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A Quantitative Review of Cognitive Functioning in Homeless Adults

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Abstract

Homeless people experience elevated rates of risk factors for cognitive impairment. We reviewed available peer-reviewed studies reporting data from objective measures of cognition in samples identified as homeless. Pooled sample-weighted estimates of global cognitive screening measures, full scale IQ, and pre-morbid IQ were calculated, in addition to pooled sample characteristics to understand the representativeness of available studies. A total of 24 unique studies were identified, with 2969 subjects. The pooled estimate for the frequency of cognitive impairment was 25%, and the mean full scale IQ score was 85, one standard deviation below the mean of the normal population. Cognitive impairment was found to common among homeless adults, and may be a transdiagnostic problem that impedes rehabilitative efforts in this population. Comparatively little data is available about cognition in homeless women and unsheltered persons.

Keywords

Homelessness; cognition; neuropsychology; serious mental illness; substance abuse

Aims of the Study

Approximately 1.5 million people in the United States experience homelessness in a year's time (AHAR, 2012). Cognitive impairment is well established as a core contributor to occupational, social, and instrumental functional disabilities in serious mental illnesses and substance abuse, and, accordingly, is now considered a primary treatment target for these illnesses (Harvey, 2010; Kalechstein & Van Gorp, 2011). A number of studies have suggested that cognitive impairment may be highly prevalent among homeless adults

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Disclosures

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(Backer & Howard, 2007; Burra, Stergiopoulos, & Rourke, 2009; Seidman et al., 1997; Spence, Stevens, & Parks, 2004). It is unclear whether cognitive impairments predate and contribute to becoming homeless or whether homelessness causes cognitive impairment. Cognitive impairment in homeless people may stem from multiple causes, including neurodevelopmental problems, such as intellectual disabilities and psychiatric disorders, or acquired brain dysfunction due to traumatic brain injury (TBI), substance use disorders, stroke, dementia, epilepsy, or other neurological conditions. It is also likely that aspects of homelessness, such as stress, malnutrition, and environmental exposures may directly impair brain function. Regardless of etiology, it is likely that planning, organization, and recall deficits interfere with the tasks necessary to sustain income to support housing, as well as in navigating and participating in preventative services or rehabilitative efforts toward reintegration once homeless. Thus, cognitive impairment may be an underappreciated barrier to efforts toward ending homelessness.

There have been prior critical literature reviews of the role of cognitive impairment in homelessness that identified a small pool of studies that generally recruited convenience samples from community shelters. (Backer & Howard, 2007; Burra et al., 2009; Spence et al., 2004). These reviews were in consensus that, given variation and limitations in sampling and methods, observed frequencies of cognitive impairment were higher than those in age-comparative groups. However, none of these reviews employed a quantitative approach, and so it is currently unknown from this body of literature what the estimated frequency of cognitive impairment are among homeless people, nor the nature of the samples with respect to demographic and clinical variables (e.g., age, duration of homelessness). Moreover, additional studies published since 2009 have not been incorporated into a review. We conducted a quantitative review of 24 identified studies that reported results from objective cognitive testing in samples of people identified to be homeless. In addition to estimating the frequency of cognitive impairment in this population, we also obtained estimates of sample characteristics and clinical factors to better understand the risk factors for cognitive impairment in the broader homeless population.

Materials and Methods

Study Selection

Articles were identified through searches in Pubmed and PSYCINFO databases, restricting inclusion to studies published between 1980 and 2013. Studies were included if they were published in peer-reviewed English-language journals and reported data from adults (aged 18 and older). Studies must have reported data from an objective measure of cognitive ability (i.e., subjective cognitive impairment was not included) in a sample that was defined by the authors as homeless at the time of testing. The search terms employed were a combination of the following sets of terms: a) homeless*, housing, and b) cogniti*, neuropsych*. Additionally, we examined reference sections of identified articles as well as previous reviews on homelessness and cognitive impairment to locate additional studies.

This initial search strategy yielded 151 articles. Each article abstract was evaluated and full text was retrieved when necessary. Articles were excluded from the review for the following reasons: Focus on children or adolescents (n=30), sample mix of homeless and non-

homeless or not homeless (n=26), no objective cognitive testing results reported (n=48), editorial or commentary (n=12), literature review (n=6), and not available in English language (n=3). A total of six articles derived from the same sample *in toto* or partially; in such cases we selected the publication with the largest sample size. The search strategy was completed independently by two of the authors, and disagreements were resolved through consensus meetings. Twenty four studies were included in subsequent analyses.

Cognitive Measures

We extracted five categories of performance-based cognitive performance data from the articles: 1) percent below impairment criteria on cognitive screening tests on the Mini-Mental State Exam (MMSE), Abbreviated Mental Test or Addenbrooke's Cognitive Evaluation, 2) mean performance on the Mini Mental State Exam, 3) mean IQ as measured by the Wechsler Adult Intelligence Scales (WAIS; various versions), Wechsler Abbreviated Scale of Intelligence (WASI), Shipley, or Ravens Progressive Matrices, 4) mean premorbid IQ as measured by the Wide Range Achievement Test-3 (WRAT-3) or American National Adult Reading Test (ANART), and 5) other neuropsychological tests (e.g., Trail Making Test, Wisconsin Card Sorting Test). Further information on the scoring, standardization, development of these tests is available in Lezak et al. (2012). We summarized the studies that employed the MMSE, indicating the percentage of the sample with MMSE scores below 23 or 24, which was the single most common criterion for cognitive impairment applied. We also obtained an average of MMSE Total scores across studies that reported it. We then pooled these findings with studies that reported a percentage of subjects falling below established cutoffs for impairment using both MMSE and alternative screening measures (e.g., Addenbrooke's Cognitive Evaluation). Mean performance on other specific neuropsychological tests was also reported, however, only the Hopkins Verbal Learning Test, Trail Making Tests A and B, Digit Symbol, Block Design, Porteus Maze Test, and Wisconsin Card Sorting Test were reported in 2 or more studies.

Demographic and Clinical Characteristics

To better understand the sample characteristics, we generated pooled estimates of available demographic and clinical data. We extracted data on the duration of homelessness, which we transformed into years of homelessness. Because the duration was sometimes characterized as lifetime and alternatively within a specified time frame, this estimate should be interpreted with caution. We categorized the sampling site into the following categories: 1) single site sheltered housing, 2) multi-site sheltered housing, 3) inpatient psychiatric facility, 4) outpatient psychiatric facility, and 5) mixed recruitment sources. Studies that employed a mixed recruitment strategy sampled from a variety of sources, including meal provision sites, social services, and outdoor settings. We also recorded the country in which the study was conducted. We recorded the percentage of diagnoses of psychotic, affective, and substance use disorder, when this information was provided. Substance use disorder included both alcohol and drug diagnoses, and in cases in which alcohol and drug use disorders were reported separately, we extracted the higher percentage of the two. In addition, some studies reported lifetime diagnoses, while others reported current or recent diagnoses. Similarly, we recorded the proportion of the sample that reported a history of

head injury. As with psychiatric diagnosis, the definition of head injury varied widely across studies, with differing criteria regarding loss of consciousness.

Statistical Analysis

Methods for the meta-analysis conformed to established methods described by Lipsey and Wilson (2001) for a fixed effects model with descriptive statistics weighted by sample size. We elected not use random effects models or weighting by quality because of the relatively small number of studies and inconsistent information with which to gauge quality. As such, we did not include sample heterogeneity as a parameter in estimates. Sample weighted averages were obtained for the following variables: mean age of the sample, percentages of the sample that were men, shelter type, duration of homelessness, and proportion with a reported head injury. We next calculated the sample weighted mean percentage falling below the criterion of MMSE < 23/24 for cognitive impairment and mean test performance values. All analyses were descriptive in nature and no correlational statistical analyses were conducted.

Results

Sample Characteristics

A total of 24 studies were identified (see Table 1). The mean sample size was 129 (sd=101, median = 82), ranging from 29 to 328, with a sum of 2969 individuals. Notably, 21 studies reported the number of subjects available to participate in research, and an average of 28% of available participants did not contribute data for the final analyses. In terms of country of sample, 41.7% (n=10) of the studies were from the United States, and 25.0% (n=5) from the United Kingdom. Remaining studies were from Australia (n=2), Brazil (n=2), Canada (n=2), or Spain (n=1) or Germany (n=1). In terms of sample populations, 41.7% (n=10) of studies were single site shelter studies and 20.8% (n=4) recruited from multiple shelters. Three were from outpatient services (2 psychiatric and one primary care), and two were from inpatient psychiatric settings. A total of five studies recruited from multiple settings, including shelters, meal provision sites, social services settings, and unsheltered/street settings.

After weighting by sample size, the mean sample age was 46.1 years (sd=6.2, range 34 to 66 years) and the average proportion of men across samples was 83.4% (sd=16.8 range 0% to 100%). The average duration of homelessness was variable across studies, with mean number of years of homelessness as reported in 12 studies of 4.7 years (sd=2.7, range 0.2 to 9 years). In terms of psychiatric diagnoses, studies variously reported lifetime and current frequencies and also varied in terms of whether structured instruments were used. We summarized the lifetime estimates where possible (and included current/past-month estimates), thus the following frequencies should be interpreted in light of this variability in definition across studies. The frequency of psychotic disorders in 12 studies was 18.1% (sd=18.9, median = 9.4%, range 2–70%). A total of 11 studies reported a frequency of affective disorders, with a mean of 27.6% (sd=18.8, median = 24%, range 2–82). The mean frequency of substance use across 10 studies was 49.7% (sd=20.8, median = 45%, range 7–82).

Cognitive Impairment

A total of 12 studies reported a proportion of the sample with MMSE scores below 23 or 24 as indicative of cognitive impairment. The mean proportion with MMSE scores below 23 or 24 was 16.1% (sd=13.1, median = 9.9, range 2 to 43%). Four additional studies reported the proportion of global cognitive impairment using either a different global cognitive screening test or a comprehensive neuropsychological battery. Integrating these studies with the ones reporting MMSE-based frequency of cognitive impairment yielded a mean of 25.4% impaired (sd=23.8, median 17.2 range, 2% to 82%). Three studies reported a mean MMSE score, and their pooled sample-weighted average was 26.3 (sd=0.2, range 26.3–27.1).

Among studies reporting IQ tests, eight studies reported a mean IQ, with a mean value of 84.8 (sd=5.1, range 77.0 to 97.3). A total of four studies reported an estimate of premorbid IQ, with a mean value of 90.0 (sd=7.9, range 81.4 to 103.0). Six studies reported neuropsychological results using the Hopkins Verbal Learning Test-Revised, Trail Making Test, Digit Symbol, Block Design, Porteus Maze Test, or Wisconsin Card Sorting Test. With the exception of the Porteus Maze Test, reported scores were, on average, below the mean in the normal population, and most were in the impaired range (see Table 2). Finally, across five studies, the mean proportion of the sample with a history of a head injury was 54.7% (sd=6.5, range 43–60%).

Discussion

In this quantitative review of homelessness and cognitive impairment, we found evidence for elevated frequencies of cognitive problems in homeless samples. We also identified a number of important gaps in the literature. In the pooled sample of 2969 homeless adults, about 25% screened positive for cognitive impairment. The mean full-scale IQ score was about one standard deviation below average, which would be below the 15th percentile. Furthermore, of the studies that used neuropsychological assessments, mean scores were almost universally below average and were more commonly in the impaired range, suggesting that there may be considerable cognitive impairment in this population that is missed by brief screening measures (e.g., the MMSE). These estimates confirm, in a larger pool of studies, the conclusions of earlier reviews that cognitive impairment is likely common among homeless adults (Backer & Howard, 2007; Burra, Stergiopoulos, & Rourke, 2009; Seidman et al., 1997; Spence, Stevens, & Parks, 2004), and should be an important element of routine screening and rehabilitation.

There was substantial variation across studies in the frequency of cognitive impairment, and this review identified some potential sources of this variation and areas of methodological improvement and need for greater representation of the homeless population. For one, variation in the assessment and quality of cognitive assessment was present. Understanding that comprehensive neuropsychological batteries are not compatible with routine care in most service settings, there are more reliable and valid screening measures than the MMSE for cognitive impairment (e.g., the Montreal Cognitive Assessment (Nasreddine et al., 2005). Additionally, performance-based measures of functional capacity (e.g., the UCSD Performance-based Skills Assessment [UPSA(Patterson, Goldman, McKibbin, Hughs, & Jeste, 2001)]) may be better able to capture impairments in instrumental living skills.

Functional Capacity measures (e.g., direct observation of instrumental activities such as financial management) are highly associated with cognitive ability in a wide variety of illnesses; one study indicated that the UPSA was sensitive to housing status (Stergiopoulos, Burra, Rourke, & Hwang, 2011).

Few studies were longitudinal and it is likely that the pathways to cognitive impairment in this population are as diverse as are those to becoming homeless. Neuropsychiatric risk factors were highly prevalent in the population, as one-fifth of sampled patients had a history of psychotic disorder and one-third had a history of affective disorder. Over half had a history of substance abuse. These estimates may underestimate lifetime psychiatric burden, given that some studies reported only current diagnosis. In addition, over half of individuals sampled reported a lifetime history of a head injury, which was variously defined. It is unclear which of these risk factors was associated with the greatest elevated risk for cognitive impairment, as studies rarely assessed the relative strength of association between putative risk factors and cognitive impairment. It is also unclear if these risk factors predated the onset of homelessness. Longitudinal research on the temporal sequelae of psychiatric, neurological, and substance abuse and homelessness would aid in determining the course of these risk factors in relationship to the onset of homelessness, duration of homelessness, and response to rehabilitative efforts. It may be likely, given the diversity of risk factors, that subgrouping based on risks (e.g., neurodevelopmental risks such as schizophrenia or intellectual disability vs. acquired ones such as traumatic brain injury or substance use disorder) may yield a more clinically informative platform for risk stratification.

Future work should also broaden the representation of homeless adults. Although varied in terms of nation of origin of the study, the samples were nearly all from residents in sheltered settings. Thus, unsheltered adults were not typically represented in these studies, likely due to the problems in recruitment that arise in such persons. Moreover, about 28% of approached persons did not participate in data collection, so the cognitive profile of people who elect not to participate in research or cognitive screening is unknown. Importantly, greater than 83% of the samples were men, yet recent estimates indicate that 38% of sheltered homeless people are women (AHAR, 2012).

Additional potential risk factors that were not well addressed by the literature include learning/intellectual disabilities and other diagnoses such as PTSD. It was notable, in the few studies that estimated pre-morbid IQ, the mean score was below average ($m=90$) and near that of full-scale IQ. This finding hints at the presence of pre-morbid and perhaps developmental deficits in a portion of the homeless population. Moreover, most of the studies in the review reported on data collected in the 1990s and early 2000s, prior to the current expansion of focus on PTSD. Given the recent wave of Veterans returning from foreign conflicts, additional surveillance systematically capturing the co-occurrence of history of traumatic injuries, homelessness, and cognitive impairment would be particularly timely.

This review was limited in providing a comprehensive picture cognitive impairment in homeless people due to the relatively small number of studies and the inconsistencies across studies in data collection strategies, definitions, and reporting of homelessness, diagnoses

and cognitive ability. As such, we were not able to examine systematically sources of variation of estimates of cognition and were not able to weight our estimate by study quality. Moreover, given the preponderance of cross-sectional studies, we could not determine the direction of the association between homelessness and cognition. Nonetheless, our review indicates that cognitive impairment is a common aspect of the complex clinical picture of homeless adults. The identified average prevalence of cognitive impairment was about 5 to 8 times greater than the rate of cognitive impairment in the U.S. population older than age 70 (the mean age across the samples was 46.1 years) (Sheffield & Peek, 2011). Future research would need to identify the extent to which homelessness exerts additional risk to cognition beyond psychiatric illnesses (e.g., psychosis or substance abuse), and whether cognitive impairment reduces the impact of housing-focused rehabilitation as it does in other rehabilitation targets (Kurtz, 2011; McGurk & Mueser, 2013; Sofuoglu, DeVito, Waters, & Carroll, 2013). As such, we hope that this review can stimulate research on the role and rehabilitation of cognitive impairment in the persistent problem of homelessness.

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Table 1

Description of Included Studies

Study	Location	Sampling Location	Sample Size	% Male	Mean age	Duration of Homelessness (in Years)	Cognitive Measure(s)	Findings
FULL SCALE IQ/PRE-MORBID IQ SCORES								
1. Adams et al. (1996)	London, UK	Single Site – Shelter	64	0	44	0.6	FSIQ (Ravens) Pre-morbid IQ (NART)	77 94
2. Bremner et al. (1996)	London, UK	Single Site – Shelter	62	100	--	--	FSIQ (Ravens)	83.6
3. Foulks et al. (1990)	New Orleans, USA	Outpatient Services	30	100	42.4	0.6	FSIQ (WAIS-R)	97
4. Louks et al. (1988)	White City, OR, USA	Single Site – Shelter	--	98	51	--	FSIQ (Shipley)	104.8
5. Pluck et al. (2011)	Sheffield, UK	Mixed	55	80	34.3	3.6	FSIQ (WASI)	88.1
6. Oakes et al. (2008)	UK	Outpatient Services	50	66	--	--	FSIQ (WASI)	91.9
7. San Augustin et al. (1988)	New York City	Multi Site – Shelter	82	100	--	--	FSIQ (Ravens) borderline or impaired	41.5% impaired
8. Seidman et al. (1997)	Boston, USA	Multi Site- Shelter	116	72	37.6		FSIQ (WAIS-R) Pre-Morbid IQ (WRAT-R)	82.8 81.4
9. Solliday-Meroy et al. (2004)	Milwaukee, USA	Single-Site Shelter	90	100	41	0.2	FSIQ (WASI)	83.9
10. Stergiopoulos et al. (2011)	Toronto, Canada	Inpatient Psychiatric	30	63	38	--	Pre-Morbid IQ (ANART)	103
GLOBAL COGNITIVE IMPAIRMENT RATES								
1. Bousman et al. (2010)	San Diego, USA	Outpatient Services	72	56	43	--	Global Deficit Score on Neuropsych. Test Battery	52%
2. Bremner et al. (1996)	London, UK	Single Site – Shelter	62	100	--	--	MMSE (<24)	7%
3. Brown et al. (2012)	Boston, USA	Multi-Site – Shelter	250	80	56	7.7	MMSE (<24)	24.5%
4. Buhrich et al. (2000)	Sydney, Australia	Multi-Site – Shelter	204	76	48	3	MMSE (<24)	10%
5. Fichter et al. (2001)	Munich, Ger.	Mixed	265	100	45.3	--	MMSE (<24)	9.9%
6. Fischer et al. (1986)	Baltimore, USA	Multi-site – Shelter	51	94	--	--	MMSE	7.8%
7. Gilchrist et al. (2005)	Glasgow, Scotland	Single Site- Shelter	266	89	53	--	Addenbrook's Cognitive Exam. (< 88)	82%
8. Geddes et al. (1996)	Edinburgh, Scotland	Multi-Site – Shelter	133	90	--	--	Abbreviated Mental Test (<7)	28%
9. Gonzalez et al. (2001)	Miami, FL	Single Site – Shelter	60	60	39.8	--	MMSE (<24) MMSE Total (mean)	35% 26.4
10. Heckert et al. (1999)	Juiz de For a, Brazil	Mixed	83	85	39.6	3	MMSE	9.6%
11. Koegel et al. (1988)	Los Angeles, CA	Mixed	328	95	36.8	--	MMSE	3.4%

Study	Location	Sampling Location	Sample Size	% Male	Mean age	Duration of Homelessness (in Years)	Cognitive Measure(s)	Findings
12. Joyce et al. (2009)	Toronto, CA	Single Site – Shelter	29	100	66	8.8	MMSE (<23) MMSE Total (Mean)	17.2% 27.1
13. Lovisi et al. (2003)	Rio de Janeiro, Brazil	Mixed	322	75.8	44.8	4.5	MMSE (<24)	36.3%
14. Munoz et al. (1998)	Madrid, Spain	Mixed	262	78.5	42	--	MMSE (<24)	6.3%
15. Teeson et al. (1993)	Sydney, Australia	Shelter- Single Site	65	100	53	1.6	MMSE (<24)	43%

Abbreviations: MMSE: Mini-Mental State Examination; NART: National Adult Reading Test; FSIQ: Full Scale Intelligent Quotient

Table 2

Neuropsychological results of tests used in at least two studies

Study	% Male	Mean age	Cognitive Measure(s)	Mean Scores (SD)	Interpretation
Seidman et al. (1997)	72	37.6	WCST Categories Completed WCST Perseverative Responses Digit-Symbol Block Design Porteus Maze Test	Raw = 2.8 (2.2) Raw = 45.5 (36.8) Scaled = 5.6 (2.3) Scaled = 6.7 (2.5) Standard = 82.0 (24.7)	Mean scores were all in the impaired range
Stergiopoulos et al. (2011)	63	38	HVLT-R Total Recall HVLT-R Delayed Recall Trail Making Test, Part A Trail Making Test, Part B WCST Categories Completed WCST Total Errors WCST Perseverative Errors Digit Symbol	Raw = 19.9 (6.6) Raw = 6.8 (3.2) Raw = 46 (28) Raw = 138 (83) Raw = 1.7 (1.3) Raw = 28.1 (11.3) Raw = 14.6 (7.8) Raw = 34.1 (13.0)	Mean raw scores were all in the impaired range
Bousman et al. (2010)	56	43	HVLT-R Total Recall HVLT-R Delayed Recall WCST-64 Perseverative Errors Digit-Symbol	T = 45 (median) T = 45 (median) T = 43 (median) T = 44 (median)	Median T-scores were all in the low average range
Brown et al. (2012)	80	56	Trail Making Test, Part B	Raw = 130 (67)	Mean raw score was in the impaired range
Gonzalez et al. (2001)	60	39.8	Trail Making Test, Part A Trail Making Test, Part B Digit-Symbol Block Design	Raw = 55.6 (39.5) Raw = 149.1 (104.9) Scaled = 6.1 (2.8) Scaled = 6.4 (2.5)	Mean raw scores were all in the impaired range
Foulks et al. (1990)	100	42.4	Porteus Maze Test	Standard = 114.2 (17.3)	Mean standard score was above average

Note. HVLT-R = Hopkins Verbal Learning Test-Revised; WCST = Wisconsin Card Sorting Test; WCST-64 = Wisconsin Card Sorting Test, 64 card version