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Cohort profile: the AUstralian Twin BACK pain and physical activity study (AUTBACK study)

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ABSTRACT

Purpose Despite the growing evidence that physical activity and familial factors play a role in low back pain (LBP), there is a lack of robust longitudinal studies that (1) investigate the types and dosages of physical activity that are protective or harmful for LBP, (2) employ objective measures of physical activity and (3) conduct appropriate adjustment for confounders. The AUstralian Twin BACK (AUTBACK) study was established to elucidate the longitudinal LBP–physical activity relationship with the benefits of controlling for familial (both genetic/nongenetic) factors that may influence physical activity engagement and LBP.

Participants Participants are twins registered at Twins Research Australia (TRA), older than 18 years, with access to internet. We collected data on LBP status (weekly) and physical activity levels (monthly) for 12 months as well as a wide range of health, lifestyle and physical activity (objective, self-reported, including different types and dosages) data.

Findings to date We included 401 twins, 157 being complete twin pairs (n=314). Lifetime prevalence of LBP was 85%. Participants spent 61% of their week in sedentary time and only 4% in moderate/vigorous intensity physical activity (accelerometer). So far, 168 participants (40% of the sample) have completed the 12-month follow-up. A total of 7150 weekly (LBP status) and 1763 monthly questionnaires (physical activity status) have been answered (92% response rate).

Future plans The 12-month follow-up will be completed by June 2020. This cohort represents a novel and comprehensive resource for researchers in the field, and includes high-quality, and frequent data on LBP and physical activity. It allows the investigation of genetic and shared environmental factors on the LBP–physical activity relationship. The AUTBACK group has planned a number of projects, with the main one being the investigation of the influence of physical activity on recurrence of LBP. Data linkage opportunities are available, including with other studies conducted by TRA.

INTRODUCTION

It is estimated that 83% of the world population will report at least one episode of low back pain (LBP) during their lifetime,[1] with 3.7 million people reporting LBP in Australia in 2014–2015.[2] Although it is well known that

Strengths and limitations of this study

► The AUstralian Twin BACK (AUTBACK) is collecting high-quality repeated measures of low back pain and physical activity with weekly pain and monthly physical activity measures.
► The sample of AUTBACK includes twins from all states in Australia. The inclusion of twins as participants allow for innovative familial and genetic analyses.
► Although objective assessment of physical activity was not available from all participants, it is still available from 92% of the sample.

LBP significantly impacts people's quality of life, its specific causes are unclear.[3 4] Risk factors for LBP are poorly understood, with the most consistently reported risk factor for a new episode of LBP being a previous episode.[5] For chronic LBP, some modifiable, but weak, risk factors have been previously identified, including smoking, psychological distress and physical inactivity.[6]

Among the modifiable risk factors for LBP, physical activity is particularly promising.[7 8] The health benefits associated with regular leisure physical activity are well established.[7 9–11] People who engage in moderate or vigorous activity at least three times per week have on average 39% less risk of cardiovascular mortality,[9 10] and four additional years in life expectancy compared with those who do not engage in physical activity.[11] Although clinical guidelines recommend engagement in leisure physical activity as a strategy to manage and reduce the risk of LBP,[12] it is still unclear what types and doses of physical activity are harmful or protective for LBP. People with chronic or persistent LBP who are physically active (ie, engage in at least 3 hours of moderate activities per week) have a better 1-year prognosis in terms of disability and pain intensity when compared with those who are inactive during leisure
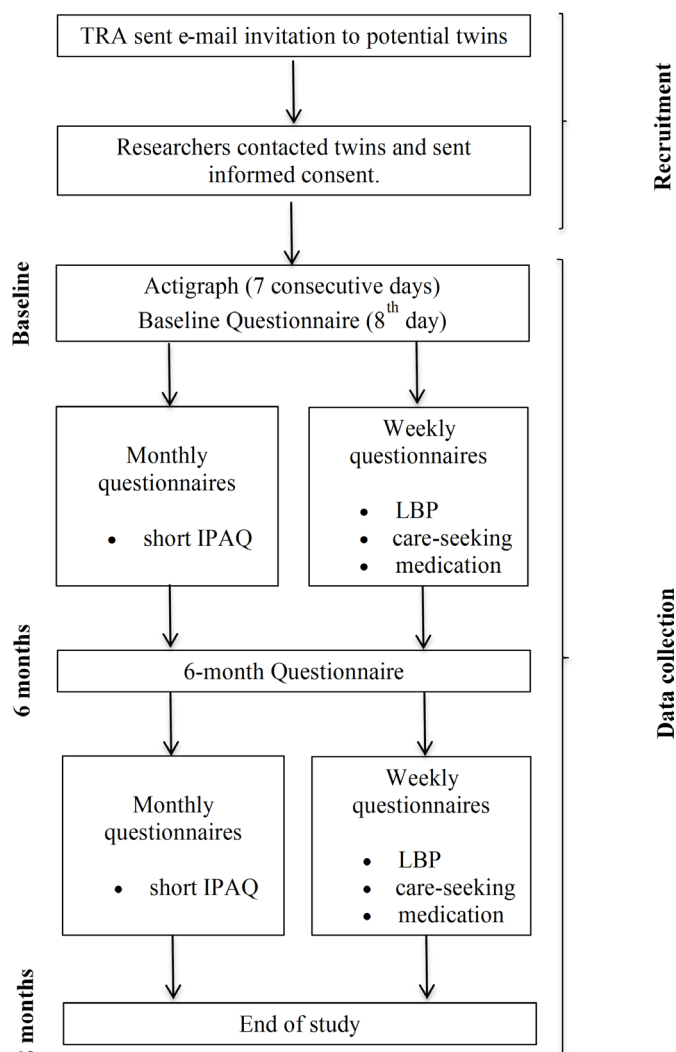
Figure 1 AUTBACK study flow chart. AUTBACK, AUstralian Twin BACK; IPAQ, International Physical Activity Questionnaire; LBP, low back pain; TRA, Twins Research Australia.

time (ie, report spending most of their leisure time sitting, and watching television).[13] Moreover, a recent systematic review, including people free of chronic-LBP at study inception, indicated that engagement in moderate (1–3 times per week), or vigorous/high (≥3–4 times per week) physical activity during leisure time is associated with a 11%–16% decreased risk of developing chronic LBP.[14] However, the impact of the interaction between different types of physical activities on LBP is intriguing. For example, people who engage in heavy domestic and recreational physical activity report a higher prevalence of LBP when compared with those who engage in heavy domestic physical activity only.[15] Given that these interactions are complex and not well understood, it is difficult for clinicians to advise patients on the role of physical activity for LBP.

One potential explanation for the lack of clarity on the relationship between LBP and physical activity is the presence of methodological differences between previous studies. First, to date, most studies have focused on the effect of a single type of physical activity (eg, leisure time or work related) on LBP.[14 16 17] However, physical activity is a complex behaviour often characterised by a combination of different dimensions (type, frequency, duration and intensity), and domains (leisure time, household, transportation and work related). Second, most of the previous studies in this field have used self-reported questionnaires to assess physical activity.[18] Although questionnaires are useful instruments to quantify physical activity repeatedly over time, non-objective measurements often overestimate people's engagement in leisure physical activity and underestimate engagement in sedentary time.[19] Therefore, self-reported tools should be supplemented by objective measures so that physical activity is validly assessed.[20 21] Third, there is a lack of robust longitudinal studies with multiple data points assessing the relationship between physical activity and LBP outcomes.[18] A person's LBP status and physical activity engagement may vary over time,[22] and therefore, the collection of data at frequent and multiple time points is critical to capture individual changes. Finally, it is known that genetics can explain up to 67% of population variance in LBP.[23 24] Twin studies offer a great opportunity to account for the influences of genetic and early shared environmental factors on the risk of developing a condition,[25] and therefore, may allow a more precise estimation of the relationship between physical activity and LBP than non-twin studies.

In light of the current gaps in the literature on the relationship between physical activity and LBP, we have designed and established the AUstralian Twin BACK (AUTBACK) study. This study was set up to expand the pilot case–control AUTBACK study conducted in 2014,[26] and therefore, allowing to answer other questions regarding the relationship between physical activity (including objectively measured physical activity) and LBP. This is the first cohort study to collect high quality, comprehensive and frequent data on LBP and physical activity in twins. The data collected can help to answer some of the questions related to the role of physical activity in LBP (eg, recurrence or incidence of LBP), and consequently produce insights on a potential target for the prevention and management of LBP. In this manuscript, we describe the study design, data collection procedures, participants' characteristics, baseline and follow-up data collected so far.

COHORT DESCRIPTION
Study design
AUTBACK is an ongoing study with a sample of twins living in Australia who are registered at Twins Research Australia (TRA), formerly known as the Australian Twin Registry—an Australian national twin registry of more than 80 000 twins who have volunteered to participate in research studies. The study was established to collect frequent and comprehensive measures of LBP (eg, pain levels, care-seeking behaviour) on a weekly basis, and

Table 1 Description of data collected

Variables	Baseline	Weekly	Monthly	6-month follow-up
Anthropometric data				
Body mass index	X			X
Height	X			X
Hip circumferences	X			X
Waist circumferences	X			X
Health-related variables				
DASS-21	X			X
Sleep quality (PSQI)	X			X
Smoking status	X			X
Low back pain (LBP)				
Prevalence				
Lifetime (yes/no)	X			X
Last 4 weeks (yes/no)	X			X
Weekly (yes/no)		X		
Activity limitation				
Lifetime (yes/no)	X			X
Last 4 weeks (yes/no)	X			X
Weekly (yes/no)		X		
LBP duration				
≤6 weeks; 6 weeks <LBP> 3 months; 3 months or more	X			X
Days (0–7)		X		
Pain intensity (NPRS)	X	X		X
Disability due to LBP (RMDQ)	X			X
Care-seeking				
Care-seeking (yes/no)	X	X		X
Healthcare sought (yes/no)		X		
Type and frequency		X		
Medication (yes/no)		X		
Type and frequency		X		
Self-management (yes/no)		X		
Type and frequency		X		
Physical activity				
Objective (Actigraph)	X			
IPAQ long version	X			X
IPAQ short version			X	
Physical Workload Index	X			X
Recent physical activity	X			X

DASS-21, Depression Anxiety Stress Scale; IPAQ, International Physical Activity Questionnaire; NPRS, Numerical Pain Rating Scale; PSQI, Pittsburgh Sleep Quality Index; RMDQ, Roland Morris Disability Questionnaire.

physical activity (objectively assessed at baseline, and self-reported during monthly follow-ups) status during a 12-month period.[26] We also assessed other health-related data (eg, smoking, mental health and sleep quality) at study inception. All surveys are collected electronically using a system built specifically for the purpose of this project.

Participants' eligibility and recruitment

Recruitment for the AUTBACK cohort occurred from October 2015 to June 2019. Initially, TRA invited a total of 3842 twins (1921 twin pairs) to participate in the study. From the total number of twins approached, 644 (20%) individuals' expressed interest to participate in the study and were contacted by study staff. Eligible participants

Table 2 Sample characteristics for the AUTBACK sample at baseline

Variables	N	Mean±SD or %
Total sample		
Age (years)	401	53±13
Body mass index	397	25±4
Gender (female)	294	73
Zygosity		
Monozygotic	262	65
Dizygotic	139	35
Depression (DASS-21 range 0–42)	401	
Depression (range 0–42)	401	3.8±6.7
Anxiety (range 0–42)	401	3.2±5.4
Stress (range 0–42)	397	7.3±7.6
Sleep Quality Index (PSQI range 0–21)	220	6.4±3.1
Smoking status		
Non-smoker	324	82
Ex-smoker	56	15
Occasional smoker	6	1
Current smoker	10	2
States and Territories		
Australian Capital Territory	13	3
New South Wales	95	24
Northern Territory	7	2
Queensland	80	20
South Australia	29	7
Tasmania	9	2
Victoria	115	29
Western Australia	53	13
Complete Pairs only	314	
Zygosity		
Monozygotic—female/female	178	57
Monozygotic—male/male	42	13
Dizygotic—female/female	56	18
Dizygotic—male/male	18	5
Dizygotic female/male	20	6
Individual twins only	87	
Gender (female)	50	57
Zygosity		
Monozygotic	41	47
Dizygotic	46	53

Individuals twins only: incomplete pair.
AUTBACK, AUstralian Twin BACK; DASS-21, Depression Anxiety Stress Scale; PSQI, Pittsburgh Sleep Quality Index.

had to be at least 18 years old with internet access via computer or smartphone and an active email account. Complete pairs (both twins in the pair), or incomplete pairs (only one twin in the pair) were eligible to participate in the study. Twins with any self-reported serious spinal pathology (eg, inflammatory, metastatic or infectious disease of the spine), pregnant women, and those who had undergone spinal surgery in the last 12 months were not eligible to take part in this study. Eligible participants received an email with a link to a website. On the study website, participants had access to the study information and an online consent form. All included participants consent to participate in the study and are being followed for 12 months. Data are collected at baseline, monthly (short International Physical Activity Questionnaire (IPAQ)), at 6 months (midterm) and weekly (LBP status) (figure 1) (table 1). All data are stored on the University of Sydney server and collected electronically through a specifically designed web-based tool.

Patient involvement
There was no patient or public involvement in this study.

Procedures
Once participants gave their consent and confirmed their availability, objective data on physical activity were collected using an accelerometer (Actigraph GT1M/ GT3X model), which is a device widely used in clinical research and has shown good reliability and validity to assess physical activity[27 28]. The ActiGraph device was sent via post to be worn for seven consecutive days. Participants were asked to wear the device on the right hip (with an elastic belt) during their waking hours[27 29] and received an SMS reminder on the third and fifth day. They were instructed to remove the device during water activities and bathing and to fill in a diary reporting their daily activities. The ActiLife V.6.13.3 software was used for data processing and extraction. The accelerometer was set up on 30 Hz frequency, data were downloaded in 60 s epoch, and were considered valid if the participant had worn it for at least 600 min in a minimum of 4 days.[29 30] To classify non-wear time, Actigraph data were validated using the Troiano algorithm—a common automated algorithm using criteria proposed by Troiano.[30] This algorithm defines the non-wear time when there is a minimum of 60 consecutive minutes of 0 activity counts, with allowance up 2 to minutes of counts between 0 and 100. This algorithm has been used by several population-based studies to detect and eliminate the non-wear time interval, in which no activity is performed.[31] Participants wore the Actigraph before answering the baseline questionnaire, and on the eighth day postwearing the device they were emailed a link to respond to the electronic baseline questionnaire.

Baseline questionnaire
We collected data on LBP lifetime prevalence, LBP in the last 4 weeks, pain intensity, symptom duration, activity limitation, disability and care-seeking due to LBP. Only participants reporting a history of LBP (ie, lifetime prevalence) were asked to answer the question regarding the presence of pain in the last 4 weeks. Only those answering

Table 3 Low back pain (LBP) status of AUTBACK participants at baseline (n=401)

All participants	Yes			No		
	Total (n) (%)	MZ (fem/male)	DZ (fem/male)	Total (n) (%)	MZ (fem/male)	DZ (fem/male)
Lifetime prevalence of LBP	342 (85)	223 (171/52)	119 (77/42)	58 (15)	38 (28/10)	20 (17/3)
Lifetime prevalence of activity limiting LBP	186 (55)	114 (84/30)	72 (47/25)	150 (45)	105 (84/21)	45 (28/17)
Prevalence of LBP in the past 4 weeks	162 (48)	113 (83/30)	49 (34/15)	174 (52)	106 (85/21)	68 (41/27)
Prevalence of activity limiting LBP in the past 4 weeks	27 (18)	18 (17/1)	9 (8/1)	121 (82)	87 (62/25)	34 (22/12)
LBP symptom length						
6 weeks or less	52 (33)	35 (26/9)	16 (10/7)	—		
6 weeks <LBP> 3 months	7 (5)	7 (5/2)	0	—		
3 months or more	95 (62)	65 (50/15)	30 (23/7)	—		
Prevalence of care-seeking in the last 4 weeks	43 (27)	31 (27/4)	12 (9/3)	118 (73)	81 (55/26)	37 (25/12)
Lifetime prevalence of LBP but pain free in the past 4 weeks	174 (52)	106 (85/21)	68 (10/27)	—		
Average intensity of LBP in the last week (0–10)*	160	3.0±1.8		—		

Twins from complete pairs only	Yes			No		
	Twins (n) (%)	MZ (fem/male)	DZ (fem/male)	Twins (n) (%)	MZ (fem/male)	DZ (fem/male)
Lifetime prevalence of LBP	268 (86)	187 (152/35)	81 (55/26)	45 (14)	32 (25/7)	13 (11/2)
Twins from concordant pairs	240 (77)	168 (136/32)	72 (4/26)	18 (6)	14 (10/4)	4 (4/0)
Twins from discordant pairs	54 (17)	38 (32/6)	16 (15/1)	—		
Lifetime prevalence of activity limiting LBP	142 (54)	94 (71/23)	48 (32/16)	120 (46)	89 (78/11)	31 (21/10)
Twins from concordant pairs	86 (37)	56 (40/16)	30 (20/10)	68 (30)	50 (46/4)	18 (14/4)
Twins from discordant pairs	74 (33)	54 (44/10)	20 (10/10)	—		
Prevalence of LBP in the past 4 weeks	126 (48)	91 (73/18)	35 (24/11)	136 (52)	92 (76/16)	44 (29/15)
Twins from concordant pairs	48 (22)	40 (34/6)	8 (5/3)	62 (29)	44 (36/8)	18 (10/8)
Twins from discordant pairs	104 (49)	68 (56/12)	36 (24/12)	—		
Prevalence of activity limiting LBP in the past 4 weeks	22 (81)	16 (15/1)	6 (5/1)	93 (19)	69 (55/14)	24 (16/8)
Twins from concordant pairs	6 (12)	6 (6/0)	0	32 (63)	26 (20/6)	6 (4/2)
Twins from discordant pairs	12 (25)	8 (8/0)	4 (2/2)	—		
LBP symptom length						
6 weeks or less	44 (26)	31 (24/7)	13 (8/5)	—		
6 weeks <LBP> 3 months	6 (5)	6 (4/2)	0	—		
3 months or more	70 (59)	50 (43/7)	20 (15/5)	—		
Prevalence of care-seeking in the last 4 weeks	41 (33)	30 (26/4)	11 (8/3)	84 (67)	60 (46/14)	24 (16/8)
Lifetime prevalence of LBP but pain free in the last 4 weeks	62 (20)	44 (36/8)	18 (10/8)	—		
Average intensity of LBP in the last week (0–10)	124	2.9±1.6		—		

AUTBACK, AUstralian Twin BACK; DZ, dizygotic; Fem, Female; LBP, Low Back Pain; MZ, monozygotic; *NPRS, Pain intensity.

Table 4 Descriptive data on physical activity

Variables	All participants		Complete pairs	
	N	Mean±SD	N	Mean±SD
Actigraph				
Sedentary time (min/week)	369	3318±671	276	3350±670
Light intensity (min/week)	369	1894±565	276	1893±567
Moderate-to-vigorous intensity (min/week)	369	210±150	276	213±153
Step count (week)	369	54 623±22 948	276	54 773±23 662
IPAQ long-form				
Sitting time (min/week)	399	2516±1353	312	2590±1364
Walking time (min/week)	397	525±683	310	470±616
Moderate-to-vigorous intensity (min/week)	396	939±1049	310	863±959
Total (min/week)	396	1465±1489	310	1334±1343
IPAQ long-form—domain				
Work (MET-min/week)	397	1939±4972	310	1709±4361
Transportation (MET-min/week)	397	698±1101	310	602±957
Domestic and Garden (MET-min/week)	397	2006±2784	310	1893±2642
Leisure-time (MET-min/week)	397	1421±2005	310	1366±2024
Physical Workload Index	371	11.4±9.1	292	11.2±9.1

IPAQ, International Physical Activity Questionnaire.

yes to the presence of pain in the past 4 weeks were asked about activity limitation, duration, intensity and whether they were receiving any treatment for LBP. Pain intensity was assessed using the 11-point Numerical Pain Rating Scale (NPRS).[32] Activity limitation was assessed by the question 'Was this pain bad enough to limit your usual activities or change your daily routine for more than 1 day?', and LBP symptom duration by the question: 'for how long have you been experiencing LBP?' Participants' disability level was assessed by the Roland Morris Disability Questionnaire (RMDQ).[33] The total RMDQ score was obtained by the sum of the items ticked, with higher scores representing higher disability levels.[34] These outcomes and assessment methods are aligned with the best practice recommendations for conducting epidemiological studies on LBP.[35]

Data on self-reported physical activity at baseline were collected using different tools, including the IPAQ long version,[19 36] the Physical Workload Index Questionnaire[37] and the Recent Physical Activity Questionnaire.[38] These questionnaires provide data on different types of physical activity, for example, recreational, leisure, work related and dosage (duration, frequency and intensity) of physical activity. The IPAQ long form assesses time spent and the intensity of five domains of physical activities: work, transport related, household, leisure time and sitting time.[36] Scores on IPAQ are reported as total time (min) and Metabolic Equivalents (MET) (min) spent in different activities and domains during a week, and were calculated according to the IPAQ protocol.[39] The Physical Workload Index questionnaire was used to assess the

workload forces on the lumbar spine while in different postures described in the questionnaire.[37] The total workload force was calculated according to the questionnaire protocol formula.[37]

We have also collected, at baseline, other variables known to have an impact on LBP and physical activity, including depression, sleep quality, smoking status, anthropometric and demographic data. The Depression Anxiety Stress Scale (DASS-21)[40] was used to assess participants' levels of depression and anxiety. The cut-off points for each component were: depression ≤9; anxiety ≤7 and stress ≤14.[40] Sleep quality was collected using the Pittsburgh Sleep Quality Index (PSQI).[41] Scores for this questionnaire range from 0 to 21 points, with scores higher than 5 points regarded as poor sleep quality.[41] Smoking status was collected using the question 'regarding your smoking habit, how would you classify yourself?': non-smoker, ex-smoker, occasional or current smoker. Participants also provided their date of birth, weight, height and hip and waist circumferences. The weight and height measurements were used to calculate body mass index (BMI). Waist and hip circumferences, measured using a tape measure posted to participants together with detailed instructions in how to perform these measurements, and these information can be used to calculate waist-hip ratio in order to classify participants' central obesity.[42]

Follow-up questionnaires (weekly, monthly and midterm)
After the completion of the baseline questionnaire, participants received weekly SMS or email and monthly questionnaires for 12 months. In the weekly survey,

Table 5 Weekly prevalence of LBP in participants with complete 12-month follow-up data

Variables	N (participants)	N (12-month episodes)	Average of days or intensity (0–10)
Text message sent	168	7150	
Text message completion	168	6945	
LBP last 7 days (yes)	131	1422	
LBP duration (days)	131	1325	35.1±56.0
LBP intensity (intensity) (0–10)	130	1323	3.2±1.8*
Activity limitation (yes)	70	277	
Work activities	27	148	17.3±47.1
Social activities	21	62	7.4±12.6
Sports	38	73	4.1±5.6
Hobbies	18	54	6.0±8.2
Intimacy	23	73	12.5±27.1
Chores	38	179	14.8±39.8
Treatments sought (yes)	55	259	
General practitioner	8	12	1.5±1.1
Physiotherapist	22	97	4.4±6.2
Chiropractor	10	40	4.0±2.7
Emergency department	2	3	1.5±0.7
Surgery	3	4	1.3±0.6
Other	16	67	2.3±1.4
Medication (yes)	78	438	
Non-opioid	56	314	13.0±37.2
Weak opioid	11	100	27.6±34.6
Strong opioid	2	5	5.0±1.4
Antidepressants	2	15	42.0±28.2
Other	9	59	4.5±11.5
Self-treatment (yes)	131	776	
Heat pack	47	346	20.0±42.1
Bed rest	24	116	7.0±7.5
Light exercise	60	407	26.0±47.5
Hot shower	50	290	23.9±55.6
Book and reading information	7	16	4.0±2.9
Other	25	108	8.3±13.6

*Intensity measured on scale 0–10.
LBP, low back pain.

participants were asked about their LBP status (yes/no). In case participants reported having LBP during the week, other subsequent questions were asked, such as 'could you please recall whether you were doing any of these tasks 2 hours before your LBP started?' (eg, bending, doing moderate physical activity, etc), the number of days suffering with the symptoms, pain intensity using the 0–10 NPRS, and activity limitation due to LBP (yes/or). If a participant's answer was affirmative for activity limitation, then subsequent questions regarding which types of activities (eg, work, socialisation, sports) and the number of days limited were asked. Furthermore, participants reporting LBP were asked whether they had sought treatment during the week (yes/no), which healthcare professional they saw (eg, General practitioner, physiotherapist) and the frequency of treatment during the week. Lastly, participants were asked regarding any self-treatment or medication (including types of medication) used due to LBP and the frequency.

Monthly data on physical activity was collected with the electronic version (through an email link) of the IPAQ questionnaire, asking about the frequency (days) and duration of engagement in physical activity of various intensities (low, light, moderate and vigorous) in the last 7 days. Participants also received a midterm questionnaire (6 months follow-up) that collected the same data as the baseline questionnaire, except for the ActiGraph data. Table 1 presents the timeline for data collection at the baseline, weekly, monthly and midterm follow-ups.

FINDINGS TO DATE
Sample characteristics
A total of 401 participants have consented to participate in the study and completed the baseline questionnaire to date. From those, 157 (n=314) are complete twin pairs (both twins in the pair were included and provided data) and 87 individual twins (only one twin in the pair was included). A total of 262 monozygotic twins (MZ) and 139 dizygotic twins (DZ) were included. The majority of the sample was female (73%) and non-smoker (82%). The mean age was 53 (SD=13) years old, with a mean BMI of $25 \, \text{kg/m}^2$ (SD=4) (table 1). Overall, participants reported a normal mean score on DASS in all three DASS components: depression: 3.8 (SD=6.7), anxiety: 3.2 (SD=5.4) and stress: 7.3 (SD=7.6). Overall participants reported poor sleep quality with a mean PSQI score of 6.4 (SD=3.1) (table 2).

Baseline data
LBP outcomes
Table 3 presents the data on LBP status at baseline for all participants stratified by complete pairs (data available from both twins in a pair) and individual twins (data available from only one twin in a pair). The inclusion of single twin pairs (individual twins) increases the study sample size and statistical power. For instance, twins can also be analysed as individuals using statistical techniques that account for the paired structure of the data, which can be an important as a first step in estimating the strength of an association before controlling for familial confounding. This association is further compared with subsequent analyses which only complete pairs are included and

therefore adjusted for early shared environmental and genetic factors (50% for DZ and 100% for MZ)[43]

The majority of the cohort (85% (n=342)), reported having at least one episode of LBP during their lifetime, of which 186 (55%) participants had usual activities limited because of LBP, and 162 (48%) reported having had a recent LBP episode (within the last 4 weeks). From those 162 participants, 43 (27%) individuals reported being currently receiving some form of treatment, and 95 (62%) reported suffering from pain for at least 3 months. The average pain score on an 11-point scale was 3.0 (SD=1.8) for those who reported having LBP in the last 4 weeks. Considering all 401 participants included in the study, a total of 174 twin individuals (52%; 106 MZ; 68 DZ) reported a history of LBP (lifetime prevalence) but were pain-free in the last 4 weeks.

The cohort comprises 157 complete twin pairs (314 twins), of which 120 pairs (240 twins) are concordant for lifetime prevalence of LBP (ie, both twins in the pair reported having or not LBP); while 27 pairs (54 twins) were discordant (ie, one twin in the pair reported no previous episode of LBP during his/her life, whereas the other twin did). Considering those who answer the question of having LBP in the past 4 weeks (262 twins), 52 pairs (n=104) were discordant, while 24 (n=48) and 31 (n=62) twin pairs were concordant for having had and not having had LBP, respectively. In general, among participants who reported LBP in the last 4 weeks, 59% reported suffering from pain that lasted for at least 3 months. From those who reported pain in the last 4 weeks, 33% were receiving some form of treatment for their LBP. In addition, considering all 157 complete pairs, a total of 31 twin pairs (n=62; 44 MZ and 18 DZ) reported a history of LBP but were pain-free in the last 4 weeks (table 3).

Physical activity

Objective and self-reported data on physical activity are reported in table 4. Overall, 369 (92%) from the total cohort of 401 participants provided valid accelerometer data. In general, participants spent 61%, 35% and 4% of their time awake time in sedentary, light, and moderate/vigorous intensity, respectively. The average number of steps per day was 7779 (SD=3278). Based on the WHO recommendations of 10 000/day[44] for individuals to be classified as physically active, only 23% (n=85) of the sample met the recommendations. The IPAQ long-form showed that participants on average spent more time in sedentary activities (sitting=2516 (SD=1353) min/week) than in a combination of walking, moderate, and vigorous activities (total=1465 (SD=1489 min/week)). When considering different types of physical activity domains (work, transportation, domestic and leisure time), participants were more active during work (1939 (SD=4972 MET-min/week)) and domestic (2006 (SD=2784 MET-min/week)) related activities than in transportation ((698 SD=1101)) or leisure time (1421 SD=2005)) activities. The mean score for the Physical Workload Index was 11.4±9.1 (range of 0 to 56), with

higher scores representing greater mechanical loads on the spine associated with body posture and weight lifting during work (table 4).

Response rate and weekly data on LBP

Although study recruitment is completed, the weekly and monthly data collection are currently underway (as of 30 October 2019). To date, 168 (41%) participants have completed the 12-month follow-up. Overall, these 168 participants received a total of 7150 text messages, with 6945 being responded, resulting in a completion rate of 97%. Table 5 shows the LBP weekly status for participants who completed the 12-month follow-up. A total of 131 participants (78%) reported pain in at least 1 week from those who completed a 12-month follow-up. The yearly average of days reporting pain (considering only those who reported LBP during at least 1 week) was 35.1 (SD=56.0) days per participant, with an average intensity of 3.2 (SD=1.8) on the 0–10 NPRS. Seventy participants (54% of those reporting LBP during at least 1 week) reported activity limitation due to LBP. A total of 55 participants sought care for their LBP, representing 42% of those who reported suffering from LBP during at least 1 week. Physiotherapists were the most commonly seen healthcare professionals (total of 97 consultations) with a yearly average of 4.4 (SD=6.2) days of physiotherapy. Seventy-eight participants (60% of those reporting LBP during at least 1 week) reported having used some form of pain medication, with non-opioids being the most frequently used, with an average per year of 13.0±37.2 days for those participants who reported LBP and used non-opioids for at least 1 week. Moreover, 131 participants reported practising some form of self-treatment (eg, using a hot package) during at least 1 week.

Response rate and monthly data

Considering participants (n=168) who have completed the 12-month follow-up, 1905 monthly online IPAQ physical activity questionnaires were sent, of which 1763 were answered, resulting in a completion rate of 92%. The monthly average physical activity engagement was categorised into low, moderate, and high intensity per each completed monthly questionnaire.

The average time (minutes per week) of physical activity participation was: low intensity activity=206 ± 216, moderate intensity=109 ± 176 and vigorous intensity=80 ± 143.

STRENGTHS AND LIMITATIONS

A key strength of the AUTBACK study is the feature of a cohort of twins with frequent data on LBP and physical activity, with participants representing a variety of LBP phenotypes, including those with a history of activity-limiting LBP, current LBP, no previous history or current LBP and a previous history of LBP but fully recovered. Another novelty of the study is the assessment of different physical activity domains and the frequent assessments

Table 6 Possible futures studies using the AUTBACK data

Research question	Description	Design	Features
Risk of LBP	What type and dosages of physical activity is a risk or protective for LBP?	Longitudinal	Participants reporting being free of LBP at baseline. Outcome: incidence of LBP during follow-up
Prognosis of LBP and physical activity	Effect of physical activity on LBP prognosis	Longitudinal	Participants reporting LBP in the past 4 weeks at baseline. Outcome: recovery of LBP at follow-up
Recurrence of LBP and physical activity	Physical activity and LBP recurrence	Longitudinal	Participants with a history of LBP but pain free at baseline. Outcome: new episode of LBP at follow-up
Medication intake and physical activity	Does physical activity reduce medication intake in people with LBP?	Longitudinal	Participants with LBP at baseline. Outcomes medication intake during follow-up
Trajectory of LBP	Trajectories of LBP	Longitudinal	Participants with LBP at baseline
Trajectory of physical activity	The pattern of physical activity throughout a year in people with and without LBP	Longitudinal	Participants with and without LBP at baseline with 1-year data on physical activity
Recurrence of LBP and physical activity: controlling for familial factors	Types and dosages of physical activity and recurrence of LBP: twin-case control	Longitudinal Case–control	Twin pairs with a history of LBP, concordant for LBP free status at baseline and discordant for recurrent LBP
Low back pain and care-seeking behaviour: controlling for familial factors	Types and dosages of physical activity and care-seeking for LBP: twin case–control	Longitudinal Case–control	Twin pairs with a history of LBP, concordant for LBP free status at baseline but discordant for care-seeking

AUTBACK, AUstralian Twin BACK; LBP, low back pain.

of physical activity and LBP status, with the additional possibility of controlling for the influences of genetic and familial factors in analytical models. The cohort presents a variety of opportunities for study designs and data analyses. For instance, twin pairs concordant for a history of LBP but free of LBP at baseline (both twins in the pair recovered from an episode of LBP) provide the opportunity to investigate if the amount of time spent in different forms of physical activity (eg, vigorous, light, moderate) at baseline (objectively measured) predicts the intensity of pain measured repeatedly over 12 months when controlling for familial factors. Conversely, due to the large number of frequent assessments of LBP and self-reported physical activity, it is also possible to investigate the trajectory of pain in relation to the pattern of physical activity engagement over time and the contribution of genetics and the early familial environment on participants' trajectory of symptoms. More examples of study designs that can be implemented with AUTBACK data are provided in table 6.

The study employs objective and self-reported measures comprising different physical activity domains (work related, home, transportation and leisure), which will provide data for the investigation of the types and dosages that may prevent, cause or worsen LBP. In additional, there is an opportunity to obtain participants' occupation data from TRA to investigate the effect of different types of physical activity on different working groups, given

that different occupations are likely to benefit from, or to be harmed by, different types and amounts of physical activity.[45] AUTBACK data will also be important to frame physical activity (eg, leisure/work-related physical activity), as well as physical behaviour (physical activity and sedentary time) as compositional analysis, which can be considered for the implementation of future studies. The study also collects data on comorbidities and lifestyle factors such as stress and depression, sleep quality and smoking, which can allow for the effective control these confounders in future analyses. Moreover, the use of an online data collection system yielded a high response rate and made it possible to include participants across Australia, regardless of their location (rural or urban) or age—making this a representative and comprehensive cohort.

A potential limitation of the AUTBACK study is that ActiGraph data were only collected at baseline. We also collected objective data on physical activity from participants at the 6 month follow-up for a subsample of 140 participants. However, we received feedback from participants that wearing the device twice during the study was too burdensome, and therefore, we decided to remove the ActiGraph measurement at the 6-month-follow up to minimise the burden on participants and optimise response rates for the questionnaires. Furthermore, at baseline, not all participants provided valid objective data of physical activity (ActiGraph). The ActiGraph devices

were mailed to participants, but 12 ActiGraph units were damaged or lost, and not all participants achieved the minimum validation wearing time. However, the total number of participants (n=369) who worn the device is a representative sample for this study, and completeness rate was higher (92%) when compared with other similar studies that employed objective assessment of physical activity reporting response rates of 66%–90%.[46–49] Another limitation of the study is that we do not have access to the data for those participants that did not express interest in participating in the study due to ethical reasons, and therefore, it is not possible to perform a response analysis on included and non-included participants.

FUTURE DIRECTIONS AND COLLABORATIONS

We expect to complete the 12-month follow-up for the whole sample by July 2020. Since this cohort is composed of participants with various LBP status, we will be able to answer various questions regarding the relationship between physical activity and LBP according to the participant's pain status. The AUTBACK working group is designing a series of research projects, with the main one being the investigation of the relationship between different types or dosages of physical activity and recurrence of LBP in people with a history of LBP but symptom-free at study baseline. The advantage of having both twins in a pair enables a higher level of adjustment for genetic and early shared environmental confounders in the analyses. As a result, twin samples commonly enable a more precise estimate of environmental effects (eg, physical activity), with greater statistical power compared with non-twin studies.[23]

We also plan to investigate factors that may influence care-seeking behaviour associated with LBP (eg, healthcare visits and use of pain medication). Data linkage opportunities that are possible through TRA include state-level patient and hospitalisation data and nationwide data from the Medicare benefits Schedule, the Pharmaceutical Benefits Scheme and data from other studies conducted by TRA. This could allow for new research questions to be explored, bringing additional value to the AUTBACK study and potentially making it a compelling resource from researchers in other disciplines. AUTBACK can also be combined with other international cohorts that have collected similar data, including data on LBP and physical activity. We did not collect biosamples, although this could be undertaken by future researchers who could consider linking biosample data to the current available data collected in AUTBACK. The AUTBACK team welcomes collaboration and research proposals from researchers with expertise in LBP.

AUTBACK is a cohort of participants with objective and self-reported data on different types and domains of physical activity and frequent data on LBP presentation and associated care-seeking behaviour. The study will provide high-quality data for the investigation of the relationship between physical activity and LBP while controlling for important confounders, including genetic and other familial factors.

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