Health Deficits Among People Experiencing Homelessness in an Australian Capital City: An Observational Study

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Keywords: health status; accelerated ageing; people experiencing homelessness; vulnerable population; public health

Article

Health Deficits Among People Experiencing Homelessness in an Australian Capital City: An Observational Study

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Abstract: People experiencing homelessness face challenges that result in poorer health outcomes compared to those in stable housing. This study provides the results from over 40 health measures that capture the general physical and mental health of a group of people experiencing homelessness aged 22 to 84 years, in an inner-city location, invited to participate in a comprehensive assessment of physical and psychological health. We found evidence of accelerated ageing, with 44.2% of people being clinically frail, 63% had poor functional movement, and 36% had pain associated with oral health. Additionally, 90.6% of participants showed health risks due to nutrition deficiencies, over half reported poor sleep quality, 55.3% reported having psychological distress, and almost half reporting fair or poor overall dental health. This study presents a path to providing a relatively easily implemented group of health assessments to help respond to a group of underlying causes for accelerated ageing, among a group of inner-city people experiencing homelessness. This work can be used to inform the prioritisation and development of community-based health services to address functional deficits that may contribute to accelerated ageing.

Keywords: 1; health status 2; accelerated ageing; 3; people experiencing homelessness 4; vulnerable population 5; public health

1. Introduction

People experiencing homelessness (PEH) face a myriad of challenges to achieve similar health outcomes to those in stable housing [1-4]. Research has shown that lived experience of homelessness is associated with poorer health-related outcomes [5], significant chronic and infectious disease morbidities [4, 6], large decreases in life expectancy [1, 5], greater rates of falling [5], and significantly higher use of acute care services, such as emergency departments (EDs) [7, 8]. The experience of homelessness is also shown to negatively affect longer-term health, whether an individual remains homeless or not [9], with those exposed to long periods of homelessness showing even poorer health [4, 10]. In Australia, those reporting being homeless are among the most socially and economically disadvantaged Australians [11, 12], and it has been shown that they may die up to 33 years earlier than those in secure housing [13].

Homelessness is a significant and complex biopsychosocial issue affecting persons of all ages and backgrounds [1, 3], with housing conditions recognised as an important determinant of health identified in the Sustainable Development Goals [14]. However, definitions of homelessness vary across countries, which challenges comprehensive global assessment of its prevalence and consequences [2, 5]. In Australia, a PEH is generally defined as any person living in a dwelling that is inadequate, has no tenure (or with short and non-extendable tenure), who does not have control of, and/or access to, space for social relations, and has no suitable alternative accommodation available to them [15].

There is a growing homelessness problem among older adults globally [2]. This has been named a national priority for federal and state governments in Australia [16], where one in seven (15.8%)

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PEH are aged 55 years or over [16]. As older people live with more complex health problems, including disabilities, chronic diseases, and geriatric symptoms [17], this adds a further layer of disadvantage to this demographic who may find it more challenging to access the specialist health services they require, both economically and socially, for best-practice preventive or chronic disease management [18, 19]. Consequently, their health management is often crisis based, 'managed' by frequent unplanned attendances at after-hours medical care and hospital EDs which can result in potentially avoidable ward admissions [7, 8, 20], adding to the mortality gap between those housed and those experiencing homelessness due to inadequate healthcare [21].

What we now know is that 'accelerated ageing', where people experience early onset of conditions usually associated with older age, is also seen among PEH globally at younger ages [12]. Two recent reviews [5, 12] have shown that PEH can experience geriatric conditions and symptoms of frailty at younger ages (those aged 40 to 50 years). This accelerated ageing affects both people experiencing homelessness for the first time, and those finding themselves at risk of, or having had experienced homelessness for a while [22]. This may be due to their inability to find stable housing, and thus, not being exposed to the same supports that come with 'ageing in place' [23], or psycho-social determinants such as increasing mental health issues, combined with various addictions, including gambling, inability to access social welfare and support programs, financial insecurity, and/or a lack of social connectedness [2]. A systematic review using administrative data from six high-income countries, despite noting limitations due to paucity of the data and probable lesser completeness of data for homeless populations, stressed that it is imperative we begin to better understand the consequences of homelessness, by suggesting the predictors of homelessness are key for a "development of policy or individual interventions to reduce homelessness and its adverse effects" [1, p.1618].

These policies and interventions may be achieved more readily by partnering with organisations that work with PEH and enabling them to provide a kind of transient stability to allow for health interventions to occur. This paper explores this by partnering with a community housing project, Common Ground [24], in Adelaide, South Australia (SA). Although we cannot 'measure' accelerated ageing, we provide here the outcomes of a core-set of health assessments able to measure functional decline in PEH and compare them by age and gender, and to expected normal values where they are available. This evidence may provide guidance for the prioritisation and development of community-based health services for PEH.

2. Materials and Methods

This cross-sectional, observational study describes the administration, outcomes, and consequences of a comprehensive set of health assessments involving PEH in inner Adelaide, SA. Description of the cohort has been published elsewhere [25]. Informed consent was obtained from all participants, and ethical approval was provided from the Southern Adelaide Clinical Human Research Ethics Committee (SAC HREC): reference 222.17. Methods were carried out in accordance with the relevant guidelines and regulations of SAC HREC.

2.1. Study Participants

All participants were aged 18 years or older and met the Australian Institute of Health and Welfare (AIHW) definition of homelessness [15]. To overcome the lack of a comprehensive register of PEH in this capital city, convenience sampling with snowballing was used [26]. Recruitment occurred by direct invitation from staff of Common Ground, or by indirect invitation through peers, or people seeing posters when they attended the organisation or any of its service network sites.

2.2. Health Assessments

Over 40 health measures were included in each assessment to capture information on the general physical and mental health of the individual. These measures were informed by a systematic literature review of health screening and assessment tools suitable for PEH [27], and consultation

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with staff and health professionals working at Common Ground and its networks, to identify any changes in administration likely to be needed when working with PEH [24]. To ensure all the constructs were relevant to homelessness, health assessments were piloted before being implemented, and any alterations in the ways these assessments were administered have been described elsewhere [27]. Participants were offered appointments over a six-day period, and on the day of assessment, were asked to give written consent before completing a standard physiological risk assessment to establish fitness for study participation. Anyone who presented with pain on the day, or with results of any screening physiological variables outside of normal values, were excluded for study participation to minimise risk to the participant.

Assessments were delivered in eight sequential stations, staffed by appropriate health professionals [25]. Each appointment was for 150-minutes, and at each station, the measurement was described in detail to the participant at the time of testing, and verbal consent was asked for prior to participation. Participants could decline to participate in any measurement, and those considered at risk of harm from an individual measurement were excluded from participating but were able to move on to others. A shared lunch was provided on the day of their assessment, and all participants were given a selection of oral and personal hygiene products in acknowledgement of participation.

2.3. Data collection and Managment

Data collection consisted of a mix of self-report using validated questionnaires on paper, and objective measurement by a qualified health professional; both informed by previous work [27, 28]. Health assessment data presented in this analysis includes: anthropometry (body mass index [BMI]: weight/height^2, waist circumference, hip circumference, and muscle mass); ear health (self-report measured by the Speech, Spatial and Qualities of Hearing Questionnaire [SSQ5] [29], audiometry using the Functional Hearing Assessment [30], and physical inspection); cognition assessed as the General Practitioner Assessment of Cognition (GPCog) [31]; dexterity (Purdue Dexterity Test) [32]; foot sensation (monofilament testing) [33]; clinical frailty (Clinical Frailty Scale) [34] and oral frailty [35]; diet and nutrition, including the DETERMINE nutritional health questionnaire [36]; functional strength and stability/flexibility (Functional Movement Screen [FMS]) [37]; past six month history of health services use; lung function (FEV1, FVC, ratio) [38]; mobility (Six Minute Walk Test [SMWT]) [39]; oral health (the Australian Research Centre for Population Oral Health [ARCPOH] Oral Health Questionnaire) [40] and the Oral Health Impact Profile questionnaire (OHIP-14) [41]; pelvic floor bother [42]; protective health behaviours (screening and vaccination); psychological distress (Kessler Psychological Distress Scale [K10]) [43]; skin condition; sleep quality (Pittsburgh Sleep Quality Index [PSQI]) [44]; and grip strength (age and gender adjusted) measured using a handheld dynamometer [45-47], and dexterity (Purdue Pegboard) [32]. The assessment descriptions have been previously reported [48]. Total scores were calculated for each of the validated measurement tools using the published scoring methods [29, 31, 34, 36, 40, 41, 43, 44]. Predicted objective scores were calculated for forced expiratory volume at one second (FEV1) and forced vital capacity (FVC); lung ratio was calculated as FEV1/FVC [49] and reported as having obstructive, restrictive, or mixed pattern airflow.

2.4. Data Analysis

Analyses were conducted using IBM SPSS Statistics version 29.0.2 (Clarivate, USA), R (R version 4.4.1), R studio [50], and Microsoft Excel. Data are reported as means (m) with standard deviation (SD), or percentages, and differences were tested using chi-squared (χ^2) tests for categorical data (95% confidence interval [CI]; p value). For assessments where recommended thresholds are available, these variables are recoded and reported as 'at risk' or 'not at risk'. Where cut-offs were not published, data were analysed as continuous data using t-tests and one-way analysis of variance (ANOVA) to test for differences.

3. Results

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An estimated 120 PEH heard about this study from posters, direct invitation by Common Ground staff and word-of-mouth. Ninety (75%) indicated interest in participating, and 70 consented to risk screening. Pre-assessment risk screening for heart rate, body temperature, blood pressure, respiratory rate, and blood oxygenation measures were within expected ranges; therefore, no one was excluded due to risk of adverse health events. All 70 were invited to participate in testing. Of these, 17 people declined to participate (24.3%), and 53 consented to at least one testing station. Rates of completion, refusal and non-completion have been previously reported [25].

Participants ranged in age from 22 to 84 years (m 49.1, SD 14.9), with 41.5% (n=22/53) aged 55 years or older. Thirty (56.6%) were men, and overall, women were younger than men, but not significantly (women range 22-69 years; mean 46.1, SD 14.3; men range 23-84 years; mean 51.4, SD 15.2). None of our participants reported having tertiary qualifications such as a diploma or degree, and most reported that their income came from a pension (94.1%) and that were more likely to be single (including those divorced, separated or widowed), with men statistically significantly (p=0.030) more likely to be single when compared to women; almost all (92.2%) spoke English as their primary language. Over 90% of participants lived in supported accommodation provided by Common Ground (92%) with the remainder living in shared, short-term rentals (8%), fulfilling the criteria used to define homelessness; e.g., having no tenure, or short and non-extendable tenure [15]. All had previously experienced living in a dwelling that was inadequate or did not allow them to have control of, and access to, space for social relations, before coming to Common Ground.

Table 1. Demographic characteristics, by gender and age group differences.

	p Value	Male (23-84 yrs)	Female (22-69 yrs)	Total (22-84 yrs)
Age in years (m, SD)		*51.4 (15.2)*	*46.1 (14.3)*	*49.1 (14.9)*
		n (%)	**n (%)**	**n (%)**
Age	0.384			
Less than 55 yrs		16 (53.3)	15 (65.2)	31 (58.5)
55 yrs or over		14 (46.7)	8 (34.8)	22 (41.5)
Marital status	**0.030**			
Married/de facto		4 (13.0)	**8 (38.1)**	12 (23.1)
Single, divorced, separated, widowed		**27 (87.0)**	13 (61.9)	40 (76.9)
Income	0.830			
Pension		29 (93.5)	19 (95.0)	48 (94.1)
Wage		nr	nr	3 (5.9)
Primary language spoken	0.081			
English		26 (86.7)	21 (100.0)	47 (92.2)
Language other then English		4 (13.3)	0 (0.0)	4 (7.8)
Level of qualifications				
High school/certificate/trade		28 (100.0)	23 (100.0)	51 (100.0)
Diploma/degree		0 (0.0)	0 (0.0)	0 (0.0)

Statistically more likely shown in bold; grp: group; m: mean; n: number observed; nr: numbers too small to report; SD: standard deviation; yrs: years.

All participants attempted at least one health measurement. Numbers of those participating in each measurement is shown in the overall column in the Table 2; the self-report questionnaires led by the station health professional were well reported. High proportions participants (no difference by gender or age group) were found to have moderate to high risk of nutritional health as measured using the DETERMINE questionnaire (90.6%); the most common contributors to the increased

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nutritional risk were eating alone most of the time (60.4%), taking three or more prescription drugs each day (45.3%), having an illness that had altered the kind and/or amount of foods eaten (41.5%), eating fewer than two meals a day (41.5%), and eating few fruits or vegetables or milk products (39.6%). Over a third of participants were obese (36.4%), two thirds measured over the recommendation of waist circumference for their gender (64.7%) and 42.1% were under the recommended age and gender adjusted muscle mass percentage. Over half (56%) of participants also reported poor sleep quality on the PSQI (those in the younger age group significantly more likely to do so), with 47.7% saying their sleep was broken three or more times a week due to having to get up in the night to use the bathroom, 40.9% using sleeping medication three or more times a week, 38.3% not being able to get to sleep within 30 minutes at least three times a week, and 25.5% sleeping less than 6 hours a night; one third of participants (34%) rated their sleep quality as fairly or very bad. Additionally, 44.2% were clinically vulnerable or mild to moderately frail, and 55.3% of participants were found to have psychological distress – significantly higher among females and those younger (see Table 2).

Almost half (47.7%; n=21/44) of the participants supplying data for ARCPOH oral health questionnaire and the OHIP-14 rated their overall dental health as fair or poor, with a third of participants reporting they thought their dental health was a little/much worse than their overall health. Participants returned an overall OHIP-14 mean score of 15.5 (SD 12.5) out of 56 (range 0 to 40) and means below 2.0 for domains one and six (functional limitation and social disability) and above 2.0 for domains two to five, and seven (physical pain, psychological discomforts, physical disability, psychological disability, and handicap), which did not differ significantly between age groups or by gender. Over half of PEH (59.1%) reported being affected occasionally, fairly or very often by at least one of the seven domains, with those 55 years and over significantly more likely to be affected. Just over 20% in both older and younger age groups reported having false teeth, and 80% of participants had had teeth extracted in the past (100% of those aged 55 years of over), with a significant difference found by age for number of teeth extracted (M, SD of 7.3, 9.7 among younger PEH and 14.8, 11.2 in the older age group. One two third (32.4%) had less than 20 functioning teeth (significantly more likely for those aged 55 years or over – 52.9%). When asked if they would see a dentist, 52% said that they avoided seeing a dentist due to cost and 58% (69% of younger PEH and 40% of those older) said that they would find it very hard to pay, or couldn't pay, an AUD$100 dentist bill – see Table 2 for full results.

However, for other preventative health behaviours, all had undergone either blood, bowel, cervix, or prostate screening, and just under half had been vaccinated against flu, shingles, meningococcal, and/or pneumonia, in the past year. Participants were also examined for nerve damage (peripheral neuropathy) using the monofilament foot test which showed that 13% of participants had abnormal foot sensation, a possible indicator of conditions such as diabetes [51]. On further skin examination, 38% (n=20) had some sort of skin rash (on the face and back most commonly) due to seborrheic dermatitis, rosacea, and/or psoriasis, and 61% (n=32) showed evidence of scarring. Although CIs are wide, due in part to having a small sample, and therefore not all differences are statistically significant, the following highlights where the main clinical differences were found. Overall:

- Women and those aged less than 55 years were significantly more likely to have psychological distress;
- Those younger were also significantly more likely to report having a mental health condition and more likely to have poor sleep quality;
- Men were significantly more likely to have a waist to hip ratio over the recommend 90%, an unknown hearing problem when tested, or experience food insecurity in the past week.

Those over 55 years were significantly more likely to:

- measure over the recommended waist circumference;
- be clinically frail;
- have an unknown hearing problem and have wax/wax occlusion/pus or discharge in one or both ears;
- show obstructive/restrictive or mixed airflow pattern in the lung function test;

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- be at risk for poor functional movement in the FMS;
- have presented at an ED in the past 12 months or had a fall, or near fall, in the past 6 months;
- have experienced food insecurity and reported having a poor appetite in the past week.

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Table 2. Health assessments, by gender and age group differences (results showing significantly more likely are in bold).

	Male		Female		Less than 55 years		55 years and over		Overall
	n	% (CI)	n	% (CI)	n	% (CI)	n	% (CI)	n/N (%)
Anthropometry (objective measurement)									
BMI – obesity	11	36.7 (19.9 – 56.1)	10	43.5 (23.2 – 65.5)	13	41.9 (24.5 – 60.9)	8	36.4 (17.2 – 59.3)	21/53 (39.6)
Over recommended waist circumference	18	69.2 (48.2 – 85.7)	13	65.0 (40.8 – 84.6)	20	69.0 (49.2 – 84.7)	11	64.7 (38.3 – 85.8)	31/46 (67.4)
Over recommended waist to hip ratio ¥¥	22	**84.6 (65.1 – 95.6)**	11	55.0 (13.5 – 76.9)	19	65. 5 (45.7 – 82.1)	14	**82.4 (56.6 – 96.2)**	33/46 (71.7)
Muscle mass under recommended thresholds	14	50.0 (30.6 – 69.3)	13	61.9 (38.4 – 81.9)	19	63.3 (43.8 – 80.1)	8	42.1 (20.2 – 66.5)	27/48 (55.1)
Audiology (objective measurement)									
Unknown hearing problem ¥¥	13	**48.1 (28.7 – 68.0)**	4	18.2 (5.2 – 40.3)	8	25.8 (11.8 – 44.6)	9	**50.0 (26.0 – 74.0)**	17/49 (34.7)
Ear health (wax, wax occlusion, pus/discharge)	10	43.5 (23.2 – 65.5)	6	31.6 (12.6 – 56.5)	7	26.9 (11.6 – 47.8)	9	**55.6 (30.0 – 80.2)**	16/42 (38.1)
Diet and nutrition (self-reported)									
Moderate to high nutritional risk	28	93.3 (78.0 – 99.2)	20	87.0 (66.4 – 33.6)	28	90.3 (74.2 – 98.0)	20	90.9 (70.8 – 98.9)	48/53 (90.6)
Poor appetite in past week ¥	15	51.7 (32.5 – 70.5)	11	47.8 (26.8 – 69.4)	14	45.2 (27.3 – 64.0)	12	**57.1 (34.0 – 78.2)**	26/52 (50.0)
Food insecurity in past week ¥¥	13	**46.4 (27.5 – 66.1)**	8	36.3 (17.2 – 59.3)	11	36.7 (19.9 – 56.1)	10	**50.0 (27.2 – 72.8)**	21/50 (42.0)
Other physical health (objective measurement)									
Grip strength (below age and gender norms)	8	33.3 (15.6 – 55.3)	5	23.8 (8.2 – 47.2)	7	25.9 (11.1 – 46.3)	6	33.3 (13.3 – 59.0)	13/45 (28.9)
FMS (at risk 3 or more movements) ¥	11	44.0 (24.4 – 65.1)	5	27.8 (9.7 – 53.5)	9	31.0 (15.3 – 50.8)	7	**50.0 (23.0 – 77.0)**	27/43 (62.8)
Obstructive/restrictive/mixed pattern airflow ¥	11	44.0 (24.4 – 65.1)	10	47.6 (25.7 – 70.2)	12	41.4 (23.5 – 61.1)	9	**52.9 (27.8 – 77.0)**	21/46 (45.6)
Skin health (≥1 skin condition on inspection)	14	56.0 (34.9 – 75.6)	10	55.6 (30.7 – 78.5)	14	50.0 (30.6 – 69.3)	10	66.7 (38.4 – 88.2)	24/43 (55.8)
Other physical health (self-reported)									
At least one health condition	29	96.7 (82.8 – 99.9)	21	91.3 (72.0 – 98.9)	29	93.5 (78.6 – 99.2)	21	95.5 (77.1 – 99.9)	50/53 (94.3)
At least one area of PFB	17	58.6 (38.9 – 76.5)	15	68.2 (45.1 – 86.1)	19	61.3 (42.2 – 78.1)	13	65.0 (40.8 – 84.6)	32/51 (62.7)
Fall/near fall in past 6 months ¥	11	39.3 (21.5 – 59.4)	11	47.8 (26.8 – 69.4)	12	38.7 (21.8 – 57.8)	10	**50.0 (27.2 – 72.8)**	22/51 (43.1)
Poor sleep quality (PSQI) ¥	15	53.6 (33.9 – 72.5)	12	60.0 (36.0 – 80.9)	19	**65.5 (45.7 – 82.1)**	8	42.1 (20.2 – 66.5)	27/48 (56.2)
Frailty - vulnerable, mildly/moderately frail	14	46.7 (28.3 – 65.7)	9	40.9 (20.7 – 63.6)	11	35.5 (19.2 – 54.6)	12	57.1 (34.0 – 78.2)	23/52 (44.2)

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Oral frailty – less than 20 functioning teeth	7	33.3 (14.6 – 57.0)	5	31.3 (11.0 – 58.7)	3	15.0 (3.2 – 37.9)	9	52.9 (27.8 – 77.0)	12/37 (32.4)
One or more of OHIP-14 domains affected ¥ǂ	14	56.0 (34.9 – 75.6)	12	63.2 (38.5 – 83.7)	13	50.0 (29.9 – 70.1)	13	**72.2 (46.5 – 90.3)**	26/44 (59.1)
Oral health (D1) Functional limitation ǂ	6	24.0 (9.3 – 45.1)	3	15.8 (3.4 – 39.6)	5	19.2 (6.5 – 39.3)	4	22.2 (6.4 – 47.6)	9/44 (20.4)
Oral health (D2) Physical pain ǂ	9	36.0 (18.0 – 57.5)	7	36.8 (16.3 – 61.6)	8	30.8 (14.3 – 51.8)	8	44.4 (21.5 – 69.2)	16/44 (36.4)
Oral health (D4) Physical disability ǂ	6	24.0 (9.3 – 45.1)	10	52.6 (28.9 – 75.5)	7	26.9 (11.6 – 47.8)	9	50.0 (26.0 – 74.0)	16/44 (36.4)
Oral health (D7) Handicap ǂ	8	32.0 (14.9 – 53.5)	5	26.3 (9.1 – 51.2)	9	34.6 (17.2 – 55.7)	4	22.2 (6.4 – 47.6)	13/44 (29.5)
Psychological health (self-reported)									
Mental health condition ¥	12	40.0 (22.6 – 59.4)	9	39.1 (19.7 – 61.4)	17	**54.8 (36.0 – 72.7)**	4	18.2 (5.2 – 40.3)	21/53 (39.6)
Psychological distress (K10) ¥¥	11	40.7 (22.4 – 61.2)	15	**75.0 (50.9 – 91.3)**	18	**62.1 (42.3 – 79.3)**	8	44.4 (21.5 – 69.2)	26/47 (55.3)
Oral health (D3) Psychological discomfort ǂ	8	32.0 (14.9 – 53.5)	8	42.1 (20.2 – 66.5)	11	42.3 (23.3 – 63.1)	5	27.8 (9.7 – 53.5)	16/44 (36.4)
Oral health (D5) Psychological disability ǂ	9	36.0 (18.0 – 57.5)	5	26.3 (9.1 – 51.2)	8	30.8 (14.3 – 51.8)	6	33.3 (13.3 – 59.0)	14/44 (31.8)
Oral health (D6) Social disability ǂ	4	16.0 (4.5 – 36.1)	4	21.1 (6.0 – 45.6)	6	23.1 (9.0 – 43.6)	2	11.1 (13.7 – 34.7)	8/44 (18.2)
Health service use (self-reported)									
ED presentation – past year * ¥	9	30.0 (14.7 – 49.4)	8	34.8 (16.4 – 57.3)	8	25.8 (11.8 – 44.6)	9	**40.9 (20.7 – 63.6)**	17/53 (32.1)
Hospital admission – past year *	9	30.0 (14.7 – 49.4)	7	31.8 (13.9 – 54.9)	8	26.7 (12.3 – 45.9)	8	36.4 (17.2 – 59.3)	16/52 (30.8)
Protective health behaviours (self-reported)									
Not undertaken health screening (blood, bowel, cervix, or prostate)	0	0.0 (0.0 – 11.6)	0	0.0 (0.0 – 14.8)	0	0.0 (0.0 – 11.2)	0	0.0 (0.0 – 15.4)	0/53 (0.0)
Not undertaken vaccination – past 5 years (flu, meningococcal, pneumonia, shingles) ¥	14	46.7 (28.3 – 65.7)	13	56.5 (34.5 – 76.8)	21	**67.7 (48.6 – 83.3)**	6	27.3 (10.7 – 50.2)	27/53 (50.9)

	m	CI, SD	m	CI, SD	m	CI, SD	m	CI, SD		m CI, SD
Strength and dexterity objective measurement)										
Grip strength standing **¥	**37.6**	**34.0 – 41.2, 8.1**	25.9	22.9 – 28.9, 6.3	33.7	30.4 – 37.1, 8.3	29.3	23.7 – 34.9, 10.5	32.0	29.1 – 34.9, 9.3
Grip strength sitting **¥	**36.0**	**32.4 – 39.6, 8.5**	24.6	21.8 – 27.4, 6.1	32.3	28.7 – 35.9, 9.1	28.3	23.5 – 33.0, 9.5	30.7	27.9 – 33.5, 9.4
Purdue Pegboard dexterity)										
Both hands, 30 seconds	7.6	6.2 – 9.1, 3.7	8.2	6.5 – 10.0, 4.0	8.6	7.1 – 10.1, 3.9	6.8	5.2 – 8.5, 3.4	7.9	6.8 – 9.0, 3.8
Sum right + left = both)	27.1	23.7 – 30.5, 8.7	30.0	26.2 – 33.9, 8.7	31.0	27.9 – 34.2, 8.4	24.4	20.8 – 28.1, 7.8	28.4	25.9 – 30.9, 8.7

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Assembly alternate hands, 60 seconds) ¥	3.7	3.2 – 4.1, 1.2	4.1	3.3 – 4.8, 1.7	**4.4**	**3.9 – 4.8, 1.3**	3.0	2.4 – 3.6, 1.3	3.8	3.4 – 4.3, 1.4
Six-minute-walk speed m/s) **¥	0.7	0.6 – 0.8, 0.1	0.8	0.7 – 0.9, 0.1	**0.8**	**0.7 – 0.9, 0.1**	0.6	0.5 – 0.7, 0.1	0.7	0.7 – 0.7, 0.1
Nutritional health self-reported)										
Water L per day)	2.0	1.1 – 3.0, 2.5	1.5	1.0 – 1.9, 1.0	1.7	0.9 – 2.4, 1.9	1.9	1.0 – 2.9, 2.0	1.8	1.2 – 2.3, 2.0
Soft drinks L per day)	0.4	0.2 – 0.6, 0.5	0.4	0.02 – 0.7, 0.8	0.3	0.1 – 0.5, 0.5	0.5	0.2 – 0.9, 0.8	0.4	0.2 – 0.6, 0.7
Junk food times per week)	1.0	0.5 – 1.4, 1.1	1.4	0.5 – 2.3, 2.1	1.4	0.7 – 2.1, 1.9	0.8	0.3 – 1.4, 1.1	1.2	0.7 – 1.6, 1.6
Oral health self-reported)										
Number of teeth extracted n=37) ¥	9.5	5.5 – 13.5, 8.8	12.4	5.3 – 19.5, 13.3	7.3	2.8 – 11.8, 9.7	**14.8**	**9.1 – 20.6, 11.2**	10.8	0.0 – 32.0, 10.9
Number of filled permanent teeth n=44) ¥	11.4	7.0 – 15.8, 10.6	9.9	4.2 – 15.6, 11.8	7.7	3.6 – 11.8, 10.1	**15.2**	**9.6 – 20.7, 11.1**	10.7	0.0 – 32.0, 11.1
OHIP-14: overall score out of 56)	14.4	9.7 – 19.1, 11.4	14.6	9.7 – 19.1, 14.3	13.7	8.0 – 19.4, 14.1	15.6	10.5 – 20.7, 10.2	14.5	10.7 – 18.3, 12.5
D1: Functional limitation out of 8)	1.8	1.0 – 2.6, 2.0	1.6	0.3 – 2.8, 2.5	1.6	0.7 – 2.6, 2.3	1.8	0.7 – 2.9, 2.2	1.7	1.0 – 2.4, 2.2
D2: Physical pain out of 8)	2.6	1.7 – 3.4, 2.0	2.7	1.3 – 4.0, 2.7	2.3	1.3 – 3.2, 2.3	3.2	2.0 – 4.3, 2.3	2.6	1.9 – 3.3, 2.3
D3: Psychological discomfort out of 8)	2.4	1.4 – 3.3, 2.2	2.3	1.1 – 3.0, 2.6	2.5	1.5 – 3.5, 2.5	2.0	1.0 – 3.1, 2.1	2.3	1.6 – 3.0, 2.3
D4: Physical disability out of 8)	1.8	1.0 – 2.5, 1.8	2.8	1.4 – 4.2, 2.9	1.8	0.8 – 2.7, 2.3	2.8	1.6 – 4.0, 2.4	2.2	1.5 – 2.9, 2.4
D5: Psychological disability out of 8)	2.4	1.5 – 3.2, 2.1	1.7	0.6 – 2.9, 2.4	2.0	0.9 – 3.0, 2.6	2.2	1.4 – 3.1, 1.7	2.1	1.4 – 2.8, 2.2
D6: Social disability out of 8)	1.1	0.3 – 1.8, 1.8	1.5	0.5 – 2.4, 2.0	1.3	0.5 – 2.2, 2.1	1.1	0.3 – 1.9, 1.6	1.2	0.7 – 1.8, 1.9
D7: Handicap out of 8)	2.0	1.2 – 2.8, 2.0	1.9	0.7 – 3.1, 2.5	1.9	0.9 – 2.8, 2.3	2.1	1.0 – 2.6, 2.2	2.0	1.3 – 2.6, 2.2

¥ p<.05 for age or gender; ¥¥ p<.05 for both age and gender; *once or more in last 12 months; **adjusted for height and gender; ǂ numbers reporting fairly/very often/always; D: domain; FMS: functional movement scale; K10: Kessler Psychological Distress Scale; L: litres; m/s: metres per second; OHIP-14: Oral Health Impact Profile-14; PFB: pelvic floor bother; PSQI: Pittsburgh Sleep Quality Index

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4. Discussion

This study has shown aspects of health that contribute to overall poorer health outcomes across multiple performance domains and body systems for PEH. This contributes to the understanding of how homelessness compromises both physical and mental health [52], and that these factors contribute to chronic age-related health conditions that include body systems failure cardiac, respiratory, musculoskeletal, or renal conditions), cognitive impairment, functional decline, and frailty [53], and cumulatively, such chronic conditions increase mortality and morbidity among PEH. Further, the findings suggest an opportunity for assessments and associated interventions to be a priority for access via organisations providing temporary accommodation or other services to PEH, to improve health status. A significantly high percentage of PEH in this study were found to have compromised cognition and memory across gender and age groups. This finding is supported by an umbrella review of cognitive functioning in homeless adults which reported up to 55% of PEH having cognitive deficiency [54]. Cognitive assessments in this study found 60% of PEH returning below-threshold scores. The prevalence of cognitive impairment in the Australian population is currently unknown, but an international review study has estimated the standardised prevalence of mild cognitive impairment in adults aged 60 years and older to be between 6% and 12% [55], far lower than found in this study. This may in part be attributed to the tools used to calculate differences in the criteria of mild cognitive decline [55], or a true reflection of the SA PEH population

There are multiple opportunities to address poor health outcomes and the resultant incipient frailty that has been associated with accelerated ageing among PEH. Frailty rates in our sample were four times higher 44%) than population norms for pre-frailty/frailty in SA 9-12%) [56]. In this study, we also found a significantly higher prevalence of poor functional movement among those aged 55 years and over, but also a high prevalence of 63%) of those failing three of more of the functional movement assessments used to assess strength and stability FMS deep squat, hurdle step, lunge, knee or toe push up, and rotary stability) and flexibility shoulder range, and straight leg raise). This was alongside high levels of those experiencing pain, at least one chronic health condition, and sleep problems. These findings are supported by a scoping review of physical functioning of people experiencing homelessness that found mobility impairments were more common in homeless populations, because of pain, chronic health conditions, sleep problems, fatigue and early onset of age-related conditions [53]. Additionally, a third of the study cohort of PEH reported diminished foot sensation, commonly associated with poor balance, falls, unexplained foot injury and poor mobility as a result of poor foot hygiene and improper footwear [49].

The poor levels of sleep quality identified in this study have been reported as inevitable for PEH due to their environmental context in other cohorts [57]. A study of 2,144 healthy people aged between 43 and 71 years in Spain found approximately 40% reported poor sleep quality using the same instrument the PSQI) as used in this study [58]. However, a systematic review of sleep quality in adults in lower- and middle-income countries found significant variability in prevalence which could not be explained by method of assessment or location [59]. Poor sleep quality has been reported in approximately four out of five people with poor mental health [60], and findings from our study concur with strong coexistence of homelessness, poor sleep quality, and poor mental health.

Recent investigations of poor mental health using the K10 have identified high, or very high distress in 11% of Australian adults, with the most socially and economically disadvantaged populations reporting distress rates at more than twice the national average 27%) [56]. These rates are still much lower than the proportion of PEH reporting elevated distress 55%) in this study. Results here also show that 75% of women, and 62% of those in the younger age group, were significantly more likely to be experiencing psychological distress. Understanding mental health conditions in this population is complex, where mental health may contribute to, or be a result of, homelessness [61]. A systematic review of interventions for women who are experiencing homelessness that target these high levels of poor mental health, has shown some recommended practice moving forward [62]. However, most studies highlight high levels of poor mental health due to the added responsibilities

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women face in life e.g., caring responsibilities for children), leaving a gap to explain the increased psychological distress among younger women in this study.

The latest AIHW data show that two in three 67%) Australian adults are overweight or obese, which rises to 75% to 80% in those 55 years and over [63]. In our study, we found much lower rates of obesity 44%) and overweight 15%). Additionally, those in the lower age bracket were more likely to be obese, and significantly more likely to be overweight p=.016), with more women than men falling into this category. This is supported by the younger ages those less than 55 years) being significantly more likely to not have a healthy weight overall 79%; p=.007) compared to those older 40%). However, those older or male were more likely to be at risk for having a waist hip ratio over the recommended ratio of 90% for men and 85% for women. We also found high levels of food insecurity 42%) and very high levels of nutritional risk 90%). The mechanisms between food insecurity and BMI are complex and there is limited literature examining this phenomenon among PEH [64]. In a Boston USA) study [64], similar proportions of overweight or obese people in community dwelling and homeless populations were found leading the authors to attribute this to the hunger-obesity paradox, where poor individuals eat cheap, energy-dense foods resulting in the co-existence of hunger and obesity. The Boston cohort reported a much lower prevalence of underweight people 1.6%) than the PEH in this sample 13.1%) which may be explained by our small numbers. However, further investigation of this is warranted in future studies.

A healthy diet reflects appropriate intake of nutrients, and has been shown to protect against chronic disease, poor health, and premature ageing [65, 66]. Nutrition should not be considered in isolation from oral and general health, and its relationship to weight and function is synergistic. Reasons for poor eating behaviours include physiological changes related to ageing and ill health, such as impaired smell and taste, becoming satiated more quickly and therefore not eating as much, living alone and/or having minimal social contacts), not motivated to prepare adequate meals, experiencing dental problems, having poor exercise behaviours leading to being less hungry and thirsty, and taking multiple medications [67]. Other reasons why nutritional intake differs between people, including culture and race, income, traditional eating patterns, food insecurity, poverty, lack of nutritional literacy, lack of access to nutritious foods and limited capacity to prepare, cook or store food [68]. In this study, we did find good levels of water consumption 1.5-2 litres per day), low sugary drink intake less than half a litre per day), except among older people where this rose to nearly a litre per day, and self-reported rates of junk food consumption of once or twice a week. Again, margin of error was large due to small numbers, and it is important to interpret these results carefully as they are all self-reported recall.

Oral health has been shown to be linked with frailty [35], highlighting the importance of interventions to improve oral health as we age [69]. It has been shown that having 20 functioning teeth or less increases the rate of oral frailty by direct impact to consumption of fruit and vegetables, proteins and micronutrients, by affecting the ability to chew [35, 69]. We find here that in this population of PEH, the average number of tooth extractions was almost 11 with some individuals having had up to all 32 teeth extracted M 10.8, SD 11.1). Using the OHIP-14 – originally developed for elderly people but found to be useful in assessing quality of life for dental needs and therefore used in this study [70, 71], we provide further evidence of poor oral health among this cohort of PEH. Significant numbers of PEH reported physical pain, psychological discomfort and physical disability all 36%) and psychological disability 32%) due to their oral health, compared with Australian population norms of 10%, 8.5%, 2.5% and 2.4% respectively [72]. A systematic review has presented an examination of strategies available to PEH, showing that oral healthcare is generally only accessed in an emergency, despite the established and concerning evidence that poor oral health negatively affects overall health and wellbeing [73].

When comparing this to published norms from an AIHW analysis of the quality of life among a representative sample of Australians [72], proportions of PEH in this study were much more likely to experience lower quality of life on all seven domains of the OHIP-14 20.5%, 36.4%, 36.4%, 36.4%, 31.8%, 18.2%, 29.5% compared to people not experiencing homelessness 9.9%, 10.6%, 8.5%, 2.5%, 1.8% and 5.9%). The evidence here that PEH are also avoiding seeing a dentist due to cost or fear, highlights

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an urgent need for the provision of safe and appropriate oral health services for this population. With a recent publication discussing the inaccessibility to care and strategies to improve outcomes among PEH in Australia, there are some encouraging statements regarding sustainable services that may improve overall oral and general health outcomes [74].

Testing for hearing level revealed that half 45.3%) of PEH reported below-threshold scores for the American Speech-*Hearing*-Language Association *ASHA*) audiometry test score, with mean score of 6.1 SD 2.3); additionally, 10% reported hearing-related disability. Blackwell et al [75] suggest that worldwide, between 2% and 8% of adults over 45 years suffer some form of hearing-related disability, in line with the reported rates in this study. This is supported by a high number of people with ear wax, wax occlusion, pus, or discharge during the ear health inspection 38%) that may lead to the comparable proportions of people with unknown hearing loss 34%) which was significantly greater p=.006) in men 48%) and those aged 55 years and over 50%). This is a health complaint that can be easily treated in a day clinic, alongside free hearing checks for PEH.

It is well-established in the literature that older adults experiencing homelessness have more complex health issues and social challenges, such as access to health and accommodation services, than those in stable housing, or those younger [22]. This study provides further evidence for this in an Australian setting. Examples of bringing community service organisations together with homelessness populations to provide services that are needed most are not unique to Australia [76]; however, services that link supported accommodation to these services appears to provide a more comprehensive solution in Australia [24]. Although numbers of PEH in supported accommodation in Australia has remained stable over the past two decades 19.3% in 2006; 20.7% in 2011; 18.2% in 2016; 19.8% in 2021) [16], supported accommodation for PEH has been shown to help reduce inappropriate health service use [77], and in the case of Common Ground, offer health enhancing services such as oral health, nutritional advice, and mental health services to clients who had previously lacked any healthcare support, resulting in socio-emotional benefits to clients [78]. All participants in this study have some community connectedness due to their association with a supported accommodation provider, giving them greater access to health services. This was evident in the relatively high proportion of participants having undergone screening and high rates of vaccination against flu, shingles, meningococcal, and/or pneumonia, in the past year 50%) – this study was conducted before the severe acute respiratory coronavirus 2 SARS-CoV-2) pandemic. This is in comparison to Australian inner-city rates of vaccination for those 65 year and over against influenza and pneumococcal disease sitting at 50% [79].

Initiatives to support PEH should target issues that are likely to have the biggest impacts across multiple health domains [18]. The participants in this study already accessed limited medical and dental services through the partner agency Common Ground. The study findings suggest that this organisation could additionally focus on improving oral health, nutrition, sleep quality and mental health to improve function and health.

This study has several limitations, including limitations of the sample. There is no register of PEH in the host city, thus there was no way of identifying a comprehensive reference population. Those approached to participate reflected only those people known to staff at the host organisation, or its networks. The invitation may not have reached PEH who did not frequent these organisations, or who did not regularly visit the inner city. Staff at the host and satellite organisations were well known to participants, and they were responsible for recruitment. This raises issues of potential selection bias hand picking) or coercion and creates the potential for power imbalances between researchers and subjects. The self-selected volunteer nature of the sample raises concerns over motivations for participation, and whether those who declined to participate differed from those who did. As homelessness is a concern for researchers from many disciplines, it may be possible that those who declined to participate did so from research fatigue, and/or mistrust of researchers' motives. Additionally, we did not collect data on the length of time the participant had been homeless, and this may have a bearing on the results. There was the potential, in the self-reported data nutrition, hearing-related disability, frailty, anxiety and depression, sleep quality) and assessor-prompted assessment cognition and memory), for latent Hawthorne effects to have occurred, where individuals

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modify or inflate behaviours because they know they are being observed [80]. Thus, the consistently poorer findings in this sample against the comparison population data, may have occurred because participants manipulated their responses to suit their perceptions of the purpose of data collection. Many participants were familiar with the K10 instrument [81], as they reported that it was regularly used during their health checks. Many could quote questions before they were asked, and there were unsolicited comments that participants were better or worse) compared with the last administration. Lastly, we did not explore instrumental activities of daily living, such as financial and medication management and the economic disadvantage associated with this. The reasons for these consistently significantly poorer findings for the PEH may however, reflect the reality of homelessness and its contexts in a large city. Poor sleep quality, poor mental health, and poor cognition and memory may reflect the lack of safety/security in lived environments for instance shared accommodation), unstructured daily routines, and/or not being in employment [68, 82]. Poor nutrition and at-risk BMI, waist circumference and waist-hip ratio may reflect lack of finances for healthy food, irregular meals, and food insecurity due to a lack of opportunity for meal preparation, and safe food storage [68].

5. Conclusions

Homelessness is a complex and potentially reversible social circumstance and is known to be associated with accelerated ageing and incipient frailty. This study reports significant health deficits which are likely to contribute to accelerated ageing. This work with an inner-city cohort living in a high-income country has shown a path to providing a relatively easily implemented group of health assessments to help unpack and therefore subsequently respond to prioritised areas of functional decline and underlying causes for accelerated again. The outcomes of this study can be used to inform the prioritisation and development of community-based health services for oral health, sleep quality and mental health specific to the needs of PEH.

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Data Availability Statement: Datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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