Observational study

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What are the similarities and differences between healthy people with and without pain?

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Abstract

Background and aims: Knowledge of pain characteristics among the healthy population or among people with minimal pain-related disability could hold important insights to inform clinical practice and research. This study investigated pain prevalence among healthy individuals and compared psychosocial and physical characteristics between adults with and without pain.

Methods: Data were from 1,000 self-reported healthy participants aged 3–101 years (1,000 Norms Project). Single-item questions assessed recent bodily pain ("none" to "very severe") and chronic pain (pain every day for 3 months in the previous 6 months). Assessment of Quality of Life (AQoL) instrument, New Generalised Self-Efficacy Scale, International Physical Activity Questionnaire, 6-min walk test, 30-s chair stand and timed up-and-down stairs tests were compared between adults with and without pain.

Results: Seventy-two percent of adults and 49% of children had experienced recent pain, although most rated their pain as mild (80% and 87%, respectively). Adults with recent pain were more likely to be overweight/obese and report sleep difficulties, and had lower self-efficacy, AQoL mental super dimension scores and sit-to-stand performance, compared to adults with no pain ($p < 0.05$). Effect sizes were modest (Cohen's $d = 0.16–0.39$), therefore unlikely clinically significant. Chronic pain was reported by 15% of adults and 3% of children. Adults with chronic pain were older, more likely to be overweight/obese, and had lower AQoL mental super dimension scores, 6-min walk, sit-to-stand and stair-climbing performance ($p < 0.05$). Again, effect sizes were modest (Cohen's $d = 0.25–0.40$).

Conclusions: Mild pain is common among healthy individuals. Adults who consider themselves healthy but experience pain (recent/chronic) display slightly lower mental health and physical performance, although these differences are unlikely clinically significant.

Implications: These findings emphasise the importance of assessing pain-related disability in addition to prevalence when considering the disease burden of pain. Early assessment of broader health and lifestyle risk factors in clinical practice is emphasised. Avenues for future research include examination of whether lower mental health and physical performance represent risk factors for future pain and whether physical activity levels, sleep and self-efficacy are protective against chronic pain-related disability.

Keywords: pain; pain assessment; health; activities of daily living.

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1 Introduction

Pain is the most burdensome global health issue causing disability at present [1]. Impacts on individuals and society are diverse and far-reaching [2, 3]. Pain is highly prevalent and experienced by individuals of all ages. Data from epidemiological studies have shown that 67% of individuals aged 15 years and over [4], and 72% of adults aged 50 years and over [5], have experienced recent bodily pain, while population-based rates of chronic pain range from 17% to 47% [6, 7].

While the problem of pain has been highlighted [8], it is important to contextualise this focus with an understanding of how healthy populations present. Pain has been associated with poor self-reported health and quality of life [2, 9], however not all individuals with pain experience high levels of disability. A 2016 systematic review reported the prevalence of chronic pain in the UK to be 43%, of which 10%–14% was classified as moderately/severely disabling [10]. Accordingly, the remaining 29%–33% of individuals presumably reported chronic pain yet experienced minimal or no disability. Further analysis of how prevalent pain is in people who perceive themselves as healthy would contribute to our understanding of the burden of pain.

The manifestation and impacts of pain vary greatly due to interactions between neurobiological, environmental, cognitive and emotional factors [11–14]. Knowledge of pain characteristics among the healthy population or those with minimal physical disability or psychological impact could hold important insights to inform clinical practice and research. However, insufficient attention has been paid to this population. In one of the few studies on profiles of healthy people, Jones et al. [15] found that only one in six persons in their population-based study ($n = 2{,}260$) did not report musculoskeletal pain across a 4-year period, and that those without pain had lower levels of psychological distress and better quality sleep compared to those who developed pain. This highlights the importance of broader health factors in influencing musculoskeletal health. To this end, investigating biopsychosocial characteristics of individuals who report pain yet suffer minimal pain-related disability could yield key discoveries regarding the (potentially modifiable) factors which contribute to maintaining a functional state despite pain, providing opportunities for prevention and treatment targets. Therefore, the primary aim of this study was to investigate the prevalence of pain (recent/chronic), among a sample of 1,000 healthy children and adults. A further aim was to compare psychosocial and physical characteristics between healthy adults with and without recent/chronic pain.

2 Methods

2.1 Participants

Data for this study were from the 1,000 Norms Project, a cross-sectional observational study investigating self-reported outcomes and physical performance in 1,000 healthy individuals aged 3–101 years, stratified by age and gender [16]. Participants were recruited via online, paper and face-to-face advertising methods through local council and state government groups; community and sporting groups; schools and tertiary education institutions; and aged care independent living facilities. A structured convenience sampling approach targeting the Greater Sydney metropolitan area, which accounts for one-fifth of Australia's population [17], was employed. Due to Australian privacy legislation and the high proportion of "mobile-phone-only" Australian households, random sampling was not feasible [16]. Ethical approval for the 1,000 Norms Project was granted by the institutional Ethics Committee (HREC 2013/640).

Participants were eligible if they considered themselves healthy by self-report and had no major physical disability. Pain minor medical conditions (e.g. history of musculoskeletal injury) were not included or excluded as such, rather the individual's physical functioning was taken into account. Potential participants were asked the following questions:

1. "Do you consider yourself healthy for your age?"
2. "Are you able to participate in normal daily activities with respect to your age?"

Individuals who responded "yes" to both questions were screened for the following exclusion criteria:

1. Inability to follow age-appropriate instructions in English;
2. Self-reported medical conditions or factors known to affect function in daily activities, including: infectious or inflammatory arthropathies; severe musculoskeletal disorders (e.g. end-stage osteoarthritis); history of joint replacement or other major surgery; diabetes; malignant cancers; demyelinating, inflammatory or degenerative neurological conditions; severe cardiac or pulmonary disease; pregnancy; body mass index (BMI) ≥40 kg/m^2 (Class III obesity) or mobility limitations necessitating dependence on mobility aids [16].

Ethnicity of participants was collected according to the Australian Standard Classification of Cultural and Ethnic Groups [18] and was classified into one of three groups using participants' country of birth: British/European, Aboriginal/Torres Strait Islander or "other" (Asian/American/African/Middle-Eastern). Socio-economic status was assessed using the socio-economic indexes for areas (index of relative socio-economic advantage and

disadvantage), ranking Australian residential postcodes in terms of relative advantage or disadvantage on a percentile score from 1 (most disadvantaged) to 100 (most advantaged) [19].

2.2 Pain prevalence

All participants were asked to rank the intensity of recent bodily (generalised) pain they had experienced in the past 4 weeks on a six-point scale from "none" to "very severe", based on the 36-Item Short Form Health Survey [20] as used by the Australian Bureau of Statistics [4]. Presence of chronic pain, defined as pain experienced every day for 3 months in the previous 6 months, was also assessed in all participants using a single-item "Yes/No" question [21]. Neither of these two items were body site-specific, and for children aged 3–10 years the parent/caregiver completed both questions.

2.3 Psychosocial characteristics

Psychosocial characteristics were collected in adults (18+ years). Mental health was evaluated using the 35-item Assessment of Quality of Life-8 Dimension (AQoL-8D) utility instrument [22]. The AQoL-8D assesses eight dimensions and generates two super-dimensions (mental and physical) as well as a global "utility", scored from 0 (death-equivalent) to 1.00 (best health state). Data for the mental super-dimension (combining "mental health", "self-worth", "relationships", "happiness" and "coping" dimensions) were analysed. To investigate sleep difficulties, responses for the AQoL-8D question regarding sleep problems in the past week were re-coded to a binary variable as "no" (never/almost never) or "yes" (sometimes/often/all the time). Although the validity of this single-item question is unknown, a similar item ranking sleep quality from 0 to 10 has demonstrated sound validity [23]. Self-efficacy was assessed using the Generalized Self-Efficacy Scale, an eight-item Likert-scale questionnaire [24]. Responses were summed to give a score from 5 (lowest) to 40 (best self-efficacy).

2.4 Physical characteristics

Self-reported physical activity level was measured in adults using the International Physical Activity Questionnaire (IPAQ)-long (18–69 years) [25] and the IPAQ-elderly (70–101 years) [26]. A categorical score of low, moderate or high physical activity was allocated and re-coded to a binary variable indicating "low/moderate" or "high" physical activity level [25]. A standardised protocol was used to collect physical measures [16]. BMI in adults (18+ years) was recorded and classified as "underweight/normal weight" (<25.0) or "overweight/obese" (≥25.0) using established cut-off scores [27]. The 6-min walk test was used to measure walking endurance [28]. Participants walked as quickly as possible for 6 min, generating a 6-min walk distance (m). Sit-to-stand ability was evaluated using the 30-s chair stand test, whereby the number of full sit-to-stands performed in 30 s was recorded [29]. The timed up and down stairs test was used to assess stair-climbing performance. Participants were asked to ascend and descend a flight of stairs as quickly and safely as possible (s) [30]. Data were scaled to leg length for the 6-min walk and timed up and down stairs tests [31]. Two experienced physiotherapists (J. N. B and M. J. M) conducted the physical assessments, with excellent inter-rater reliability ($ICC_{2,1} = 0.94–0.98$) established through pilot testing ($n = 10$, age range 6–67 years).

2.5 Statistical analysis

Data were managed using REDCap (Research Electronic Data Capture, Nashville, TN, USA) [32]. SPSS for Windows 22.0 software package was used for statistical analyses (IBM SPSS Inc., Chicago, IL, USA). Cases with missing data were removed from analyses. To compare adults with and without recent pain, responses to the recent bodily pain question were coded into two groups: "none" and "mild/moderate/severe". To examine differences in demographic, psychosocial and physical characteristics between adults with and without (recent/chronic) pain, Pearson χ^2 tests with continuity correction were used for binary variables and independent sample *t*-tests for continuous variables. Effect sizes for continuous data for the psychosocial and physical measures were calculated using Cohen's *d* where results were statistically different between groups ($p < 0.05$).

3 Results

The ethnic profile of the 1,000 participants was similar to the Australian population, however participants were from more socio-economically advantaged areas (Table 1). A similar proportion of children aged 3–17 years were overweight/obese compared to Australian children aged

Table 1: Characteristics of the 1,000 Norms Project sample compared to the Australian population.

Characteristic	1,000 Norms Project	Australian population
Age		
Median (IQR)		
Males	39.5 (16–66)	36.5 [17]
Females	39.5 (16–64)	38.3 [17]
Gender % (*n*)		
Male	50.0 (500)	49.8 [17]
Female	50.0 (500)	50.2 [17]
Socio-economic status[b]		
Median (IQR)	84.0 (60–96)	50.0 (25–75)[a]
Ethnicity % (*n*)		
British/European	74.4 (744)	68.1 [33]
Aboriginal/Torres Strait Islander	1.5 (15)	3.0 [34]
Other (Asian/American/African/ Middle-Eastern)	24.1 (241)	Data not available
Country of birth % (*n*)		
Australia	67.8 (678)	71.8 [35]
Overweight/obese % (*n*)		
3–17 years		
Males	23.1 (31)	26.8 [27][c]
Females	24.6 (33)	24.8 [27][c]
18+ years		
Males	53.0 (194)	70.8 [27]
Females	37.2 (196)	56.3 [27]

[a]Statistically significant difference between 1,000 Norms Project sample and Australian population, $p < 0.05$ (not calculated for data reported as percentages). [b]Percentile rank for index of relative socio-economic advantage and disadvantage. [c]Australian data reported for 2–17 year-olds.

Table 2: Pain intensity and chronic pain prevalence in the 1,000 Norms Project sample compared to Australian population-based data [4, 6].

Age group	Gender	1,000 Norms Project	Australian population
Pain intensity % (*n*)			
None			
3–17 years	Males	53.0 (71)	Data not available
	Females	50.4 (67)	
18+ years	Males	27.3 (100)	33.8 [4]
	Females	28.4 (104)	30.1 [4]
Very mild/mild			
3–17 years	Males	42.5 (57)	Data not available
	Females	41.4 (55)	
18+ years	Males	57.1 (209)	39.1 [4]
	Females	58.7 (215)	39.1 [4]
Moderate/severe			
3–17 years	Males	4.5 (6)	Data not available
	Females	8.3 (11)	
18+ years	Males	15.6 (57)	27.1 [4]
	Females	12.8 (47)	30.8 [4]
Chronic pain % (*n*)			
3–17 years	Males	1.5 (2)	Data not available
	Females	5.2 (7)	
18+ years	Males	15.0 (55)	17.1 [6]
	Females	14.5 (53)	20.0 [6]

No significant gender differences, $p > 0.05$.

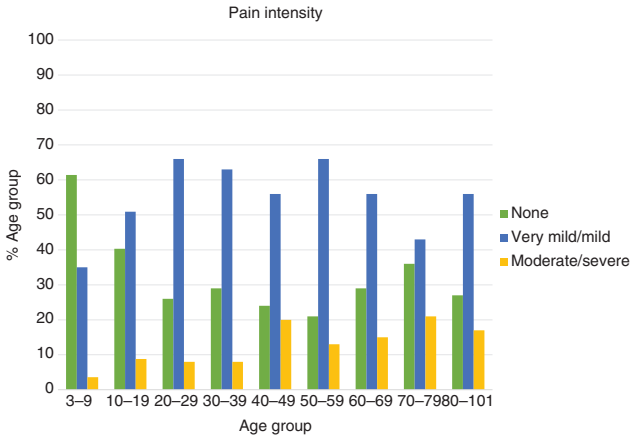

Fig. 1: Generalised pain intensity by age decade.

2–17 years, although a lower proportion of adult participants were overweight/obese compared to Australian adults.

3.1 Pain prevalence

Sixty-six percent of all participants ($n = 657$) had experienced some pain within the past 4 weeks. Seventy-two percent of adults ($n = 528$) and 48.5% ($n = 129$) of children had experienced recent pain, although most (80.3% of adults, 86.8% of children) rated their pain as very mild/mild (Table 2). Moderate/severe pain was reported by 15.6% of adult males and 12.8% of adult females aged 18–101 years, and by 4.5% of paediatric males and 8.3% of paediatric females. Generalised pain was lowest among children, as 67% ($n = 47$) of boys and 56% ($n = 39$) of girls aged 3–9 years had experienced no pain in the past 4 weeks, while moderate/severe pain was highest for adults aged 40–49, 70–79 and 80+ years (Fig. 1).

Chronic pain was reported by 11.7% ($n = 117$) of all participants, including 14.8% ($n = 108$) of adults and 3.4% ($n = 2$) of children (Table 2). Chronic pain was lowest among children aged 3–9 years (1%, $n = 1$ males; 4%, $n = 3$ females), and highest among older males aged 60–69, 70–79 and 80–101 years (22%, $n = 11$ for each group) and among older females aged 80+ years (22%, $n = 11$) (Fig. 2). No participants reported "very severe" pain, and there

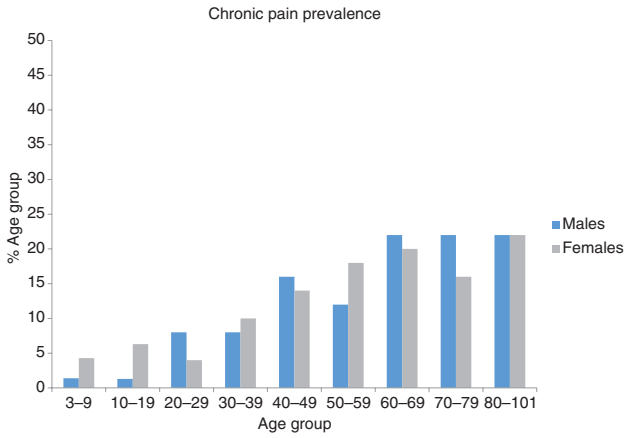

Fig. 2: Chronic pain prevalence by gender and age decade.

were no differences in pain intensity or chronic pain between genders or among ethnic backgrounds ($p > 0.05$).

3.2 Psychosocial and physical characteristics of adults with and without pain

Adults who had recently experienced pain (mild/moderate/severe) ($n = 528$) were more likely to be overweight/obese and report sleep difficulties, reported lower mental super dimension and self-efficacy scores, and had lower performance on the 30-s chair stand test, compared to adults with no pain ($n = 204$, $p < 0.05$) (Table 3). Effect sizes for the differences in mental health, self-efficacy and physical performance were modest (Cohen's $d = 0.16–0.39$) and therefore unlikely clinically significant. There were no differences in physical activity levels ($p > 0.05$).

Adults who had experienced chronic pain in the past 6 months ($n = 108$) were older, were more likely to be overweight/obese, reported lower mental super dimension scores and had lower performance on the 6-min walk, 30-s chair stand and timed up and down stairs tests, compared to adults without chronic pain ($n = 624$, $p < 0.05$) (Table 4). Again, effect sizes were modest (Cohen's $d = 0.25–0.40$). Levels of self-efficacy were similar between adults with and without chronic pain, and there was no difference in the proportion of individuals with sleep difficulties or physical activity levels across these groups ($p > 0.05$).

4 Discussion

Pain was common in this sample of 1,000 healthy individuals, with 72% of adults and 48% of children experiencing recent pain, although most rated their pain as mild. Recent pain was linked with higher rates of overweight/obesity and sleep problems, and lower mental health, self-efficacy and sit-to-stand performance. Chronic pain was reported by 14% of adults and 3% of children. Adults with chronic pain were older and more likely to be overweight/obese, reported lower mental health and had lower physical performance compared to adults without pain. However, differences in psychosocial and physical characteristics between adults with and without pain (recent/chronic) were unlikely clinically significant.

Rates of recent pain in this study were similar to population-based studies reporting that 67% of Australians aged 15 years and over [4] and 66% of Swedish adults [36] had experienced recent pain. These findings suggest that pain is a common, likely "normal", human experience,

Table 3: Demographic, psychosocial and physical characteristics of adults with no pain compared to adults with recent (mild/moderate/severe) pain.

	No pain ($n = 204$)	Recent pain ($n = 528$)	*p*-Value	Effect size (Cohen's *d*)
Age (year)	52.8 (21.0)	52.2 (20.8)	0.570	–
Female gender % (*n*)	51.0 (108)	49.6 (262)	0.805	–
Self-efficacy (5–35)	33.6 (4.3)	32.9 (4.2)	0.046	0.16
Mental super dimension (0–1)	0.58 (0.16)	0.52 (0.15)	<0.001	0.39
Sleep problems % (*n*)	33.3 (68)	44.8 (236)	0.006	–
Overweight/obese % (*n*)	38.2 (78)	47.7 (252)	0.026	–
High physical activity % (*n*)	65.3 (132)	66.0 (348)	0.930	–
6-min Walk distance (scaled)	747.3 (108.7)	734.3 (142.5)	0.188	–
30-s Chair stand test (*n*)	21.7 (6.4)	20.6 (6.9)	0.043	0.17
Timed up and down stairs test (scaled)	2.8 (1.3)	2.9 (1.4)	0.203	–

Effect sizes only calculated for continuous outcome measure variables where $p < 0.05$. Data are reported as [mean (SD)] unless otherwise indicated.

Table 4: Demographic, psychosocial and physical characteristics of adults with and without chronic pain.

	No chronic pain ($n=624$)	Chronic pain ($n=108$)	p-Value	Effect size (Cohen's d)
Age (year)	51.0 (20.9)	60.3 (18.6)	<0.001	–
Female gender % (n)	50.2 (313)	49.1 (53)	0.917	–
Self-efficacy (5–35)	33.2 (4.1)	32.4 (4.7)	0.059	–
Mental super dimension (0–1)	0.54 (0.16)	0.50 (0.16)	0.035	0.25
Sleep problems % (n)	40.1 (250)	50.5 (54)	0.056	–
Overweight/obese % (n)	43.1 (269)	56.5 (67)	0.013	–
High physical activity % (n)	66.4 (413)	62.6 (67)	0.515	–
6-min Walk distance (scaled)	745.0 (127.7)	697.4 (160.7)	0.004	0.33
30-s Chair stand test (n)	21.3 (6.7)	18.6 (6.9)	<0.001	0.40
Timed up and down stairs test (scaled)	2.8 (1.4)	3.3 (1.5)	0.003	0.34

Effect sizes only calculated for continuous outcome measure variables where $p < 0.05$. Data are reported as [mean (SD)] unless otherwise indicated.

even among healthy individuals. Notably, while the overall prevalence of bodily pain in our study was similar to population-based reports, moderate or severe pain was much lower; 16% of adult males and 13% of adult females reported moderate/severe pain, compared to population-based reports of 27% and 31%, respectively [4]. It might be that individuals with moderate/severe pain were less likely to volunteer or be recruited into our study due to perceptions of health status or due to physical or psychological disability, given that higher pain intensity is linked with greater disability [37]. In our study adults with chronic pain were older, in keeping with previous research [6, 38], although results from earlier studies are conflicting [36, 39]. Nonetheless, this finding suggests a greater acceptance of pain as a "normal" phenomenon, particularly among older adults.

Despite selecting healthy individuals, adults with recent/chronic pain in our study were more likely to be overweight/obese and had lower physical performance, although effect sizes were small. While an association between pain and overweight/obesity has been established [40–45], particularly among older adults in whom abdominal obesity almost doubles the likelihood of chronic pain [46], the direction and nature of this complex relationship remains an area for further investigation [47, 48]. One hypothesis is that adipocytokines could provide a metabolic link between obesity and inflammatory conditions, as demonstrated in osteoarthritis [49] and low back pain [45]. Nevertheless, an important clinical implication arising from these observations is the potential for treatments targeting both obesity and pain. For example, there is promising evidence for lifestyle interventions resulting in weight loss, improved function and decreased pain among adults with knee pain [50–52], likely attributable to reductions in both mechanical load and systemic inflammation [53, 54].

Our finding that adults with recent/chronic pain reported lower mental health is in keeping with the literature; lower mental health has been associated with spinal pain and is prognostic of worse outcomes [55–57]. This is consistent with the growing focus on the multi-dimensionality of pain [58, 59]. Efforts have been made to integrate psychosocial factors in back pain assessment [60], however our data suggest that screening and addressing broader health risks is also necessary, a practice promoted through the "Making every contact count" initiative of the UK National Health Service [61]. Further, although longitudinal studies regarding the prognostic value of mental health in otherwise healthy people are needed, these findings could indicate a pre-clinical state and early intervention strategies to address these modifiable factors should be evaluated.

This study has several limitations. First, as the questions used to measure recent and chronic pain were generic, we cannot ascertain the body site affected or the underlying cause of pain. Second, we did not employ random sampling techniques. Although the highly-structured convenience sampling strategy targeted individuals from a wide range of backgrounds reflective of the ethnic diversity of the Australian population, our participants were from more socio-economically advantaged areas, and this may influence results. Third, as we measured generalised and not pain-specific self-efficacy, further studies investigating pain self-efficacy among healthy individuals are indicated.

Ultimately, understanding the characteristics of adults who report pain yet consider themselves healthy and maintain normal (or sufficient) functioning can help identify factors that protect against pain-related disability. Importantly, in our study levels of self-efficacy were similar between healthy adults with and without chronic

pain. Although we measured general and not pain-specific self-efficacy, other studies have shown that pain self-efficacy is an important determinant of disability [37] and also mediates the relationship between chronic pain and disability [62, 63]. High self-efficacy could help in maintaining good health and function despite pain, an observation supported by previous studies finding higher self-efficacy predicts better health outcomes among individuals with low back pain [64, 65]. We also found that levels of physical activity were similar between adults with and without recent/chronic pain. While evidence for the link between physical activity and pain is mixed [66], it is possible that high physical activity could contribute to the preservation of good health in the presence of pain, although our cross-sectional study design precludes drawing inferences about cause and effect. Other factors such as resilience also likely contribute to protecting against pain-related disability and warrant further investigation [67].

5 Conclusions

Mild pain is common among healthy individuals. Adults who consider themselves healthy but experience pain (recent/chronic) display slightly lower mental health and physical performance, although these differences are unlikely clinically significant.

6 Implications

The findings of this study emphasise the importance of assessing pain-related disability in addition to prevalence when considering the disease burden of pain. Early assessment of broader health and lifestyle risk factors in clinical practice is emphasised. Avenues for future research include examination of whether lower mental health and physical performance represent risk factors for future pain and whether physical activity levels, sleep and self-efficacy are protective against chronic pain-related disability.

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Conflict of interest: There are no conflicts of interest for any of the listed authors.

Informed consent: Informed, written consent was given by all participants aged 18 years and over, or by the parent/guardian of participants aged under 18 years.

Ethical approval: The institutional Ethics Committee approved the study (HREC 2013/640).

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