

Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:

Lee, SM;Lewis, M;Leighton, D;Harris, B;Long, B;Macfarlane, S

Title:

A comparison of the neuropsychological profiles of people living in squalor without hoarding to those living in squalor associated with hoarding

Date:

2017-12-01

Citation:

Lee, S. M., Lewis, M., Leighton, D., Harris, B., Long, B. & Macfarlane, S. (2017). A comparison of the neuropsychological profiles of people living in squalor without hoarding to those living in squalor associated with hoarding. *International Journal of Geriatric Psychiatry*, 32 (12), pp.1433-1439. <https://doi.org/10.1002/gps.4631>.

Persistent Link:

<https://hdl.handle.net/11343/292204>

A comparison of the neuropsychological profiles of people living in squalor without hoarding to those living in squalor associated with hoarding

Authors: Dr Sook Meng Lee MBBS FRACP^{1,2}, Dr Matthew Lewis PhD¹, Deborah Leighton MA (Clin Neuro)³, Dr Ben Harris PhD⁴, Dr Brian Long DPsych (Clin. Neuro.)⁵ A/Prof Stephen Macfarlane MBBS FRANZCP^{1,6}

Affiliations

1. Aged Psychiatry Service, Caulfield Hospital, Alfred Health
2. Department of Geriatric Medicine, Western Health
3. Neuropsychology, The Royal Melbourne Hospital, Melbourne Health
4. Neuropsychology, Kingston Centre, Monash Health
5. Neuropsychology, Monash Medical Centre, Monash Health
6. The Dementia Centre, HammondCare, Sydney, NSW, Australia

Running Head: Cognition in squalor vs squalor with hoarding

Word Count: 3145

Keywords: squalor, hoarding, neuropsychology, cognition, ageing

Key points:

- 1 Squalor and hoarding commonly co-occur
- 2 Both squalor and hoarding are associated with a range of cognitive impairments, predominantly frontal in nature
- 3 Impaired mental flexibility strongly predicted squalor only as opposed so squalor with hoarding

Funding Source: Caulfield Hospital Aged Psychiatry Service Research Fund

Corresponding author

Name: Associate Professor Stephen Macfarlane

Postal address: The Dementia Centre: HammondCare

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: [10.1002/gps.4631](https://doi.org/10.1002/gps.4631)

Pallister House, Greenwich Hospital

97-115 River Road

Greenwich, NSW 2065

Australia

Email: smacfarlane@hammond.com.au

Phone: +61 (0)2 8437 7355

Author Manuscript

Abstract

Objective: Squalor affects 1 in 1000 older people and is regarded as a secondary condition to other primary disorders such as dementia, intellectual impairment and alcohol abuse. Squalor frequently is associated with hoarding behaviour. We compared the neuropsychological profile of people living in squalor associated with hoarding to those presenting with squalor only.

Methods: Retrospective case series of hospital inpatient and community healthcare services of 69 people living in squalor (49 from aged care; 16 from aged psychiatry; 3 from acute medical; and one from a memory clinic). 40% had comorbid hoarding behaviours. The main outcomes were neuropsychologists' opinions of domain specific cognitive impairment.

Results: The Squalor-Hoarding group (M age 75.8, SD=6.9,) was significantly older ($p<0.05$) than the Squalor-Only group (M age 69.9 years, SD=13.1), significantly more likely to have vascular or Alzheimer's type neurodegeneration ($p<0.05$) and significantly less likely to have alcohol related impairment ($p<0.05$). Chi-square analyses revealed significantly greater rates of impairment for the Squalor-Only group ($p<0.05$) in visuospatial reasoning, abstraction, planning, organisation, problem solving and mental flexibility, compared with the Squalor-Hoarding group. Logistic regression analysis indicated that impaired mental flexibility was a significant predictor and strongly indicated Squalor-Only (OR = 0.07; 95%CI: 0.01-0.82).

Conclusions: Preliminary evidence suggests that squalor associated with hoarding may have distinct neuropsychological features compared against squalor only. Future work should be conducted using a larger sample and a common neuropsychological battery to better understand the deficits associated with hoarding related squalor.

Author Manuscript

Introduction

At least 1 in 1000 older people lives in conditions so unclean, messy and unhygienic that intervention would be considered essential (Snowdon and Halliday 2011; Snowdon, et al. 2012a). The antecedents to this severe domestic squalor remain poorly understood as people who live in squalor rarely seek assistance and do not readily engage with the health system or participate in research. Squalor presents heterogeneously as a secondary condition to a range of medical or psychiatric conditions, and has a strong association with impaired frontal executive function (Beauchet, et al. 2002; Gregory, et al. 2011; Lee, et al. 2014). An overlap has been observed between hoarding and squalor, with up to 66% of people who live in squalor exhibiting hoarding behaviours (Snowdon and Halliday 2011). In this study, we explored the relationship between hoarding and squalor by comparing the neuropsychological profiles of people living in squalor with comorbid hoarding behaviours to those living in squalor without evidence of hoarding.

Hoarding Disorder has attained an increased profile with its addition to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (American Psychiatric Association 2013). Hoarding Disorder is diagnosed if there are persistent difficulties discarding possessions resulting in clutter that compromises the utility of living areas causing significant distress or

impairment in function and that is not attributable to another medical condition (American Psychiatric Association 2013). Hoarding behaviour is believed to be linked to impaired executive function (Ayers, et al. 2013) including decreased reaction time, impulsivity (Grisham, et al. 2007), and poor planning and categorization (Grisham, et al. 2010). Neuroimaging has demonstrated involvement of the frontal regions of the brain in hoarding, including the anterior cingulate gyrus, posterior cingulate gyrus and the anterior prefrontal cortex (An, et al. 2009; Ohtsuchi, et al. 2010; Saxena and Saxena 2008a, b). Research investigating the neuropsychology of squalor has indicated dorsolateral-prefrontal cortex (DL-PFC) involvement (Gregory et al. 2011; Lee et al. 2014). The DL-PFC is responsible for higher order executive function including planning, working memory, organisation, abstract thinking and the regulation of intellectual function (Funahashi 2001) which, when impaired, are cognitive domains likely to contribute to the development of squalor (Lee, et al., 2014).

Few studies to date have examined the relationship between hoarding and squalor, and its neuropsychological underpinnings. In recent work, we reported that 40% of a sample identified as living in squalor had some evidence of hoarding in their records; including entrenched hoarding behaviour, excessive collection, difficulty discarding items or excessive acquisition of items (Lee et al. 2014). This rate of hoarding behaviour observed in people living in squalor is consistent with other studies that have reported this co-occurrence in 20- 66%. (Clark 1975;

Snowdon and Halliday 2011) In this study, we sought to characterise and compare the neuropsychological profiles of people who presented with squalor only and those with both squalor and hoarding.

Methods

A complete description of the methods has been described elsewhere along with the full demographic details of the sample (Lee et al. 2014). A summary is presented here. The study was approved by the Human Research Ethics Committee of participating services.

Clinicians submitted a total of 75 neuropsychological reports of patients living in squalor. The reports were screened to ensure that there was a comprehensive examination of key neuropsychological domains of basic attention, visuospatial reasoning, information processing speed and memory function. Some additional features such as communication, impulsivity, sexual disinhibition and overfamiliarity were drawn from clinical observations and medical history, and were presumed to be absent if not recorded. Neuropsychological assessments

were not able to be standardised due to the retrospective nature of the study, and the following data are based on individual neuropsychological determinations on whether a cognitive domain was impaired or not. Records were examined for descriptions of entrenched behaviour of hoarding, excessive collection, unusable living areas as a result of accumulated possessions, difficulty discarding and excessive acquisition of free or bought items. If any of these were described in the records, that patient was allocated to the Squalor-Hoarding group, and the patient was allocated to the Squalor-Only group if there was no such description. As data collection was conducted prior to the release of DSM 5 (American Psychiatric Association 2013) and we used these broad inclusion and exclusion criteria. Data were initially extracted by one of the authors (SML) and were also independently extracted by a psychogeriatrician for a separate publication (Gleason, et al. 2015). Both sets of data were compared and any discrepancies resolved. The majority of participants were assessed as inpatients in a hospital setting.

Sample

After screening, the neuropsychology reports of 69 individuals living in squalor underwent analysis. Two groups were formed; the Squalor-Only group (n=41, 51.2% male) and the Squalor-Hoarding group (n=28, 42.9% male) based on whether hoarding behaviours were

described in the reports. Using these criteria, 40.5% of the sample had hoarding associated with squalor. The demographic profiles of these two groups are shown in Table 1.

Insert Table 1 about here

Statistical Analysis

Analysis was conducted using SPSS v18 (IBM Corp, 2010). Continuous demographic data were analysed using one-way ANOVA or the Brown-Forsythe test if the equal variances assumption has been violated. Categorical data was analysed using χ^2 . The neuropsychological summary variables were analysed using a series of 2 (squalor type: Squalor-only vs Squalor-Hoarding) by 2 (neuropsychological domain: impaired vs normal) χ^2 analyses. The dichotomous neuropsychological summary variables (impaired/normal) were entered into the binomial logistic regression model if $p < 0.25$ on χ^2 consistent with recommendations (Mickey and Greenland 1989). The logistic regression model had Squalor-Only/Squalor-Hoarding as the dependent variable and the included cognitive domains as predictors. The neuropsychological variables were examined for collinearity. Results are presented so that an odds ratio (OR) < 1 indicates increased likelihood of impairment in the Squalor-Only group. All significance levels have been maintained at 0.05.

Results

Demographics

Both the Squalor-Only and the Squalor-Hoarding groups were similar demographically (Table 1). Gender, Mini Mental State Examination (MMSE) scores, education level, premorbid intellectual function classifications and living situation did not differ significantly between groups. The Squalor-Hoarding group (M age 75.8, SD=6.9,) was significantly older (Browne Forsythe (1,63.7) = 5.7, $p<0.05$) than the Squalor-Only group (M age 69.9 years, SD=13.1). Alcohol related problems were recognised as key contributors in 37% of the Squalor-Only group and 3.6% of the Squalor-Hoarding group. This difference was significant ($p<0.05$). Vascular and Alzheimer's type neurodegeneration were significantly more common ($p<0.05$) in the Squalor-Hoarding group compared with the Squalor-Only group.

Insert Table 2 about here

Neuropsychological domains

Chi square analyses were conducted comparing the dichotomous impairment outcomes of the neuropsychological domains between the Squalor-Only and Squalor-Hoarding groups and results are presented in Table 2. Of the included domains, visuospatial reasoning, abstraction, planning, organisation, problem solving and mental flexibility all differed significantly between groups. The proportion of people with impairment was highest for the Squalor-Only group for all variables.

Neuropsychological domains where chi square analysis indicated that alpha was <0.05 were entered into a bivariate logistic regression model with Squalor-Only/Squalor-Hoarding as the dependent variable and the cognitive domains as predictors. Collinearity diagnostics indicated unacceptably high variance inflation factor values and low tolerance values for both planning and organisation. On inspection, both planning and organisation showed a high level of overlap and a decision was made to remove organisation from the model.

The results from the logistic regression analysis are shown in Table 3. The overall model was significant ($\chi^2(10) = 19.24, p = 0.04$). Nagelkerke's r^2 was 0.37 indicating that the variables moderately explained the variance in the model. The model correctly predicted the group membership of 77.3% of the sample with 89.5% of those in the Squalor-Only group and 60.7% of the Squalor-Hoarding group being correctly identified. Of the included neuropsychological variables, only impaired mental flexibility emerged as a significant predictor and strongly indicated that a person belonged to the Squalor-Only group (OR = 0.07; 95%CI: 0.01-0.82).

Insert Table 3 about here

Discussion

In this study of patients living in squalor, 40.5% of the sample had evidence of hoarding behaviour in their records and formed the Squalor-Hoarding group. The remaining patients, who showed no evidence of hoarding, formed the Squalor-Only group. The Squalor-Only group were significantly younger than the Squalor-Hoarding group and had significantly greater impairment in visuospatial reasoning, abstraction, planning, organisation, problem solving, and mental flexibility. The other domains did not differ significantly between the two groups. Impaired mental flexibility was the only significant neuropsychological predictor that emerged in a binomial logistic regression model and strongly predicted inclusion in the Squalor-Only group.

It was somewhat unexpected, that the mean age of those in the Squalor-Only group was significantly lower ($M = 69.9$ years, $SD=13.1$) than the Squalor-Hoarding group ($M = 75.8$ years, $SD=6.9$) particularly given that squalor has traditionally been observed in an aged population whereas hoarding has been known to begin in adolescent years, albeit with worsening of symptoms with age (Ayers, et al. 2014; Ayers, et al. 2010; Ayers et al. 2013; Dozier, et al. 2016). This may reflect sampling bias to some extent however given that existing work suggests that both squalor and hoarding are observed in younger adults but increase in prevalence with age (Halliday, et al. 2000; Samuels, et al. 2008). Halliday et al. (2000) reported that the prevalence rate per 1000 population is 0.2 cases of squalor per 1000 people aged under 65 (204, 000), and 1.17 cases of squalor per 1000 population aged over 65 (34,000) according to the population estimate presented in the manuscript. Those aged over 65 were 5.85 times more likely to have squalor. Samuels et al. (2008) similarly reported that hoarding prevalence increased with rising from 2.3% of their youngest age group, to 6.2% in the oldest.

The reasons for the age difference between the Squalor-Only and Squalor-Hoarding groups are likely to be complex and multifactorial, and may reflect differing aetiological factors. Alcohol related impairment was noted in 47% of cases aged less than 65 years (compared with 17% in those older than 65), and the majority of those younger than 65 year (92.3%) were in the Squalor-Only group. Alcohol related impairment was far more commonly observed in the

Squalor-Only sample (37%) compared against the Squalor-Hoarding sample (3.6%). Alcohol misuse may lead to earlier contact with the health system due to its involvement in 10% of “injury-related hospitalisations” (McKenzie, et al. 2010) and its associations with chronic health conditions (Shield, et al. 2014). Alcohol misuse is also associated with impaired frontal executive function (Moselhy, et al. 2001) which in turn is associated with squalor (Lee et al. 2014). An alternate explanation for the age discrepancy between groups is that hoarding may begin quite benignly at an early age in a cluttered, but not necessarily squalid environment that devolves as people who hoard become older. Later age is associated with increased executive dysfunction and difficulties in daily life for people with diagnosed hoarding disorder (Dozier et al. 2016). Factors such as loss of a domestic partner, frailty and later onset neurocognitive disorders may then create difficulties in maintaining cleanliness in an already cluttered environment leading to squalor. In our study, we found that the rate of neurocognitive disorders due to Alzheimer’s disease and vascular aetiologies was twice as high in the Squalor-Hoarding sample (75%) than in the Squalor-Only sample (37%) which provides some support for this explanation. It is possible that this group would come to the attention of clinicians at a later age than may occur in cases of squalor without hoarding.

These hypotheses for the age discrepancy receive some support given that health professionals are more likely to be involved when squalor is present as it has a higher association with health risks including self-neglect (McDermott 2010). It could also be hypothesised that in those with

hoarding behaviour, the presence of a non-hoarding co-resident (e.g. within a marital relationship) might serve to maintain order within the environment until such time as the partner dies or the relationship dissolves, at which point the hoarding behaviour can proceed unopposed. These scenarios could delay the presentation of hoarding with squalor until later in life. Unfortunately, we do not have access to data or a suitable sample size that would allow us to meaningfully test these hypotheses.

Frontal regions of the brain have been implicated in both squalor and hoarding (An et al. 2009; Ayers et al. 2013; Grisham et al. 2010; Lee et al. 2014). These impairments are likely to manifest as failure of the patient to appreciate their squalid living conditions and their inability to plan or execute a clean-up. From our clinical experience, patients may be able to articulate how they plan to clean up but rarely ever carry through with it. There was a high degree of cognitive impairment in both the Squalor-Only and Squalor-Hoarding groups; however, greater cognitive impairment was detected in the Squalor-Only group. For most domains this did not reach significance except for visuospatial reasoning, abstraction, planning, organisation, problem solving and mental flexibility. Poor planning has also been found in people who hoard (Grisham et al. 2010), and in our sample the majority of the Squalor-Hoarding group (71.4%) had impaired planning; however, there was a significantly greater risk of planning impairment in the Squalor-Only group (92.7% impaired). Similar patterns were seen for problem solving (Squalor-Hoarding: 71% impaired; Squalor – Only: 90% impaired), and this pattern was

continued for visuospatial reasoning (Squalor-Hoarding: 53.6%; Squalor-Only: 78%), abstraction (Squalor-Hoarding: 75% impaired; Squalor-Only: 92.7% impaired), and organisation (Squalor-Hoarding: 67.9% impaired; Squalor-Only: 92.7% impaired). These findings may indicate that squalor that has been preceded by hoarding is not as readily attributable to impairment in these domains compared to patients with squalor without hoarding. Squalor-Only patients often clinically present as more apathetic and less motivated compared to hoarders. Effort and motivation during testing, although not specifically measured, may have an influence on performance results on tests of planning and organisational abilities. While it is unclear which tasks were used to assess these domains, it is possible that these significant impairments arose from either the Rey Complex Figure Test or Block Design from the Wechsler Adult Intelligence Scale. If this were the case, the possibility exists that some form of underlying executive dysfunction led to secondary deficits in visuospatial reasoning, planning and organisation, and that this was greater in the Squalor-Only group. Interestingly, there were no significant differences between the research groups on the MMSE. However, given that the MMSE has demonstrable shortcomings in detecting executive dysfunction (Pendlebury, et al. 2010) and that both hoarding and squalor are associated with executive dysfunction, it is likely that the MMSE lacks the sensitivity to detect these differences.

In the logistic regression analysis, mental flexibility emerged as the only significant predictor of group membership. Impaired mental flexibility was a strong predictor that the person was a

member of the Squalor-Only group. Spontaneous mental flexibility is defined as the ability to generate ideas and is usually tested by verbal fluency tasks. People with impaired spontaneous flexibility tend to be adynamic and have difficulties creating order and imposing structure on situations, lending a plausible model for the neuropsychological underpinnings of squalor (Eslinger and Grattan 1993).

This study is limited as it is retrospective in nature, relies on submitted neuropsychological assessments, reports on findings at the cognitive domain level, does not use a common pre-determined neuropsychological battery and uses a small sample which may limit the efficacy of the regression analysis. Working with a population with squalor is inherently difficult given their reluctance in engaging with clinicians and researchers, and research is either on selected samples or potentially an atypical sample that volunteers to be involved in a research study. In this study, we have used a sample that required neuropsychological assessment that may not be representative of the whole hoarding or squalor populations. We were precluded from using a more precise or consistent definition of hoarding or squalor across reports, so that we were unable to grade the severity of the squalor and hoarding behaviour or separate patients with Hoarding Disorder, hoarding associated with obsessive compulsive disorder and organic hoarding. The term organic hoarding is used when referring to excessive accumulation by people with brain pathology such as dementia or brain injury (Mataix-Cols, et al. 2011). Although the neuropsychological profiles of the different categories of hoarders are not fully

defined as yet, patients with organic hoarding appear to have a stronger association with squalor (Mataix-Cols et al. 2011; Snowden, et al. 2012b). Future prospective research using a larger sample and with clearly defined diagnostic criteria, more detailed demographic background and medical history, standardized neuropsychological testing and a control group may be able to clarify some of the trends that were found in our study.

Conclusion

This study found that executive dysfunction was present in people who live in squalor regardless of whether there is associated hoarding or not. There were some cognitive differences between those with hoarding and those with just squalor and may indicate a different type of executive dysfunction, but this is not conclusive and requires further investigation. Whilst it is possible that the underlying neuropathology is different in patients presenting with these two squalor subtypes, we found that their neuropsychological profiles are broadly similar. Whenever the syndrome of squalor is present, there is a high likelihood that the occupant has executive dysfunction and this should be taken into consideration during assessment and management planning.

Acknowledgements:

We would like to thank Inna Brodsky, Asawari Henderson, Jo-Anne Buchanan, Jennifer McDowall, Jane Khoo, Chris Hutchison, Natalie Genardini and Lina Forlano for submitting neuropsychology reports.

Declaration of Conflicting Interests: The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding: The current project received Departmental funding via Caulfield Hospital Aged Psychiatry Service Research Fund to fund investigator initiated research within the Aged Psychiatry Service. The funding source did not influence the preparation of the manuscript.

Author Manuscript

References

American Psychiatric Association 2013 *Diagnostic and Statistical Manual of Mental Disorders: DSM-5*. Arlington, VA: American Psychiatric Association

An SK, Mataix-Cols D, Lawrence NS, Wooderson S, Giampietro V, Speckens A, Brammer MJ & Phillips ML 2009 To discard or not to discard: the neural basis of hoarding symptoms in obsessive-compulsive disorder. *Mol. Psychiatry* **14** 318-331.

Ayers CR, Ly P, Howard I, Mayes T, Porter B & Iqbal Y 2014 Hoarding severity predicts functional disability in late-life hoarding disorder patients. *Int. J. Geriatr. Psychiatry* **29** 741-746.

Ayers CR, Saxena S, Golshan S & Wetherell JL 2010 Age at onset and clinical features of late life compulsive hoarding. *Int. J. Geriatr. Psychiatry* **25** 142-149.

Ayers CR, Wetherell JL, Schiehser D, Almklov E, Golshan S & Saxena S 2013 Executive functioning in older adults with hoarding disorder. *Int. J. Geriatr. Psychiatry* **28** 1175-1181.

Beauchet O, Imler D, Cadet L, Blanc P, Ramboa P, Girtanner C & Gonthier R 2002 [Diogenes syndrome in the elderly: clinical form of frontal dysfunction? Report of 4 cases]. *Rev. Med. Interne* **23** 122-131.

Clark AN 1975 The Diogenes syndrome. *Nurs. Times* **71** 800-802.

- Dozier ME, Wetherell JL, Twamley EW, Schiehser DM & Ayers CR 2016 The relationship between age and neurocognitive and daily functioning in adults with hoarding disorder. *Int. J. Geriatr. Psychiatry* n/a-n/a.
- Eslinger PJ & Grattan LM 1993 Frontal lobe and frontal-striatal substrates for different forms of human cognitive flexibility. *Neuropsychologia* **31** 17-28.
- Funahashi S 2001 Neuronal mechanisms of executive control by the prefrontal cortex. *Neurosci. Res.* **39** 147-165.
- Gleason A, Lewis M, Lee SM & Macfarlane S 2015 A preliminary investigation of domestic squalor in people with a history of alcohol misuse: neuropsychological profile and hoarding behavior - an opportunistic observational study. *Int. Psychogeriatr.* **27** 1913-1918.
- Gregory C, Halliday G, Hodges J & Snowden J 2011 Living in squalor: neuropsychological function, emotional processing and squalor perception in patients found living in squalor. *Int. Psychogeriatr.* **23** 724-731.
- Grisham JR, Brown TA, Savage CR, Steketee G & Barlow DH 2007 Neuropsychological impairment associated with compulsive hoarding. *Behav. Res. Ther.* **45** 1471-1483.
- Grisham JR, Norberg MM, Williams AD, Certoma SP & Kadib R 2010 Categorization and cognitive deficits in compulsive hoarding. *Behav. Res. Ther.* **48** 866-872.
- Halliday G, Banerjee S, Philpot M & Macdonald A 2000 Community study of people who live in squalor.[see comment]. *Lancet* **355** 882-886.

Lee SM, Lewis M, Leighton D, Harris B, Long B & Macfarlane S 2014 Neuropsychological characteristics of people living in squalor. *Int. Psychogeriatr.* **26** 837-844.

Mataix-Cols D, Pertusa A & Snowden J 2011 Neuropsychological and neural correlates of hoarding: a practice-friendly review. *J. Clin. Psychol.* **67** 467-476.

McDermott S 2010 Professional judgements of risk and capacity in situations of self-neglect among older people. *Ageing & Society* **30** 1055-1072.

McKenzie K, Harrison JE & McClure RJ 2010 Identification of alcohol involvement in injury-related hospitalisations using routine data compared to medical record review. *Aust. N. Z. J. Public Health* **34** 146-152.

Mickey RM & Greenland S 1989 The impact of confounder selection criteria on effect estimation. *Am. J. Epidemiol.* **129** 125-137.

Moselhy HF, Georgiou G & Kahn A 2001 Frontal lobe changes in alcoholism: a review of the literature. *Alcohol Alcohol* **36** 357-368.

Ohtsuchi H, Matsuo K, Akimoto T & Watanabe Y 2010 Fronto-limbic abnormalities in a patient with compulsive hoarding: a 99mTc-ECD SPECT study. *Psychiatry Clin. Neurosci.* **64** 580-583.

Pendlebury ST, Cuthbertson FC, Welch SJV, Mehta Z & Rothwell PM 2010 Underestimation of Cognitive Impairment by Mini-Mental State Examination Versus the Montreal Cognitive Assessment in Patients With Transient Ischemic Attack and Stroke: A Population-Based Study. *Stroke* **41** 1290-1293.

- Samuels JF, Bienvenu OJ, Grados MA, Cullen B, Riddle MA, Liang KY, Eaton WW & Nestadt G 2008 Prevalence and correlates of hoarding behavior in a community-based sample. *Behav. Res. Ther.* **46** 836-844.
- Saxena S & Saxena S 2008a Neurobiology and treatment of compulsive hoarding. *Cns Spectrums* **13** 29-36.
- Saxena S & Saxena S 2008b Recent advances in compulsive hoarding. *Curr. Psychiatry Rep.* **10** 297-303.
- Shield KD, Parry C & Rehm J 2014 Chronic Diseases and Conditions Related to Alcohol Use. *Alcohol Research : Current Reviews* **35** 155-171.
- Snowdon J & Halliday G 2011 A study of severe domestic squalor: 173 cases referred to an old age psychiatry service. *International Psychogeriatrics / IPA* **23** 308-314.
- Snowdon J, Halliday G & Banerjee S 2012a *Severe domestic squalor*. Cambridge: Cambridge University Press.
- Snowdon J, Pertusa A & Mataix-Cols D 2012b On hoarding and squalor: a few considerations for DSM-5. *Depress. Anxiety* **29** 417-424.

Table 1. Demographics of the Squalor-Only and Squalor-Hoarding Groups

	Squalor-Only (n=41)	Squalor-Hoarding (n=28)	Analysis
Age (SD)	69.9 (13.1)	75.8 (6.9)	Browne forsythe (1,63.66) = 5.7, p=0.02
Gender (% male/female)	51.2/48.8	42.9/57.1	$\chi^2(1, n=69) = 0.47, p = 0.50$
MMSE n; M (SD)	28; 25.0 (4.4)	23; 25.7 (3.4)	F (1,49) = 0.43, p=0.52
Education n(%)			$\chi^2(3, n=66) = 0.72, p = 0.87$
Nil	2 (5.3)	1 (3.6)	
Primary	10 (26.3)	10 (35.7)	
Secondary	20 (52.6)	13 (46.4)	
Tertiary	6 (15.8)	4 (14.3)	
Alcohol related impairment (n) (yes/no)	15/26	1/27	$\chi^2(1, n=69) = 10.18, p < 0.01$
Vascular or Alzheimers neurodegeneration	15/26	21/7	$\chi^2(1, n=69) = 9.84, p < 0.01$

(n) (yes/no)

Premorbid intelligence

$$\chi^2(2, n=69) = 5.45, p = 0.07$$

n(%)

Lower than average	11 (26.8%)	5 (17.9%)
Average	25 (61.0%)	13 (46.4%)
Higher than Average	5 (12.2%)	10 (35.7%)

Living n(%)

$$\chi^2(1, n=69) = 1.8, p = 0.18$$

Alone	38 (92.7%)	23 (82.1%)
With Spouse/de facto	3 (7.3%)	5 (17.9%)

Table 2. Neuropsychological Overview of the Squalor-Only and Squalor-Hoarding groups

	Squalor-Only		Squalor-Hoarding		Chi Sq
	Normal	Impaired	Normal	Impaired	
Information Processing Speed	3	37	5	23	$\chi^2(1)=1.70$, $p=0.19$
Basic Attention	12	29	11	17	$\chi^2(1)=0.75$, $p=0.39$
Visuospatial reasoning	9	32	13	15	$\chi^2(1)=4.59$, $p=0.03$
Communication	20	21	16	12	$\chi^2(1)=0.47$, $p=0.50$
Abstraction	3	38	7	21	$\chi^2(1)=4.20$, $p=0.04$
Verbal Fluency	5	35	7	21	$\chi^2(1)=1.77$, $p=0.18$
Higher attention	5	36	3	25	$\chi^2(1)=0.04$, $p=0.85$
Planning	3	38	8	20	$\chi^2(1)=5.61$, $p=0.02$
Organisation	3	38	9	19	$\chi^2(1)=7.14$, $p=0.01$
Problem Solving	4	36	8	20	$\chi^2(1)=3.91$, $p=0.05$
General Reasoning	7	34	9	19	$\chi^2(1)=2.12$, $p=0.15$
Mental flexibility	1	40	8	20	$\chi^2(1)=10.01$, $p=0.002$
Impulsivity	20	21	20	8	$\chi^2(1)=3.50$, $p=0.06$
Memory – new learning	20	21	10	18	$\chi^2(1)=1.16$, $p=0.28$
Memory – Rapid forgetting	26	15	19	9	$\chi^2(1)=0.15$, $p=0.70$

Memory – Retrieval	6	35	7	21	$\chi^2(1)=1.17, p=0.28$
Orientation	20	21	20	8	$\chi^2(1)=3.50, p=0.06$
Sexual Disinhibition	39	2	25	3	$\chi^2(1)= 0.84, p=0.36$
Overfamiliarity	29	12	23	5	$\chi^2(1)=1.17, p =0.28$

Author Manuscript

Table 3. Logistic regression results comparing the odds of a predictor contributing to being in the Squalor-Only group (OR<1) or being in the Squalor-Hoarding group (OR>1).

	B	Sig.	OR	95%CI Lower	95%CI Upper
Information Processing Speed	.589	.608	1.802	.190	17.115
Visuospatial reasoning	-.697	.289	.498	.137	1.809
Abstraction	-.975	.444	.377	.031	4.573
Verbal Fluency	-.693	.355	.500	.115	2.173
Planning	-.918	.355	.399	.057	2.792
Problem Solving	-.097	.926	.908	.119	6.953
General Reasoning	1.116	.306	3.053	.360	25.911
Mental flexibility	-2.656	.034	.070	.006	.818
Impulsivity	-.303	.628	.739	.217	2.515
Orientation	-.918	.169	.399	.108	1.476

Model $\chi^2(10) = 19.24, p = 0.04$. $R^2 = 0.37$ (Nagelkerke), 0.25 (Cox & Snell)

Author Manuscript