initiative has been the largest and most systematic effort to address these methodological problems to date based on retrospective reports being obtained from adult WMH respondents about childhood ADHD and separate questions being asked about adult ADHD.

Previous WMH reports presented data from the first 10 national samples to assess ADHD in terms of prevalence and correlates regarding both childhood and adult ADHD (Fayyad *et al.* 2007), the associations of childhood ADHD with subsequent secondary comorbid disorders (Kessler *et al.* 2011), the predictors of ADHD persistence into adulthood (Lara *et al.* 2009), and the role impairments associated with adult ADHD (de Graaf *et al.* 2008). The current chapter presents an update on these results based on the most recent WMH data, which come from the 20 WMH surveys out of the 29 included in this volume that assessed ADHD (Fayyad *et al.* 2017).

Methods

Diagnostic Assessment

As with other diagnoses, lifetime prevalence of DSM-IV ADHD was assessed with the WHO Composite International Diagnostic Interview (CIDI) Version 3.0 (Kessler & Üstün 2004), but in the case of childhood ADHD the CIDI retrospective assessment was based on the Diagnostic Interview Schedule (DIS) (Robins & Helzer 1985). Included here were questions about the nine DSM-IV symptoms of inattention (AD) and the nine symptoms of hyperactivity-impulsivity (HD) (at least six of nine in one or both sets required for a diagnosis), age-of-onset of these symptoms (at last some of which had to start before age seven), and impairments caused by these symptoms (which had to occur in at least two role domains).

Although our original intent was to assess only childhood ADHD in the WMH surveys, we included questions in the ADHD section to parallel those in other diagnostic sections asking respondents whether they still had problems with inattention or impulsivity-hyperactivity and, if so, how much these symptoms caused impairments in their daily functioning. When we began analysis of the data for the earliest WMH surveys, we were struck by the high proportions of respondents with diagnoses of childhood ADHD who reported still having symptoms that interfered with their current functioning. Based on this observation, we became familiar with a nascent literature suggesting that a substantial proportion of cases of childhood ADHD persist into adulthood (Faraone *et al.* 2000; Weiss *et al.* 2000), but this claim was at the time controversial (Wolf & Wasserstein 2001).

Multiple Imputation Strategy to Arrive at Adult ADHD Prevalence Estimates

We conducted a small (n = 154) follow-up study of respondents with childhood ADHD in the US sample.

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The follow-up survey was carried out by telephone with trained clinical interviewers administering the Adult ADHD Clinical Diagnostic Scale (ACDS) Version 1.2 (Adler & Cohen 2004; Adler & Spencer 2004). As reported elsewhere (Kessler *et al.* 2006), a substantial number of respondents met criteria for DSM-IV adult ADHD, and a number of others had subthreshold adult ADHD with significant role impairment. Based on these results, we developed an imputation scheme using information available in all WMH surveys. Diagnostic classification accuracy based on this approach was quite good in the clinical reappraisal sample, with area under the receiver operating characteristic curve (AUC) of 0.86. Based on this result, Multiple Imputation (MI; Rubin 1987) was used to assign imputed clinical diagnoses of adult ADHD to respondents in all WMH surveys based on the coefficients in the prediction equation in the US clinical reappraisal sample. Importantly, this approach assumes that the association between CIDI responses and clinical diagnoses is constant across countries. The statistical details of the MI method are discussed elsewhere (Kessler *et al.* 2006). The important points to emphasize here are that MI generates unbiased prevalence estimates under the model, that individual-level estimates have good accuracy when, as in this case, AUC is high, and that a simulation adjusts standard errors for the effects of classification error due to imperfect imputation. The imputation equation used here was somewhat less refined than in the earlier US study because not all countries included all predictors used in the US imputation equation.

Results

ADHD Prevalence in Childhood and Persistence into Adulthood

Estimated prevalence of ADHD in childhood averages 2.2% across the surveys, but varies strongly across samples (0.1–8.1%) resulting in a wide inter-quartile (IQR) range (0.9–2.9%) (Table 14.1). Prevalence is significantly related to country income level, with prevalence of 3.3% in high-, 2.2% in upper-middle-, and 0.6% in low/lower-middle-income countries (χ^2_2 = 113.3, P < 0.001). Subthreshold childhood ADHD (4–5 rather than 6+ AD and/or HD symptoms in addition to other required criteria) is even more prevalent (3.7% across countries; 4.7% in high-, 4.0% in upper-middle-, and 2.2% in low/lower-middle-income countries; χ^2_2 = 48.9, P < 0.001). Conditional prevalence of current (at the time of interview) adult ADHD averages 57.0% across surveys among respondents with a history of childhood ADHD (56.2% in high-, 54.1% in upper-middle-, and 71.7% in low/lower-middle-income countries; χ^2_2 = 2.4, P = 0.30) and 41.1% among respondents with a history of subthreshold childhood ADHD (36.9% in high-, 46.8% in upper-middle-, and 45.9% in low/lower-middle-income countries; χ^2_2 = 3.9, P = 0.14).

Current prevalence of adult ADHD in the total sample averages 2.8% across surveys, again varying strongly across samples (0.6–7.3%) resulting in a wide IQR (1.8–4.1%) and with a higher prevalence in high-income countries (3.6%) and upper-middle-income countries (3.0%) than in low/lower-middle income (1.4%) countries (χ^2_2 = 40.5, P < 0.001). Adult ADHD is thus more prevalent than childhood ADHD and this pattern is consistent in high- (3.6% versus 3.3%), upper-middle- (3.0% versus 2.2%), and low/lower-middle- (2.8% versus 2.2%) income countries.

Socio-demographic Correlates

Pooled across surveys, childhood ADHD is significantly more common among men than women (OR 1.6) and significantly but non-monotonically associated with educational attainment (χ^2_1 = 21.1, P < 0.001) (Table 14.2). Childhood ADHD is not significantly associated with respondent age at the time of interview (which, as noted above, was 18–44), current (at time of interview) employment status, current marital status, or current income. The same basic socio-demographic patterns are found with subthreshold childhood ADHD. Persistence of childhood ADHD into adulthood (i.e., current prevalence) among childhood cases, in comparison, is significantly associated with respondent employment status (employed versus all others; χ^2_1 = 11.3, P = 0.001) due to comparatively low persistence among the currently employed. None of the socio-demographic variables are significantly related to adult ADHD among subthreshold childhood cases.

The strength of associations between socio-demographic variables and adult ADHD is, in effect, a weighted combination of the associations with childhood ADHD in the total sample and adult persistence among childhood threshold and subthreshold cases. Adult ADHD prevalence is significantly higher among men than women (OR 1.6) and significantly associated with young age (χ^2_1 = 12.4, P < 0.001), less than college educational attainment (χ^2_1 = 16.1, P< 0.001), and being unmarried (χ^2_1 = 8.4, P = 0.004). The higher

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Table 14.1 Multiply imputed prevalence estimates of DSM-IV attention-deficit hyperactivity disorder (ADHD) in each WMH sample[a]

	Childhood ADHD				Adult ADHD among childhood cases of ...				Adult ADHD in the total sample		(N)[b]
	Threshold		Subthreshold		Threshold		Subthreshold				
	%	(SE)	%	(SE)	%	(SE)	%	(SE)	%	(SE)	
Low/lower-middle-income countries											
Colombia	1.2	(0.3)	2.9	(0.5)	84.9	(10.2)	51.5	(8.8)	2.5	(0.5)	(1,731)
Iraq	0.1	(0.1)	1.0	(0.2)	77.0	(19.2)	47.9	(14.6)	0.6	(0.2)	(3,227)
Peru	0.8	(0.2)	2.5	(0.5)	58.4	(14.1)	35.4	(12.4)	1.4	(0.5)	(1,287)
PRC[c] (Shenzhen)	0.7	(0.2)	3.0	(0.6)	62.8	(21.4)	46.1	(8.2)	1.8	(0.4)	(2,190)
Total	**0.6**	**(0.1)**	**2.2**	**(0.2)**	**71.7**	**(9.5)**	**45.9**	**(5.5)**	**1.4**	**(0.2)**	**(8,435)**
Upper-middle-income countries											
Brazil (São Paulo)	2.5	(0.4)	7.0	(1.0)	76.2	(14.5)	58.2	(10.7)	5.9	(1.2)	(1,824)
Colombia (Medellin)	2.5	(0.5)	3.0	(0.7)	59.2	(10.7)	51.5	(12.5)	3.0	(0.7)	(970)
Lebanon	1.5	(0.4)	3.3	(1.2)	52.4	(15.0)	29.9	(17.1)	1.8	(0.7)	(595)
Mexico	3.0	(0.4)	3.7	(0.7)	32.8	(7.3)	25.8	(8.6)	1.9	(0.4)	(1,736)
Romania	0.4	(0.3)	0.7	(0.4)	45.7	(40.8)	54.7	(24.3)	0.6	(0.4)	(940)
Total	**2.2**	**(0.2)**	**4.0**	**(0.4)**	**54.1**	**(7.0)**	**46.8**	**(7.6)**	**3.0**	**(0.5)**	**(6,065)**
High-income countries											
Belgium	2.9	(1.1)	8.6	(2.1)	71.9	(16.5)	22.7	(10.0)	4.1	(1.5)	(486)
France	4.7	(1.2)	8.9	(1.4)	58.8	(14.0)	50.9	(10.5)	7.3	(1.8)	(727)
Germany	1.8	(0.7)	5.6	(1.5)	67.9	(16.1)	33.7	(8.5)	3.1	(0.8)	(621)
Italy	0.9	(0.2)	3.7	(0.7)	84.1	(11.1)	55.1	(11.2)	2.8	(0.6)	(853)
Netherlands	2.9	(0.9)	9.2	(1.6)	82.3	(14.4)	28.4	(9.3)	5.0	(1.6)	(516)
Northern Ireland	3.2	(0.8)	4.5	(0.7)	98.8	(2.0)	64.0	(8.2)	6.0	(0.8)	(907)
Poland	0.3	(0.1)	0.8	(0.2)	69.7	(9.4)	62.6	(14.5)	0.8	(0.2)	(2,276)
Portugal	1.5	(0.4)	4.0	(0.7)	56.3	(15.3)	54.0	(11.1)	3.0	(0.7)	(1,070)
Spain	1.8	(0.8)	1.9	(0.5)	33.6	(20.6)	29.2	(12.3)	1.2	(0.6)	(960)
Spain (Murcia)	2.0	(0.5)	4.2	(0.7)	72.9	(21.6)	44.3	(17.5)	3.3	(1.1)	(631)
United States	8.1	(0.6)	6.6	(0.5)	46.0	(4.9)	22.5	(4.6)	5.2	(0.6)	(3,197)
Total	**3.3**	**(0.2)**	**4.7**	**(0.3)**	**56.2**	**(4.8)**	**36.9**	**(4.3)**	**3.6**	**(0.4)**	**(12,244)**
All countries combined	**2.2**	**(0.1)**	**3.7**	**(0.2)**	**57.0**	**(4.4)**	**41.1**	**(4.3)**	**2.8**	**(0.3)**	**(26,744)**
χ^2	113.3*		48.9*		2.4		3.9		40.5*		

*Significant at the 0.05 level, two-sided test.
[a]Sample restricted to respondents ages 18–44 at interview and Part II sample.
[b]These are denominator N's; that is, the number of people assessed rather than the number with ADHD.
[c]People's Republic of China.

Table 14.2 Socio-demographic correlates of multiply imputed DSM-IV attention-deficit hyperactivity disorder (ADHD) in all WMH countries combined (n = 26,744)[a]

	Childhood ADHD				Adult ADHD among childhood cases of ...				Adult ADHD in the total sample		(N)[b]
	Threshold		Subthreshold		Threshold		Subthreshold				
	%	(SE)	%	(SE)	%	(SE)	%	(SE)	%	(SE)	
Gender											
Male	2.7	(0.2)	4.3	(0.2)	57.5	(4.9)	42.0	(4.4)	3.4	(0.3)	(11,491)
Female	1.7	(0.1)	3.2	(0.2)	56.2	(5.2)	39.8	(5.2)	2.2	(0.2)	(15,253)
χ^{2c}	24.0*		18.4*		0.0		0.3		26.8*		
Age											
18–24	2.4	(0.2)	4.3	(0.3)	60.9	(6.0)	43.5	(5.0)	3.3	(0.4)	(6,632)
25–34	1.9	(0.2)	3.7	(0.2)	57.2	(6.0)	43.8	(5.3)	2.7	(0.3)	(10,112)
35–44	2.3	(0.2)	3.3	(0.3)	53.2	(5.6)	34.7	(5.4)	2.4	(0.3)	(10,000)
χ^{2c}	1.3		12.3*		2.8		1.4		12.4*		
Education											
No education	0.8	(0.5)	1.9	(0.9)	26.9	(23.4)	61.8	(20.3)	1.4	(0.8)	(570)
Some primary	2.3	(0.4)	4.1	(0.6)	75.2	(8.2)	47.1	(8.2)	3.6	(0.6)	(1,690)
Finished primary	1.4	(0.2)	4.4	(0.8)	71.2	(8.4)	37.8	(11.8)	2.7	(0.7)	(2,137)
Some secondary	2.5	(0.3)	3.7	(0.4)	54.5	(8.3)	35.5	(5.6)	2.6	(0.4)	(5,027)
Finished secondary	2.3	(0.2)	3.9	(0.3)	58.0	(5.9)	44.0	(5.2)	3.1	(0.3)	(8,244)
Some college	2.8	(0.3)	4.3	(0.4)	54.9	(5.2)	41.6	(6.3)	3.4	(0.4)	(4,662)
Finished college	1.6	(0.2)	2.6	(0.3)	50.1	(7.5)	38.1	(6.7)	1.8	(0.3)	(4,414)
χ^{2c}	21.1*		16.1*		1.6		0.4		16.1*		
Employment status											
Employed	2.3	(0.1)	4.1	(0.2)	52.7	(4.7)	41.4	(4.5)	2.9	(0.3)	(17,660)
Student	1.7	(0.3)	2.5	(0.4)	74.1	(9.2)	41.2	(8.9)	2.3	(0.4)	(1,669)
Homemaker	1.1	(0.2)	2.3	(0.3)	61.7	(9.3)	44.4	(7.9)	1.7	(0.3)	(4,020)
Retired	3.2	(2.2)	1.2	(0.8)	52.0	(16.2)	39.8	(29.4)	2.2	(1.5)	(78)
Unemployed	2.9	(0.4)	4.3	(0.5)	68.1	(7.5)	37.4	(8.0)	3.6	(0.6)	(3,317)
χ^{2c}	0.5		0.2		11.3*		0.1		1.4		
Marital status											
Married/cohabitating	2.0	(0.1)	3.5	(0.2)	53.6	(5.1)	38.8	(4.9)	2.4	(0.3)	(16,000)
Previously married	4.2	(0.5)	4.2	(0.8)	54.8	(7.4)	43.8	(11.8)	4.1	(0.8)	(1,862)
Never married	2.3	(0.2)	4.1	(0.3)	61.8	(5.8)	43.5	(4.5)	3.2	(0.3)	(8,882)
χ^{2c}	2.8		3.2		3.2		1.2		8.4*		
Household Income[d]											
Low	2.1	(0.2)	3.6	(0.3)	65.3	(5.1)	43.1	(5.2)	3.0	(0.3)	(7,528)
Low-average	2.6	(0.3)	4.0	(0.3)	51.2	(6.6)	42.0	(5.8)	3.0	(0.4)	(6,263)
High-average	2.4	(0.2)	3.8	(0.4)	58.0	(5.8)	37.3	(5.6)	2.8	(0.4)	(6,719)
High	1.7	(0.2)	3.5	(0.3)	51.7	(7.1)	41.9	(6.0)	2.4	(0.3)	(6,234)
χ^{2c}	1.1		0.9		0.0		0.5		1.6		

*Significant at the 0.05 level, two-sided design-based multiply-imputed test.

[a]Based on multivariate logistic regression equations in which all predictors were included simultaneously. All models include dummy variable controls for surveys.

[b]These are denominator N's; that is, numbers of respondents in the total sample with the socio-demographic characteristic defined by the row heading.

[c]Each χ^2 test has one degree of freedom. Tests for age, education, and income are based on continuous versions of those predictors. The test for employment status compares employed to all others. The test for marital status compares married/cohabiting to all others.

[d]Income is defined as the ratio of pre-tax family income to number of household members. Households with ratios half the median within-survey value or lower were categorized as 'low' income; those with ratios between half the median and the median were categorized as 'low-average'; those with ratios greater than the median up to three times the median as 'high-average'; and those greater than three times the median as 'high'.

prevalence among men than women is due to the significantly elevated odds of childhood ADHD noted above. The significant inverse association of age with current adult ADHD is due to a significant inverse association of age with subthreshold childhood ADHD, an insignificant inverse association of age with childhood threshold ADHD, and a significant inverse association of age with adult persistence of ADHD among childhood cases. The significant association of current adult ADHD with being unmarried is due to significantly elevated odds of childhood threshold ADHD with being previously married at the time of interview, in addition to insignificant trend associations of being previously married and never married with persistence among childhood threshold and subthreshold cases.

Comorbidity

Twelve-month adult ADHD is significantly and positively comorbid with 12-month prevalence of other mental disorders considered in the WMH surveys (Table 14.3). ORs are in the range between 2.5 (major depressive disorder) and 15.0 (oppositional defiant disorder) with individual comorbid disorders, 4.4 with a summary variable of having any comorbid disorder, and increasing ORs with number of comorbid disorders (3.0 with exactly one comorbid disorder, 6.2 with exactly two, and 9.6 with three or more; $\chi^2_2 = 66.7$, $P < 0.001$). Retrospective age-of-onset reports were used to date temporal priorities between onset ages of ADHD and comorbid disorders. Given the early age-of-onset of ADHD required in DSM-IV, it is not surprising that we find ADHD to be the temporally primary disorder in the vast majority of cases of comorbidities involving mood disorders (86.0–94.0%), anxiety disorders other than specific phobia (70.5–90.2%), and substance-use disorders (94.8–99.1 %). Specific phobia is the only comorbid disorder that was more likely to be temporally primary than ADHD (specific phobia first in 53.1% of cases, ADHD first in 29.1%, and same year in the remaining 17.8%).

Given the strong temporal priority of ADHD over the vast majority of comorbid disorders, we examined the extent to which ADHD predicted the subsequent first onset of the other disorders assessed in the surveys. We distinguished between respondents who had (i) AD-only versus HD (with or without AD) childhood symptom profiles in order to see if those profiles are differentially associated with the subsequent onset of temporally secondary disorders. Also, we distinguished between active and remitted ADHD cases in order to determine if the ORs of secondary disorders occurring decrease significantly with the remission of ADHD. In initial models, we also evaluated the significance of the difference between active and remitted ADHD depending on whether the childhood ADHD had an AD-only or HD symptom profile. However, as this interaction was not significant in all models ($\chi^2_1 = 0.0–3.4$, $P = 0.88–0.07$), we focused on the coefficients in the additive model (Table 14.4). Three broad patterns of results are noteworthy. First, all but one of the ORs for secondary disorders associated with *remitted* ADHD are elevated (ORs = 1.1–2.7, with a median of 1.6 and IQR of 1.2–2.0) and nearly half are statistically significant ($\chi^2_1 = 4.4–37.3$, $P = 0.036$ to <0.001). Second, the odds of secondary disorders associated with *active* ADHD are consistently elevated relative to those associated with remitted ADHD (ORs = 1.2–4.6) and nearly two-thirds of these ORs are statistically significant ($\chi^2_1 = 4.3–15.9$, $P = 0.041$ to <0.001). Third, the ORs associated with the AD-only subtype do not differ meaningfully from those associated with the HD subtype, with each of the two having the same median (1.6) and very similar IQRs (1.1–2.0 for AD-only; 1.2–2.2 for HD).

Disability

Unlike most other chapters in this volume, functioning in the prior 30 days was examined with the WHO Disability Assessment Schedule (WHO-DAS; Üstün et al. 2010) rather than the SDS because WHO-DAS, unlike SDS, contains a scale for impairments in cognition. The latter are believed to be of special importance for adult ADHD. We found that respondents with adult ADHD are more likely to have disability in cognition (21.8%) than in any other WHO-DAS dimensions, although respondents with adult ADHD have significantly elevated odds of all these outcomes (Table 14.5). Respondents with current ADHD are also significantly more likely than others to report at least one day out of role in the 30 days before interview due to health problems (OR 2.6). However, further analysis showed that these significant associations are to some extent due to comorbid disorders, as indicated by the ORs attenuating when controls are introduced for 12-month comorbid disorders.

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Table 14.3 Bivariate 12-month co-occurrence and lifetime age-of-onset temporal priority of multiply imputed DSM-IV adult attention-deficit hyperactivity disorder (ADHD) with other DSM IV disorders (n = 26,744)[a]

	Conditional prevalence estimates				Age-of-onset temporal priority								
	ADHD/Co[b]		Co/ADHD[c]		ADHD first		Other disorder first		Both in the same year				
	%	(SE)	%	(SE)	%	(SE)	%	(SE)	%	(SE)	OR	(95% CI)	(N)[d]s
I. Mood disorders													
Major depressive disorder	8.1	(0.8)	15.0	(1.5)	86.0	(2.7)	8.9	(2.3)	5.1	(2.1)	2.5*	(2.0–3.2)	(199)
Bipolar spectrum disorder	15.2	(1.7)	9.4	(1.3)	94.0	(2.7)	3.1	(2.1)	2.8	(1.9)	5.4*	(4.0–7.2)	(92)
Any mood disorder	9.3	(0.8)	21.9	(1.9)	86.4	(2.2)	8.3	(1.8)	5.3	(1.6)	3.2*	(2.6–4.1)	(287)
II. Anxiety disorders													
Generalized anxiety disorder	8.3	(1.5)	3.8	(0.7)	83.9	(7.4)	9.3	(6.2)	6.8	(4.5)	2.6*	(1.7–3.9)	(47)
Panic disorder	14.4	(2.3)	5.7	(1.0)	90.2	(3.9)	3.9	(2.0)	5.9	(3.7)	4.5*	(3.0–6.6)	(70)
Specific phobia	8.9	(0.9)	20.9	(1.9)	29.1	(4.4)	53.1	(4.6)	17.8	(3.0)	3.4*	(2.6–4.3)	(250)
Social phobia	12.0	(1.4)	12.6	(1.4)	70.5	(4.7)	16.5	(3.8)	13.0	(2.7)	3.9*	(2.9–5.1)	(152)
Any anxiety disorder	8.8	(0.7)	34.2	(2.4)	48.0	(3.4)	37.9	(3.5)	14.2	(2.1)	3.7*	(3.0–4.6)	(400)
III. Substance-use disorders													
Alcohol abuse without dependence	9.4	(1.7)	5.1	(1.0)	98.0	(2.0)	2.1	(2.0)	0.0	(0.0)	3.0*	(1.9–4.6)	(49)
Drug abuse without dependence	16.1	(5.1)	2.7	(0.9)	94.8	(5.3)	0.0	(0.0)	5.2	(5.3)	4.8*	(2.3–10.1)	(16)
Any substance-use disorder	11.5	(1.5)	11.4	(1.6)	99.1	(0.9)	0.9	(0.9)	0.0	(0.0)	3.8*	(2.8–5.2)	(100)
IV. Disruptive Behaviour disorders													
Intermittent explosive disorder	10.9	(1.4)	12.8	(1.6)	78.7	(5.1)	12.6	(4.5)	8.7	(3.2)	3.8*	(2.7–5.2)	(101)
Oppositional defiant disorder	35.5	(4.5)	8.3	(1.4)	49.8	(7.6)	25.7	(6.9)	24.5	(7.9)	15.0*	(9.7–23.2)	(83)
Any disruptive behaviour disorder	15.6	(1.6)	15.2	(1.7)	64.5	(5.3)	19.0	(4.1)	16.5	(4.5)	6.2*	(4.6–8.4)	(169)
V. Total													
Exactly one[e]	5.5	(0.6)	23.0	(1.9)	73.8	(3.8)	18.1	(3.3)	8.1	(2.3)	3.0*	(2.3–3.9)	(242)
Exactly two[e]	11.2	(1.3)	14.3	(1.7)	90.6	(3.1)	5.6	(2.6)	3.8	(1.7)	6.2*	(4.4–8.8)	(163)
Three or more[e]	17.7	(1.7)	14.4	(1.6)	90.2	(2.6)	3.2	(1.2)	6.6	(2.1)	9.6*	(6.9–13.3)	(180)
Any	8.3	(0.6)	51.7	(3.1)	55.6	(2.8)	31.2	(2.8)	13.2	(2.0)	4.4*	(3.4–5.7)	(585)

*Significant at the 0.05 level, two-sided test.

[a]All models assessed with Part II weight (except Iraq and Romania) and control for countries. ADHD is the outcome variable in the models. Countries without the row disorder are dropped from the % calculations and the models. ESEMeD countries (Belgium, Germany, Italy, Netherlands, Spain, France) do not have dysthymia, bipolar, drug-use, and intermittent explosive disorder. PRC (Shenzhen) does not have posttraumatic stress disorder, any of the substance-use disorders, oppositional defiant disorder or adult antisocial behaviour disorder. Portugal does not have drug-use disorders. Iraq does not have oppositional defiant disorder or adult antisocial behaviour disorder. Mexico, Spain (Murcia), and Colombia (Medellin) all do not have intermittent explosive disorder.

[b]Conditional prevalence estimates of adult ADHD in the subsamples of respondents with the comorbid disorders.

[c]Conditional prevalence estimates of the comorbid disorders in the subsample of respondents with adult ADHD.

[d]Denominator N is the number of people with both ADHD and the row disorder.

[e]Onset of 'Exactly two' disorders takes the age-of-onset of the second earliest disorder the respondent was assessed with. Onset of 'Three or more' disorders takes the third earliest disorder the respondent was assessed with.

Table 14.4 Associations of childhood ADHD subtypes and comorbid lifetime DSM-IV disorders, in all countries combined (N = 26,744)[a]

	Active versus remitted ADHD		Remitted childhood AD-only		Remitted childhood HD	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
I. Mood disorders						
Major depressive disorder	1.2	(1.0–1.6)	2.0*	(1.6–2.5)	1.7*	(1.3–2.2)
Bipolar spectrum disorder	2.0*	(1.3–2.9)	1.7*	(1.0–2.8)	2.3*	(1.5–3.6)
II. Anxiety disorders						
Panic disorder/agoraphobia	1.5	(1.0–2.1)	1.9*	(1.2–2.9)	1.6*	(1.1–2.6)
Generalized anxiety disorder	1.6	(1.0–2.7)	1.4	(0.8–2.5)	1.9*	(1.1–3.4)
Specific phobia	1.9*	(1.1–3.3)	1.3	(0.7–2.2)	1.2	(0.7–2.2)
Social phobia	1.7*	(1.0–2.7)	1.6	(1.0–2.7)	1.3	(0.8–2.3)
III. Substance-use disorders						
Alcohol abuse with or without dependence	1.3	(0.9–1.7)	2.0*	(1.5–2.8)	2.2*	(1.6–2.9)
Drug abuse with or without dependence	1.4*	(1.1–2.0)	2.0*	(1.4–3.0)	2.7*	(1.8–4.0)
IV. Disruptive Behaviour disorders						
Intermittent explosive disorder	2.7*	(1.7–4.4)	1.1	(0.7–1.8)	1.2	(0.7–2.1)
Oppositional defiant disorder	4.6*	(1.7–12.1)	0.8	(0.3–2.3)	1.1	(0.4–2.8)

*Significant at the 0.05 level, two-sided test.
[a]All models are person-year models assessed with Part II weight (except Iraq and Romania), controlling for time-invariant dummies for country, gender, dummy for threshold childhood ADHD, time-varying continuous age, age-squared, and dummy active (time-varying dummy for whether the person-year is less than or equal to the age of recency of ADHD).

Table 14.5 Disability in 30-day functioning associated with DSM-IV adult attention-deficit hyperactivity disorder (n = 26,744)

Disability domain	Prevalence of disability		With controls for socio-demographics[b]		With controls for socio-demographics and comorbid 12-month DSM-IV disorders[c]	
	%[a]	(SE)	OR	(95% CI)	OR	(95% CI)
Cognition	21.8	(2.0)	3.8*	(2.9–4.8)	2.1*	(1.6–2.8)
Social interaction	10.8	(1.4)	3.3*	(2.4–4.4)	1.5*	(1.1–2.1)
Self-care	4.8	(0.9)	2.1*	(1.4–3.3)	1.2	(0.8–1.8)
Mobility	15.5	(1.6)	2.5*	(1.9–3.3)	1.6*	(1.2–2.0)
Days-out-of-role	29.3	(2.2)	2.6*	(2.1–3.3)	1.6*	(1.3–2.1)

*Significant at the 0.05 level, two-sided test.
[a]% with disability among those with ADHD.
[b]Based on logistic regression equations controlling for country, gender, age, education, employment, marital status, and income. Twelve-month disability is the outcome variable in the models. The ORs presented are for ADHD as the predictor.
[c]Based on logistic regression equations controlling for country, gender, age, education, employment, marital status, income, any 12-month mood disorder, any 12-month anxiety disorder, any 12-month substance-use disorder. Thirty-Day disability is the outcome variable in the models. The ORs presented are for ADHD as the predictor.

Treatment

Roughly one-fifth (21.8%) of respondents with 12-month ADHD received some treatment for mental health problems in the 12 months before interview (Table 14.6). This treatment rate is significantly related to country income level (28.8% in high, 15.5% in upper-middle-, and 6.8% in low/lower-middle-income countries; $\chi^2_2 = 35.8$, $P < 0.001$). In high-income countries, the majority of these patients were treated either

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Table 14.6 Twelve-month treatment among respondents with multiply imputed DSM-IV adult attention-deficit hyperactivity disorder (ADHD) (N = 26,744)

	General medical		Any mental health		Human services		CAM[b]		Any professional		Any treatment for ADHD	
	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)
Low/lower-middle-income countries												
Colombia	0.6	(0.4)	6.4	(3.3)	0.4	(0.4)	0.8	(0.8)	7.2	(3.4)	0.0	(0.0)
Iraq	0.0	(0.0)	0.0	(0.0)	0.7	(1.2)	0.0	(0.0)	0.7	(1.2)	0.0	(0.0)
Peru	0.0	(0.0)	12.9	(4.9)	0.0	(0.0)	3.6	(3.5)	15.7	(5.7)	0.0	(0.0)
PRC[c] (Shenzhen)	1.0	(0.8)	2.3	(2.3)	0.0	(0.0)	2.4	(1.3)	5.4	(2.8)	0.0	(0.0)
Total	**0.6**	**(0.3)**	**5.0**	**(1.6)**	**0.3**	**(0.2)**	**1.6**	**(0.8)**	**6.8**	**(1.8)**	**0.0**	**(0.0)**
Upper-middle-income countries												
Brazil (São Paulo)	7.2	(2.4)	12.3	(3.3)	1.1	(1.0)	4.8	(2.1)	20.4	(4.2)	1.9	(1.1)
Colombia (Medellin)	1.3	(1.3)	7.7	(3.7)	0.0	(0.0)	0.0	(0.0)	9.0	(4.4)	0.0	(0.0)
Lebanon	0.3	(1.5)	0.8	(0.9)	0.0	(0.0)	0.0	(0.0)	1.1	(1.7)	0.0	(0.0)
Mexico	2.9	(1.9)	8.2	(4.9)	0.0	(0.0)	2.1	(1.4)	12.4	(5.1)	1.9	(1.9)
Romania	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
Total	**4.9**	**(1.5)**	**9.8**	**(2.2)**	**0.7**	**(0.6)**	**3.1**	**(1.3)**	**15.5**	**(2.8)**	**1.4**	**(0.7)**
High-income countries												
Belgium	10.5	(10.5)	13.8	(7.8)	0.0	(0.0)	0.0	(0.0)	21.5	(11.1)	0.0	(0.0)
France	7.4	(2.7)	5.6	(3.3)	0.0	(0.0)	0.0	(0.0)	9.6	(3.6)	0.0	(0.0)
Germany	0.0	(0.0)	6.9	(5.8)	2.7	(2.8)	0.0	(0.0)	9.7	(6.0)	0.0	(0.0)
Italy	10.6	(4.2)	4.4	(2.8)	0.0	(0.0)	1.3	(1.3)	11.9	(4.5)	0.0	(0.0)
Netherlands	18.6	(9.1)	18.8	(10.5)	2.2	(2.2)	12.3	(8.6)	23.8	(10.8)	1.9	(1.7)
Northern Ireland	18.9	(6.7)	13.9	(6.2)	0.6	(0.6)	2.6	(2.6)	25.5	(9.1)	0.6	(0.6)
Poland	7.2	(5.9)	3.5	(2.6)	4.2	(3.1)	0.0	(0.0)	12.9	(6.9)	5.8	(5.7)
Portugal	20.4	(8.0)	4.9	(3.3)	1.8	(1.8)	0.0	(0.0)	22.4	(8.1)	0.0	(0.0)
Spain	10.2	(5.6)	13.9	(6.9)	0.0	(0.0)	0.0	(0.0)	19.9	(8.9)	3.2	(3.4)
Spain (Murcia)	10.4	(5.8)	4.2	(6.0)	0.0	(0.0)	0.0	(0.0)	14.6	(5.2)	0.0	(0.0)
United States	27.9	(4.3)	28.6	(3.8)	12.5	(2.5)	9.3	(2.3)	49.7	(4.1)	13.2	(2.9)
Total	**17.9**	**(2.2)**	**15.9**	**(2.0)**	**4.9**	**(1.0)**	**4.4**	**(1.1)**	**28.8**	**(2.6)**	**5.1**	**(1.1)**
All countries combined	**11.8**	**(1.4)**	**12.6**	**(1.4)**	**3.1**	**(0.7)**	**3.7**	**(0.7)**	**21.8**	**(1.9)**	**3.3**	**(0.7)**
χ^2	51.7*		13.7*		1.5*		3.6		35.8*		3.6	

*Significant at the 0.05 level, two-sided test.
[a]% with 12-month treatment among those with ADHD.
[b]Complimentary and alternative medicine.
[c]People's Republic of China.

in the mental health specialty sector (15.9% of all cases) or the general medical sector (17.9%). In upper-middle and low/lower-middle-income countries, in comparison, patients were considerably more likely to be treated in the mental health specialty sector (9.8% in upper-middle- and 5.0% in low/lower-middle-income countries) than the general medical sector (4.9% in upper-middle- and 0.6% in low/lower-middle-income countries).

Two other observations about the 12-month treatment data are noteworthy. First, the sum of the proportions of cases treated in each of the four service sectors considered in the WMH surveys is roughly 50% higher in high-income countries (43.1% [i.e., 17.9% + 15.9% + 4.9% + 4.4%]) than the proportion of cases with any treatment in one or more of those sectors (28.8%). This means that the average person with 12-month ADHD in high-income countries who received treatment for mental health problems in the past 12 months was seen in 1.5 service sectors. This average is considerably lower in upper-middle- (1.2 service sectors) and low/lower-middle- (1.1 service sectors) income countries. Previous WMH analyses have shown that this pattern of obtaining care for emotional problems in multiple service sectors in high-income countries is typical of people with a wide range of other DSM-IV disorders and is not unique to ADHD (Wang et al. 2007).

Second, 12-month treatment *specifically for ADHD* among respondents with 12-month ADHD (shown in the last column of the table) is dramatically lower than 12-month treatment for any emotional problems among the same respondents (3.3% vs. 21.8%). This same pattern is found in high- (5.1% vs. 28.8%), upper-middle- (1.4% vs. 15.5%), and low/lower-middle- (0.0% vs. 6.8%) income countries. This is consistent with the finding that a substantial part of the impairment of adult ADHD is associated with comorbid disorders. A question can be raised as to how often the treating clinicians are aware that these patients have comorbid ADHD.

Discussion

Several limitations of the analysis are noteworthy. The most obvious one is that childhood ADHD was assessed retrospectively and adult ADHD was estimated from an imputation model rather than directly. Retrospective assessment could be problematic because people with ADHD often lack insight into their conditions, leading to under-reports of prevalence (Murphy & Adler 2004) and considerably higher prevalence estimates when information is also provided by informants (Alexander & Liljequist 2016; Breda *et al.* 2016). Another limitation is that MI calibration was carried out only in the US which was an outlier in terms of prevalence, raising questions about the accuracy of the diagnostic threshold in other countries. A third limitation is that estimates of associations with outcomes are attenuated in MI models due to the inclusion of imputation error. A final noteworthy limitation is that the population to which imputation was made was restricted to WMH respondents who met full criteria for childhood ADHD.

Within the context of these limitations, the results reported here build on previous evidence about the cross-national epidemiology of ADHD in a number of ways. The most basic of these involves prevalence estimates. Population prevalence estimates for childhood ADHD have varied widely in previous epidemiological surveys, from less than 1% to over 20%, but with a central tendency of 4–6%. A recent quantitative analysis of worldwide studies reported pooled current prevalence estimates of 6.5% for children and 2.7% for adolescents (Polanczyk et al. 2007). The WMH retrospective estimate of 3.3% in high-income countries is intermediate between these two estimates, while the estimate of 2.2% in upper-middle-income countries is lower and the estimate of 0.6% in low/lower-middle-income countries is substantially lower than the lower bounds of these estimates.

Much less evidence exists on the population prevalence of adult ADHD. Early studies suggested that prevalence is low based on evidence of low adult persistence in studies that followed patients who were treated for ADHD as children into adulthood (Hill & Schoener 1996; Faraone *et al.* 2006), but there are a number of obvious methodological flaws with such studies (Sawilowsky & Musial 1988; Mannuzza *et al.* 2003). General population screening studies subsequently carried out found much higher prevalence estimates, with a meta-analysis estimating average prevalence to be 2.5% (Simon *et al.* 2009) and subsequent community surveys reporting results generally consistent with this estimate: 5.8% in Brazil (Polanczyk *et al.* 2010), 3.0% in France (Caci *et al.* 2014), 4.7% in Germany (de Zwaan *et al.* 2012), 1.3–4.6% (threshold-subthreshold) in Hungary (Bitter *et al.* 2010), and 1.1% in South Korea (Park *et al.* 2011). The WMH prevalence estimate of 2.8% is very similar to the average estimate in the meta-analysis (which, importantly, did

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not include any of the WMH surveys in the review), although the WMH series includes a much wider range of countries and, as with childhood ADHD, finds a strong association between country income level and prevalence.

One striking result of our prevalence analysis is that the estimated prevalence of adult ADHD is higher than that of childhood ADHD. This is true because a substantial proportion of adult threshold cases were subthreshold childhood cases according to retrospective reports. As one might expect, transition probabilities for becoming an adult case were higher for childhood threshold than subthreshold cases, but the fact that there were so many childhood subthreshold cases and that the transition probabilities to adult caseness were substantial for subthreshold childhood cases combine to result in a substantial proportion of adults with ADHD reporting subthreshold ADHD in childhood.

Previous prospective studies that focused on follow-up of childhood cases into adulthood are unable to evaluate the possibility that many adults with ADHD had subthreshold symptoms in childhood, as the denominator population for these studies consisted of patients who had threshold ADHD in childhood. It would be valuable for prospective community-based research to investigate this issue by following epidemiological samples of children who were classified as having either threshold or subthreshold ADHD in community surveys or school surveys (e.g., Green *et al.* 2010) into adulthood to determine whether or not the retrospective WMH results hold up prospectively. Another possibility is that this pattern in the WMH data might be due to downward recall bias about the severity of childhood symptoms among adults with threshold ADHD. It is noteworthy, though, that another related issue is that a higher proportion of subthreshold childhood cases will become threshold cases in adulthood when DSM-5 diagnostics are used, as DSM-5 requires only five symptoms of either AD or HD for a diagnosis of adult ADHD compared to six in DSM-IV and six for childhood cases in both DSM-IV and DSM-5.

By combining retrospectively recalled threshold and subthreshold childhood ADHD in the total sample (2.2% and 3.7%, respectively), the current rate of 2.8% of adult ADHD reflects a persistence rate of 47.4%. Since we did not measure subthreshold adult ADHD, this persistence rate is likely to be an underestimate of the true persistence of ADHD from childhood into adulthood. As noted above, recent community cohort studies have suggested that there may be later-onset cases of ADHD, including adult onset cases that have no history of ADHD in childhood (Moffitt *et al.* 2015; Agnew-Blais *et al.* 2016; Caye *et al.* 2016a). As noted above, the CIDI did not inquire about new onset ADHD in adulthood among respondents who did report at least subthreshold ADHD in childhood. As a result, our reported prevalence excludes these individuals from consideration.

It is unclear whether the association of ADHD prevalence with country income level reflects differences in true prevalence, differential recall, differential validity of the CIDI questions across countries, or some combination of these factors. One strong possibility is that objectively assessed inattention and hyperactivity-impulsivity might be less impairing in lower-income than higher-income countries given that these symptoms might interfere less with the role demands of people in the former than latter countries. Given the very strong cross-national gradient and the plausibility of this possibility, it would be valuable to carry out a cross-national comparative analysis that used objective performance-based neurocognitive tests to evaluate prevalence of the cognitive deficits underlying adult ADHD rather than relying only on self-report assessments. It is noteworthy in this regard that performance-based neurocognitive tests have been used in a number of recent studies of adult ADHD (e.g., Dehili *et al.* 2013; Surman *et al.* 2015; Micoulaud-Franchi *et al.* 2016) and could be used in parallel in community surveys using recently-developed technology for administering such tests in web-based surveys (www.manybrains.net). It is important to note, though, that the neurocognitive tests studied in adult ADHD up to now have been heterogeneous, in many cases only weakly correlated with each other, and non-specific for adult ADHD, making it unclear whether this line of research has yet progressed sufficiently to warrant implementing such tests in large-scale cross-national community epidemiological surveys.

Previous research has also studied socio-demographic correlates of ADHD. Perhaps the most consistently documented correlate is gender, with prevalence consistently higher among boys than girls and a higher relative prevalence of the predominantly inattentive subtype among girls than boys (Rucklidge 2010). Although earlier estimates indicated a male-to-female ratio of 9:1, a subsequent meta-analysis concluded that the true prevalence ratio is closer to 2.45:1 in non-referred community samples (Polanczyk & Jensen 2008). This finding suggests that previously reported higher ratios may have been a function of referral or treatment bias, as it is known that a higher proportion

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of boys than girls with ADHD receive treatment (Derks *et al.* 2007). The WMH OR of 1.6 for childhood ADHD among boys:girls is somewhat lower than that average. We also found the same OR for adult ADHD due to the absence of a significant gender difference in persistence of childhood ADHD into adulthood. This finding is consistent with a recent meta-analysis (which, it should be noted, included the results of an early WMH analysis of the predictors of persistence of childhood ADHD into adulthood based on our first 10 surveys (Lara *et al.* 2009)), which failed to find a significant gender difference in persistence of ADHD into adulthood (Caye *et al.* 2016b).

Age is a second socio-demographic characteristic that has been examined in studies of ADHD prevalence. Meta-analysis finds that this association is negative (Simon *et al.* 2009), a result that we replicate in the WMH surveys despite the fact that the age range of our sample was truncated (18–44). Other commonly studied correlates are various indicators of socio-economic status (SES). Although the associations of childhood ADHD with these correlates are confounded in treatment samples by selection bias, we would expect an inverse association with parental SES by virtue of the high heritability of childhood ADHD (Posthuma & Polderman 2013) along with an association of ADHD with low socio-economic attainment (Polderman *et al.* 2010). Meta-analysis shows, consistent with this expectation, that parental SES is inversely related to childhood ADHD, with children from low-SES families having an ADHD prevalence close to twice that of other children (Russell *et al.* 2016).

The WMH data focused on respondent SES rather than parental SES. We found that while both threshold and subthreshold childhood ADHD were associated with significant reductions in odds of completing college, persistence of childhood ADHD into adulthood was not associated with educational attainment. The significant association of childhood ADHD with reduced educational attainment is consistent with the results of a meta-analysis (Polderman *et al.* 2010), but we are unaware of any previous research on educational attainment and persistence of childhood ADHD into adulthood. It is conceivable that low educational attainment is influenced by childhood but not adult ADHD, while level of educational attainment among individuals who have completed their education has no influence on the course of ADHD. A more perplexing finding is that we failed to find a significant association between respondent household income per family member and adult ADHD. This result is inconsistent with other evidence suggesting that adult ADHD is associated with low household income (Martel 2013). The reason for this discrepancy between the WMH results and the results of earlier studies is unclear.

Finally, we found that respondents with adult ADHD were significantly less likely than other respondents to be currently married due to elevated odds of being previously married. This finding is consistent with previous research showing that adult attention deficits are elevated among people who are divorced (Bouchard & Saint-Aubin 2014). Our finding of high comorbidity in ADHD is consistent with much previous research (Babcock & Ornstein 2009; Mao & Findling 2014; Karlsdotter *et al.* 2016), although it is unclear from these data whether ADHD is a causal risk factor or a noncausal risk marker. Our finding that respondents with remitted ADHD continue to have elevated risk of subsequent first onset of several other disorders argues indirectly for ADHD being a noncausal risk marker, but the even more consistently significant elevated odds of secondary disorders associated with active than remitted ADHD raises the possibility that ADHD might also be a causal risk factor for secondary disorders. This issue is becoming one of increasing public health importance, as interest grows in focusing on treatment of childhood ADHD as a secondary prevention strategy for downstream disorders. Research in this area is coming to recognize that a number of mediators and moderators of the presumed effects of ADHD on secondary disorders might exist that represent alternative targets for preventive intervention (Molina & Pelham 2014). Our retrospective finding that individuals with remitted ADHD have the same significantly elevated risk of some subsequent secondary disorders such as alcohol-use disorder as those with active ADHD could be of value here in leading a recognition that *history* of childhood ADHD (i.e., whether or not still active) is a risk marker for subsequent onset of alcohol abuse (Tuithof *et al.* 2012).

Our results regarding role impairments in adult ADHD are also consistent with much previous research (Ivanchak *et al.* 2012; Kupper *et al.* 2012; Bouchard & Saint-Aubin 2014). However, we also showed that substantial proportions of these associations are more proximally due to comorbid mental disorders. Given the evidence that remitted ADHD often predicts subsequent onset of secondary disorders, a question can be raised whether some unmeasured biological and/or environmental determinants of both ADHD and

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later-onset disorders might account for the impairments associated with ADHD. An investigation of this possibility is beyond the scope of this chapter. However, we know from experimental research on the effects of ADHD treatment on objective performance data that some part of the association between adult ADHD and role performance is due to a direct and modifiable causal effect of ADHD (Biederman *et al.* 2012), implying that if role impairments played a part in predicting subsequent onset of temporally secondary disorders we would expect that risk of these disorders would return to their level in the general population with the remission of ADHD. That the WMH results suggest that this risk does not return to the population level after ADHD remission consequently implies that factors other than the impairment caused by ADHD account for the associations of remitted ADHD with subsequent onset of temporally secondary disorders.

Our results regarding 12-month adult ADHD treatment, finally, are broadly consistent with much other research in showing that only a minority of people with mental disorders obtain treatment and that this treatment rate is lower in less developed than developed countries (Wang *et al.* 2007). Other WMH research on treatment seeking for mental disorders has shown that the most important barrier is failure to recognize that the symptoms of the disorder constitute evidence of an 'illness' that could profit from treatment (Andrade *et al.* 2014). Not only ADHD but also other disorders with symptoms that are, in effect, extreme versions of normal experiences that either begin in childhood (e.g., extreme shyness in social phobia) or develop slowly over time (e.g., extreme worry in generalized anxiety disorder) have this profile of low treatment seeking for the disorder (ten Have *et al.* 2013), and the majority of patients are in treatment for a comorbid disorder that is more readily recognized as a condition needing treatment (e.g., depression, alcohol abuse). This lack of awareness has been noted in the past and has led to calls for increased public and professional training on how to diagnose adult ADHD (Asherson *et al.* 2012). Our results suggest strongly that training programmes of this sort are needed.

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References

Adler, L., & Cohen, J. (2004). Diagnosis and evaluation of adults with attention-deficit/hyperactivity disorder. *The Psychiatric Clinics of North America* 27, 187–201.

Adler, L., & Spencer, T. (2004). *The Adult ADHD Clinical Diagnostic Scale (ACDS), version 1.2*. New York: New York University School of Medicine.

Agnew-Blais, J. C., Polanczyk, G., Danese, A., *et al.* (2016). Persistence, remission & emergence of ADHD in young adulthood: results from a longitudinal, prospective population-based cohort. *JAMA Psychiatry*, 73, 713–20.

Alexander, L., & Liljequist, L. (2016). Determining the accuracy of self-report versus informant-report using the Conners' Adult ADHD Rating Scale. *Journal of Attention Disorders* 20, 346–52.

Alhraiwil, N. J., Ali, A., Househ, M. S., Al-Shehri, A. M., & El-Metwally, A. A. (2015). Systematic review of the epidemiology of attention deficit hyperactivity disorder in Arab countries. *Neurosciences (Riyadh)* 20, 137–44.

Andrade, L. H., Alonso, J., Mneimneh, Z., *et al.* (2014). Barriers to mental health treatment: results from the WHO World Mental Health (WMH) surveys. *Psychological Medicine* 44, 1303–17.

Asherson, P., Akehurst, R., Kooij, J. J., *et al.* (2012). Under diagnosis of adult ADHD: cultural influences and societal burden. *Journal of Attention Disorders* 16(Suppl 5), 20S–38S.

Babcock, T., & Ornstein, C. S. (2009). Comorbidity and its impact in adult patients with attention-deficit/hyperactivity disorder: a primary care perspective. *Postgraduate Medicine* 121, 73–82.

Biederman, J., Fried, R., Hammerness, P., *et al.* (2012). The effects of lisdexamfetamine dimesylate on the driving performance of young adults with ADHD: a randomized, double-blind, placebo-controlled study using a validated driving simulator paradigm. *Journal of Psychiatric Research* 46, 484–91.

Bitter, I., Simon, V., Balint, S., *et al.* (2010). How do different diagnostic criteria, age and gender affect the prevalence of attention deficit hyperactivity disorder in adults? An epidemiological study in a Hungarian community sample. *European Archives of Psychiatry and Clinical Neuroscience* 260, 287–96.

https://doi.org/10.1017/9781316336168.014 Published online by Cambridge University Press

Bouchard, G., & Saint-Aubin, J. (2014). Attention deficits and divorce. *Canadian Journal of Psychiatry* 59, 480–6.

Breda, V., Rovaris, D. L., Vitola, E. S., *et al.* (2016). Does collateral retrospective information about childhood attention-deficit/hyperactivity disorder symptoms assist in the diagnosis of attention-deficit/hyperactivity disorder in adults? Findings from a large clinical sample. *The Australian and New Zealand Journal of Psychiatry* 50, 557–65.

Caci, H. M., Morin, A. J., & Tran, A. (2014). Prevalence and correlates of attention deficit hyperactivity disorder in adults from a French community sample. *The Journal of Nervous and Mental Disease* 202, 324–32.

Caye, A., Rocha, T. B.-M., Anselmi, L., *et al.* (2016a). Attention-deficit/hyperactivity disorder trajectories from childhood to young adulthood: evidence from a birth cohort supporting a late-onset syndrome. *JAMA Psychiatry* 73, 705–12.

Caye, A., Spadini, A. V., Karam, R. G., *et al.* (2016b). Predictors of persistence of ADHD into adulthood: a systematic review of the literature and meta-analysis. *European Child & Adolescent Psychiatry*, 25, 1151–9.

de Graaf, R., Kessler, R. C., Fayyad, J., *et al.* (2008). The prevalence and effects of adult attention-deficit/hyperactivity disorder (ADHD) on the performance of workers: results from the WHO World Mental Health Survey Initiative. *Occupational and Environmental Medicine* 65, 835–42.

de Zwaan, M., Gruss, B., Müller, A., *et al.* (2012). The estimated prevalence and correlates of adult ADHD in a German community sample. *European Archives of Psychiatry and Clinical Neuroscience* 262, 79–86.

Dehili, V. M., Prevatt, F., & Coffman, T. P. (2017). An analysis of the Barkley Deficits in Executive Functioning Scale in a college population: does it predict symptoms of ADHD better than a visual-search task? *Journal of Attention Disorders*, 21, 567–74.

Derks, E. M., Hudziak, J. J., & Boomsma, D. I. (2007). Why more boys than girls with ADHD receive treatment: a study of Dutch twins. *Twin Research Human Genetics* 10(5), 765–70.

Faraone, S. V., Biederman, J., & Mick, E. (2006). The age-dependent decline of attention deficit hyperactivity disorder: a meta-analysis of follow-up studies. *Psychological Medicine* 36, 159–65.

Faraone, S.V., Biederman, J., Spencer, T., *et al.* (2000). Attention-deficit/hyperactivity disorder in adults: an overview. *Biological Psychiatry* 48, 9–20.

Fayyad, J., de Graaf, R., Kessler, R., *et al.* (2007). Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. *The British Journal of Psychiatry* 190, 402–9.

Fayyad, J., Sampson, N. A., Hwang, I., *et al.* (2017). The descriptive epidemiology of DSM-IV adult ADHD in the World Health Organization World Mental Health Surveys. *Attention Deficit and Hyperactivity Disorders* 9, 47–65.

Green, J. G., Avenevoli, S., Finkelman, M., *et al.* (2010). Attention deficit hyperactivity disorder: concordance of the adolescent version of the Composite International Diagnostic Interview Version 3.0 (CIDI) with the K-SADS in the US National Comorbidity Survey Replication Adolescent (NCS-A) supplement. *International Journal of Methods in Psychiatric Research* 19, 34–49.

Hill, J. C., & Schoener, E. P. (1996). Age-dependent decline of attention deficit hyperactivity disorder. *American Journal of Psychiatry* 153, 1143–6.

Ivanchak, N., Fletcher, K., & Jicha, G.A. (2012). Attention-deficit/hyperactivity disorder in older adults: prevalence and possible connections to mild cognitive impairment. *Current Psychiatry Reports* 14, 552–60.

Karlsdotter, K., Bushe, C., Hakkaart, L., *et al.* (2016). Burden of illness and health care resource utilization in adult psychiatric outpatients with attention-deficit/hyperactivity disorder in Europe. *Current Medical Research and Opinion* 32, 1547–56.

Kessler, R. C., Adler, L., Barkley, R., *et al.* (2006). The prevalence and correlates of adult ADHD in the United States: results from the National Comorbidity Survey Replication. *The American Journal of Psychiatry* 163, 716–23.

Kessler, R. C., Ormel, J., Petukhova, M., *et al.* (2011). Development of lifetime comorbidity in the World Health Organization world mental health surveys. *Archives of General Psychiatry* 68, 90–100.

Kessler, R. C., & Üstün, T. B. (2004). The World Mental Health (WMH) Survey Initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *International Journal of Methods in Psychiatric Research* 13, 93–121.

Kessler, R. C., & Üstün, T. B. (Eds). (2008). *The WHO World Mental Health Surveys: Global Perspectives on the Epidemiology of Mental Disorders*. Cambridge, UK: Cambridge University Press.

Knäuper, B., Cannell, C. F., Schwarz, N., *et al.* (1999). Improving accuracy of major depression age-of-onset reports in the US National Comorbidity Survey. *International Journal of Methods in Psychiatric Research* 8, 39–48.

Kupper, T., Haavik, J., Drexler, H., *et al.* (2012). The negative impact of attention-deficit/hyperactivity disorder on occupational health in adults and adolescents. *International Archives of Occupational and Environmental Health* 85, 837–47.

Lara, C., Fayyad, J., de Graaf, R., *et al.* (2009). Childhood predictors of adult attention-deficit/hyperactivity disorder: results from the World Health Organization World Mental Health Survey Initiative. *Biological Psychiatry* 65, 46–54.

Mannuzza, S., Klein, R. G., & Moulton, J. (2003). Persistence of Attention-Deficit/Hyperactivity Disorder into adulthood: what have we learned from the prospective follow-up studies? *Journal of Attention Disorders* 7, 93–100.

https://doi.org/10.1017/9781316336168.014 Published online by Cambridge University Press

Mao, A. R., & Findling, R. L. (2014). Comorbidities in adult attention-deficit/hyperactivity disorder: a practical guide to diagnosis in primary care. *Postgraduate Medicine* 126, 42–51.

Martel, M. M. (2013). Individual differences in attention deficit hyperactivity disorder symptoms and associated executive dysfunction and traits: sex, ethnicity, and family income. *American Journal of Orthopsychiatry* 83, 165–75.

Micoulaud-Franchi, J. A., Lopez, R., Cermolacce, M., *et al.* (2016). Sensory gating capacity and attentional function in adults with ADHD: a preliminary neurophysiological and neuropsychological study. *Journal of Attention Disorders*. DOI: 10.1177/1087054716629716 [Epub ahead of print].

Moffitt, T. E., Houts, R., Asherson, P., *et al.* (2015). Is adult ADHD a childhood-onset neurodevelopmental disorder? Evidence from a four-decade longitudinal cohort study. *American Journal of Psychiatry* 172, 967–77.

Molina, B. S., & Pelham, W. E., Jr. (2014). Attention-deficit/hyperactivity disorder and risk of substance use disorder: developmental considerations, potential pathways, and opportunities for research. *Annual Review of Clinical Psychology* 10, 607–39.

Murphy, K. R., & Adler, L. A. (2004). Assessing attention-deficit/hyperactivity disorder in adults: focus on rating scales. *The Journal of Clinical Psychiatry* 65(Suppl 3), 12–17.

Park, S., Cho, M. J., Chang, S. M., *et al.* (2011). Prevalence, correlates, and comorbidities of adult ADHD symptoms in Korea: results of the Korean epidemiologic catchment area study. *Psychiatry Research* 186, 378–83.

Polanczyk, G., de Lima, M. S., Horta, B. L., Biederman, J., & Rohde, L. A. (2007). The worldwide prevalence of ADHD: a systematic review and metaregression analysis. *The American Journal of Psychiatry* 164, 942–8.

Polanczyk, G., & Jensen, P. (2008). Epidemiologic considerations in attention deficit hyperactivity disorder: a review and update. *Child and Adolescent Psychiatric Clinics of North America* 17, 245–60.

Polanczyk, G., Laranjeira, R., Zaleski, M., *et al.* (2010). ADHD in a representative sample of the Brazilian population: estimated prevalence and comparative adequacy of criteria between adolescents and adults according to the item response theory. *International Journal of Methods in Psychiatric Research* 19, 177–84.

Polanczyk, G. V., Willcutt, E. G., Salum, G. A., *et al.* (2014). ADHD prevalence estimates across three decades: an updated systematic review and meta-regression analysis. *International Journal of Epidemiology* 43, 434–42.

Polderman, T. J., Boomsma, D. I., Bartels, M., *et al.* (2010). A systematic review of prospective studies on attention problems and academic achievement. *Acta Psychiatrica Scandinavica* 122, 271–84.

Posthuma, D., & Polderman, T. J. (2013). What have we learned from recent twin studies about the etiology of neurodevelopmental disorders? *Current Opinion in Neurology* 26, 111–21.

Robins, L., & Helzer, J. (1985). *Diagnostic Interview Schedule (DIS Version III-A)*. St. Louis, MO: Washington University, Department of Psychiatry.

Rubin, D. (1987). *Multiple Imputation for Nonresponse in Surveys*. New York: John Wiley & Sons.

Rucklidge, J. J. (2010). Gender differences in attention-deficit/hyperactivity disorder. *The Psychiatric Clinics of North America* 33, 357–73.

Russell, A. E., Ford, T., Williams, R., *et al.* (2016). The association between socioeconomic disadvantage and Attention Deficit/Hyperactivity Disorder (ADHD): a systematic review. *Child Psychiatry and Human Development* 47, 440–58.

Sawilowsky, S., Musial, J.L. (1988) Modeling ADHD exponential decay. *The ADHD Report 1988* 6(1),10–11.

Simon, V., Czobor, P., Balint, S., *et al.* (2009). Prevalence and correlates of adult attention-deficit hyperactivity disorder: meta-analysis. *The British Journal of Psychiatry* 194, 204–11.

Surman, C. B., Biederman, J., Spencer, T., *et al.* (2015). Neuropsychological deficits are not predictive of deficient emotional self-regulation in adults with ADHD. *Journal of Attention Disorders* 19, 1046–53.

ten Have, M., de Graaf, R., van Dorsselaer, S., *et al.* (2013). Lifetime treatment contact and delay in treatment seeking after first onset of a mental disorder. *Psychiatric Services* 64, 981–9.

Thomas, R., Sanders, S., Doust, J., *et al.* (2015). Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics* 135, e994–1001.

Tuithof, M., ten Have, M., van den Brink, W., *et al.* (2012). The role of conduct disorder in the association between ADHD and alcohol use (disorder). Results from the Netherlands Mental Health Survey and Incidence Study-2. *Drug and Alcohol Dependence* 123, 115–21.

Üstün, T. B., Chatterji, S., Kostanjsek, N., *et al.* (2010). Developing the World Health Organization Disability Assessment Schedule 2.0. *Bulletin of the World Health Organization* 88, 815–23.

Wang, P. S., Aguilar-Gaxiola, S., Alonso, J., *et al.* (2007). Use of mental health services for anxiety, mood, and substance disorders in 17 countries in the WHO World Mental Health surveys. *Lancet* 370, 841–50.

Weiss, M., Hechtman, L., & Weiss, G. (2000). ADHD in parents. *Journal of the American Academy of Child and Adolescent Psychiatry* 39, 1059–61.

Wolf, L. E., & Wasserstein, J. (2001). Adult ADHD. Concluding thoughts. *Annals of the New York Academy of Sciences* 931, 396–408.