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Perceptions of gym staff toward resistance training technique in New Zealand

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ABSTRACT

Purpose: To gain understanding of New Zealand gym staff's perceptions towards resistance training exercise technique of gym users using knowledge, attitudes, and behaviour [KAB] related questions, and to understand whether any fitness trends are emerging that are likely to cause injury. Methods: A Qualtrics XM online survey was distributed to staff of a gym chain in New Zealand. Questions probed respondents KAB towards resistance training exercises performed with poor or unsafe technique and those perceived to cause musculoskeletal injuries of the lower back and shoulders. Results: Ninety-nine full and partial responses are reported. Knowledge of respondents highlighted deadlifts, squats, cleans/clean & press, push ups, and chest press are frequently performed with poor and unsafe technique and perceived to cause injury. Ninety-six percent of respondents (n = 53) observed poor technique more than 40% of the time. All respondents perceived gym users were only sometimes or rarely aware of their poor technique, and 64% (n = 35) perceived gym users do not understand the link between poor technique and injury. Attitudes revealed that 85% of gym staff (n = 46) were only sometimes or never asked for help with performing exercises. Behaviours of respondents emphasised 62% (n = 33) would approach someone performing poor technique and 91% (n = 48) would intervene with unsafe technique. Emerging trends likely to cause injury are those that involve high complexity and high-volume training. Conclusions: There is opportunity for Gym Managers to increase knowledge, skills and confidence of Group Fitness Instructors and Personal Trainers for coaching deadlifts, squats, cleans/clean & press, push ups, and chest press technique to novice gym users, through staff training and upskilling. Attitudes can be improved by providing tools to facilitate conversations between gym staff and gym users. Behaviours should focus on building confidence of all gym staff to provide feedback and intervene with poor or unsafe technique.

1. Introduction

Physical activity helps maintain good health and reduce the risk of chronic disease (Dhuli et al., 2022; Warburton et al., 2006). Resistance training exercise can improve muscular strength and bone density (Gómez-Cabello et al., 2012; Nelson et al., 2007). Despite benefits of regular resistance training, many people do not engage in resistance training on a regular basis (Harne & Bixby, 2005; Hurley et al., 2018). Perceived barriers to resistance training are time/effort and the physical hardships of weightlifting (Harne & Bixby, 2005; Hurley et al., 2018). A survey of 432 college students identified physical barriers of resistance training to

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include looking silly and being too uncoordinated (Myers & Roth, 1997). Additional studies have validated these findings and reported a lack of knowledge as a contributing factor amongst females (Harne & Bixby, 2005; Hurley et al., 2018). A recent systematic review and meta-analysis of 20 papers, highlighted inadequate knowledge as a frequent barrier to resistance training, specifically "not knowing how to lift weights", "what to do", "which ones to do", and not remembering how to perform the exercises or how to use equipment (Vasudevan & Ford, 2022).

It has been recommended that weightlifters and bodybuilders receive instruction and supervision to ensure proper technique (Goertzen et al., 1989). However, it is common that recreational resistance training participants and gym users seldom receive formal coaching and often have no formal induction to a gym facility (Crozier et al., 2020). With the rise of 24-hour gyms, gym floor instructor role eliminations with the COVID 19 pandemic, and gym users typically working out alone or with a friend, gym users are often unsupervised and unable to interact with trained gym staff. In a 2014 survey from New Zealand, respondents stated they were actively seeking knowledge and coaching in their sporting endeavours (Sport New Zealand, 2015). It is important that gym users wishing to participate in resistance training are adequately equipped with the knowledge to perform exercises with the correct technique to prevent injury (Haupt, 2001; Mazur et al., 1993).

In New Zealand, citizens and visitors can claim treatment compensation and rehabilitation costs through the Accident Compensation Corporation [ACC] following an accidental personal injury. In 2020 ACC reported an 18% increase in gym injuries in New Zealand over the previous five years (2015 to 2020) with the cost of support rising by 43% (Accident Compensation Corporation [ACC], 2020). In response, our analyses of 10 years (2011 to 2020) of ACC's gym and fitness related injury claims, found the most common cause of injury from gym and fitness activities in New Zealand was lifting/carrying/strain resulting in lower back/spine and shoulder soft tissue injuries (Cuthbertson-Moon et al., 2024). The injury data provided by ACC were deidentified and included a free text "accident description" field which in some cases gave a short description of what the claimant was doing at the time of injury, the words were analysed by word frequency and categorised. The most frequent words relating to exercise were *press, squat, bench, pull, deadlift, up,* and *push* (Cuthbertson-Moon et al., 2024). Common resistance training exercises that result in shoulder and lower back injury include bench press, shoulder press, deadlifts, and squats (Faigenbaum & Myer, 2010; Keogh & Winwood, 2017). Resistance training injuries can occur through a variety of mechanisms, including overuse, sudden trauma, poor technique, fatigue and inappropriate loads are some examples discussed in the literature (Grier et al., 2022; Lavallee & Balam, 2010; Martins Utida et al., 2024). Whilst resistance training is inherently safe in comparison with other sports activities (Serafim et al., 2023) this is a risk that the private fitness sector has a responsibility to mitigate including appropriately qualified staff who act in accordance with their training.

In order to create effective interventions, it is important that practitioners have a thorough knowledge of the incidence, severity and mechanisms of the injuries that their prevention programme is targeting (Finch, 2006; van Mechelen, 1997; van Mechelen et al., 1992). Coaches play an important role in implementation of injury prevention programmes therefore it is crucial gain an understanding of their knowledge, attitudes, and beliefs (Geertsema et al., 2021; McKay et al., 2014; Räisänen et al., 2021). The Knowledge, Attitudes, and Behaviour (KAB) approach is a multi-construct method used to assess and evaluate performance and learning in complex environments, recognizing that learning involves more than just cognitive development (Schrader & Lawless, 2004). KAB studies evaluate not only knowledge, but also attitudinal and behavioural change. The relationship between knowledge, attitudes, and behaviour is complex, dynamic, and potentially reciprocal. Knowledge alone is often not enough to influence behaviour change, interventions should ideally involve all three (Schrader & Lawless, 2004). In concussion research for example an understanding of knowledge, attitudes, and behaviours has proven to identify gaps that can be addresses with targeted initiatives (Theadom et al., 2020).

1.1. Aim

We developed a survey to question gym staff on their observations. One aim of the survey was to gain an understanding of New Zealand gym staff (Group Fitness Instructors, Gym Managers, Personal Trainers) observations of gym users resistance training exercise technique and the link to musculoskeletal injury, using questions relating to gym user knowledge of poor technique and injury. Another aim was to understand gym staff knowledge of which resistance training exercises were perceived to contribute the most to shoulder and lower back injuries in the gym environment, and what technique faults the surveyed gym staff commonly observed during gym user practice. Attitudes and behaviours were linked to questions regarding gym staffs' observation of gym users performing poor and unsafe technique and what the gym staff would do in this scenario. To help prepare for future gym injury types, an additional question was asked to the gym managers to describe any emerging fitness trends they observe to be causing injury amongst gym users. The purpose of gathering the information was to aid the development of an intervention study targeted at providing gym users with exercise technique coaching.

2. Methods

Ethical consent for the research was obtained from the Auckland University of Technology Ethics Committee [AUTEC] (22/108), and informed consent was collected from each participant at the time of the survey.

2.1. Participants and recruitment

A survey link was emailed to the Fitness Managers of a New Zealand gym chain by the project team (BH) and disseminated by the Gym Managers of the 12 gyms to their teams of Personal Trainers and Group Fitness Instructors. The survey was open from 1st June 2022 until 15th September 2022. Two reminder emails were sent during this period. Participation was anonymous and voluntary.

2.2. Survey method and questionnaire

The online survey developed using Qualtrics XM (Qualtrics, SAP, Seattle, WA, USA) (Supplementary Table 1) consisted of a maximum of 21 questions and took approximately 10 minutes to complete. The survey was used to assess knowledge and behaviours toward gym user resistance training exercise technique and the link to injury. The design of the questionnaire was based on those from previous studies (Murphy, 2015; O'Reilly et al., 2020; Theadom et al., 2020). Questions related to respondents' experiences, opinions, and observations regarding poor and unsafe resistance training exercise technique and to rank a selection of exercises commonly associated with shoulder and lower back injuries. The Checklist for Reporting Results of Internet E-Surveys [CHERRIES] (Eysenbach, 2004) was used to aid survey design (Supplementary Table 2).

Respondents were requested to rank order a set of exercises that they perceived to cause the most risk of shoulder and lower back injuries. Rank order data were extracted from Qualtrics in raw data format and the weighted average calculated in Microsoft Excel. In addition, respondents were asked to select exercises, from a list provided, where they typically observe technique-based faults, and poor or unsafe technique. Respondents were also asked to state the specific faults commonly observed for the exercises selected in a free text format.

Gym managers were requested to rank order specific exercises in terms of their contribution to gym user injuries, "Based on your experience, please reorder the following exercises to rank in terms of their contribution to gym user injuries (1 = most likely to result in injury, 10 = least likely to result in injury)." Gym managers were asked how they train their staff to observe and approach gym users performing unsafe technique, and what additional resources, if any, would be needed to assist with staff training. Gym managers were also asked a question relating to the emerging fitness trends that they perceive to be associated with an increased risk of injury.

2.3. Data analysis

All data were exported into a Microsoft Excel spreadsheet (Microsoft Excel for Mac 16.70, Microsoft Corporation, Redmond, WA, USA). Percentages and weighted averages were calculated using Microsoft® Excel and free text entries were analysed in NVivo® for Mac (NVivo 1.6.2, QSR International Pty Ltd, Burlington, MA, USA.) the top five words were tabulated, and word clouds generated.

3. Results

Of 122 individuals who clicked the survey link and agreed to participate in the survey, 99 respondents either fully or partially completed the survey (81.1%), while 23 took no further action. There was a median time of 7.7 minutes to complete the survey. Results are reported for the 99 fully or partially completed responses and question specific sub-groups.

3.1. Respondent demographics

Responses came from a total of 99 Group Fitness Instructors, Gym Managers and Personal Trainers, located at 12 gyms throughout New Zealand; 61% of respondents ($n = 61$) were based in Auckland, 16% ($n = 16$) were based in Wellington, the remaining 23% ($n = 23$) were distributed throughout Christchurch, Dunedin and Hamilton. The industry experience of respondents (i.e., time worked in the fitness industry) varied from less than one year to over 21 years, with 53% ($n = 53$) of respondents having industry experience between three and 10 years (Supplementary Table 3).

Of the 99 respondents, 53 (53%) identified their main role as Group Fitness Instructor, 26 (26%) Personal Trainer, and 20 (20%) Gym Manager (brief role descriptions are provided in Supplementary Table 4). Of the 53 Group Fitness Instructors, 57% ($n = 30$) taught resistance training (e.g., Les Mills BODYPUMP®), 40% ($n = 21$) taught High Intensity Interval Training [HIIT] (e.g., Les Mills GRIT®), and 9% ($n = 5$) taught functional training (e.g., CROSSFIT®, Les Mills CEREMONY®). A Group Fitness Instructor may teach one or multiple class types (Table 1).

Table 1: Types of group exercise classes taught by respondents.

Class Type	Number	Percent (%)
Strength Training (e.g., Les Mills BODYPUMP®)	30	57
Cardio (e.g., Les Mills BODYCOMBAT®, Les Mills BODYATTACK®)	26	49
Cycling (e.g., Les Mills RPM®, Les Mills SPRINT®, Les Mills THE TRIP®)	23	43
HIIT (e.g., Les Mills GRIT® series)*	21	40
Core training (e.g., Les Mills CORE® and Les Mills TONE®)	21	40
Yoga/Pilates (including Les Mills BODYBALANCE®)	12	22
Dance (e.g., Les Mills BODYJAM®, Les Mills SH'BAM®, Les Mills Barre®)	8	15
Step Aerobics (e.g., Les Mills BODYSTEP®)	7	13
Functional Training (e.g., CROSSFIT®, Les Mills Ceremony®)*	5	9
Other	1	2

Note: *Les Mills GRIT® and Les Mills Ceremony® include a significant component of resistance training.

The 53 Group Fitness Instructor respondents were asked a follow up question whether they coach or had coached resistance training to determine their suitability to answer the questions. If they answered "no" to this question (n = 34) the survey ended, while if they answered yes (n = 19) they survey continued. Two Group Fitness Instructors answered yes but did not complete the remainder of the survey (drop out). There were also one Gym Manager drop out and four Personal Trainers who dropped out. The 17 Group Fitness Instructors with experience in coaching resistance training, along with 19 Gym Managers, and 22 Personal Trainers, resulted in a total of 58 respondents who went on to fully or partially complete the remainder of the survey (Supplementary Figure 1).

3.2. Knowledge of musculoskeletal injuries and resistance training

Cleans/clean & press, and overhead shoulder press were ranked joint first as the exercises perceived to have the greatest risk of shoulder injuries, chest press/chest fly was the third highest ranked exercise (Supplementary Table 5). Deadlift was ranked the highest risk exercise for lower back injury, followed by squats and cleans/clean & press (Supplementary Table 6).

Analysis of responses to the free text fields to identify "other" exercises perceived to result in shoulder and lower back injuries revealed bench press and shoulder rotator raise to be the most frequently stated for shoulder injury, while the leg press and hip/glute bridge for lower back injury (Figure 1).

Shoulder injury "other" (9 responses)		Lower back injury "other" (10 responses)	
Word	Weighted percent (wt.%)*	Word	Weighted percent (wt.%)*
press	19	bridges	10
bench	10	hip	10
machine	10	leg	10
rotators	10	press	10
side	10	abdominals	5



Figure 1: Word frequency of the top five words and word cloud for all or free text descriptive entries for "other" exercises that were perceived to put people at risk of shoulder and lower back injury. *Note:* *percentages do not add up to 100% because only the top five words are presented in the table.

3.3. Gym user technique of specific exercises

Of the respondents, 54 answered the question "*what exercises (including free weights and resistance machines) do you typically observe technique-based faults or unsafe technique"* Deadlift (91%, n = 49), squat (89%, n = 48), push up (76%, n = 41), cleans/clean & press (72%, n = 39), and chest press (63%, n = 34) were the most frequently selected exercises by respondents observed to be performed with poor or unsafe technique (Figure 2). Common answers for technique faults associated with the five most selected exercises were as follows; deadlift; *rounding of the back*, squats; *knee alignment* and *forward lean*, push up; *hand alignment and core control*, cleans/clean & press; *cleaning the bar away from the body,* and chest press; *bar above the shoulders. "*Other" exercises performed with poor or unsafe technique were selected 13% (n = 7) of the time and named by respondents in the free text field, were *kettlebell swing* (n = 2), *box jumps* (n = 2), and *lunges* (n = 2) (Table 2).

Table 2: Summary of typical technique faults observed by the gym staff for the named exercises.

Exercise	Common technique faults observed
Deadlift	Arched back, rounded back, posture.
Squat	Knee alignment, knees caving in, chest tipping forward, performing a '*good morning' exercise* rather than a 'squat'.
Push up	Core activation, hand/elbow position.
Cleans/clean & press	Reverse curling the bar, cleaning away from the body.
Chest press	Bar above shoulders/head, grip.
Bent over row	Rounded back.
Overhead shoulder press	Overextending, leaning back.
Lat pull down	Behind head, rocking.
Lateral raise	Swinging /shrugging the weight.
Biceps curl	Swinging the body.
Chest fly	Range.
Triceps dip	Shoulder positioning.
Upright row	Hand/wrist position, rounded shoulders.
Triceps extension	Elbow flare, rounded shoulders.
Pull up/chin up	Scapular control.
Other	Lunges, kettlebell swings, box jumps.

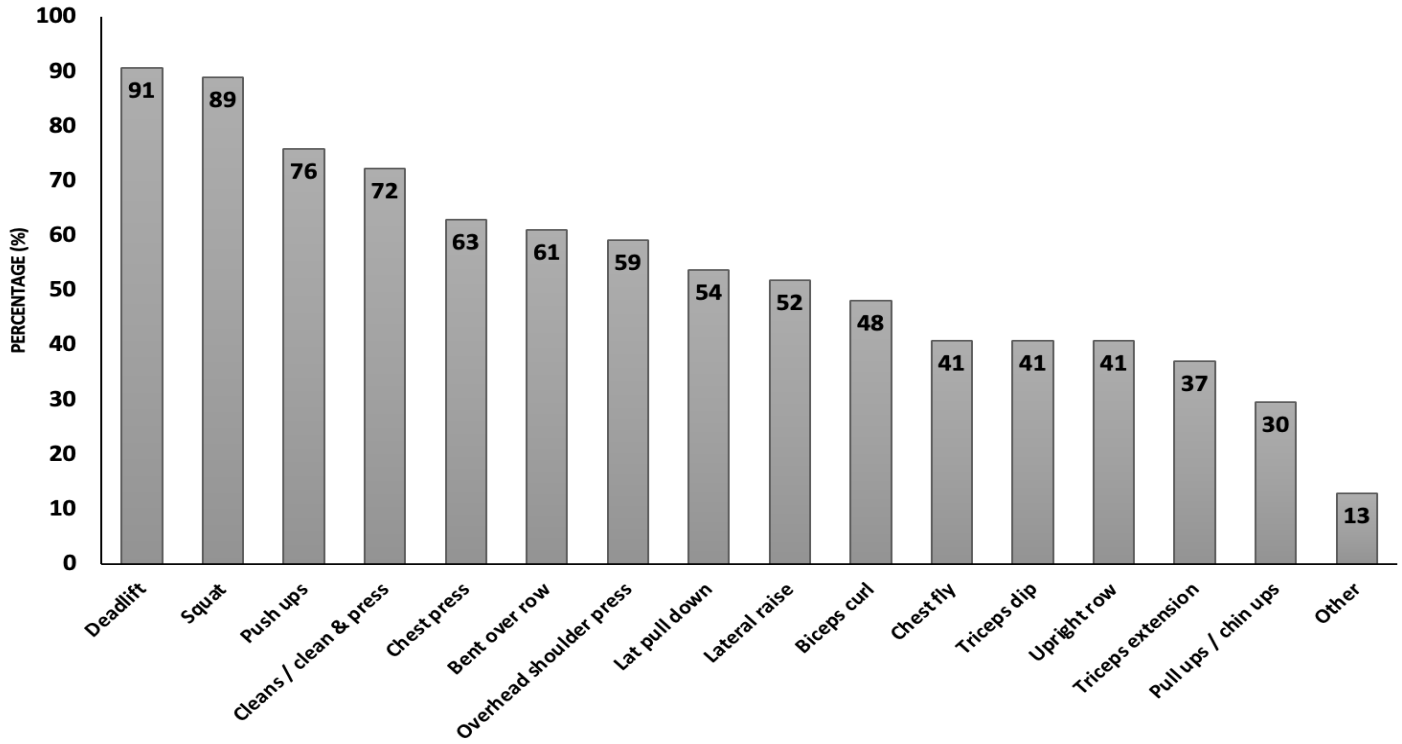


Figure 2: Percentages (%) of respondents that selected exercises for the question "What exercises (including free weights and resistance machines) do you typically observe technique-based faults or unsafe technique?" (Total respondents n = 54).

For the 16 Gym Managers who answered this question, deadlift was the highest ranked exercise most likely perceived to result in injury, followed by squats, cleans/clean & press, chest press, and overhead shoulder press (Supplementary Table 7). Regarding staff training, a variety of responses were obtained from Gym Managers. The most common theme amongst Gym Manager responses was gym staff education through training and upskilling, and effective communication with gym users. A representative selection of responses is summarised in Supplementary Table 7. When asked what additional information Gym Managers needed to train and assist gym staff in observing and intervening to prevent gym user injury, training resources was the most emphasised response (Supplementary Table 8).

3.4. Emerging fitness trends resulting in injury

Emerging fitness trends observed by Gym Manager respondents were coded and analysed using thematic analysis (Braun & Clarke, 2006, 2012). The most frequent words were "CrossFit", 'training", "activation", "exercise", and "fast" (Figure 3 provides weighted percentages and a word cloud). Ten of the 16 responses (63%) indicated workouts that incorporated high complexity or high-volume training, including CROSSFIT®, and HIIT. Other comments can be grouped thematically into *type of workout*, "WODs", "bootcamp", "plyometric"; *style of training* "explosive", "compound", "volume"; *equipment* "Olympic", "bands"; *movement or movement pattern* "handstands", "pressing", "squats", "deads"; *intensity* "tempo", "max"; *body part* "shoulder", "glute", "core".

Word	Weighted percent (wt.%)*
CrossFit	7
training	4
activation	3
exercise	3
fast	3

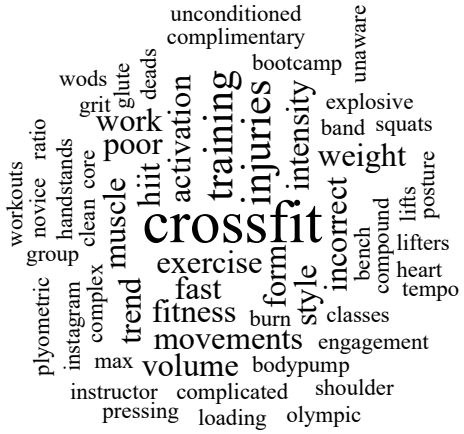


Figure 3: Word frequency of the top five words and word cloud of most frequent words in free text form for the question "Are there any emerging fitness trends that are resulting in injuries?" *Note:* *percentages do not add up to 100% because only the top 5 words are presented in the table.

3.5. Attitudes towards musculoskeletal injuries and resistance training

The survey asked four questions related to observations of technique within the gym (Table 3). All 53 respondents stated they had observed poor technique in the gym and 96% (n = 52) stated they had observed poor technique from gym users moderately often (more than 40% of the time), 57% (n = 31) observed poor technique often (more than 60% of the time), and 30% (n = 16) observed poor technique very often (more than 80% of the time). All 53 respondents perceived that gym users are rarely or only sometimes aware they are performing poor technique, and no respondents reporting that they perceive gym users to be often or very often aware of their poor technique. Only 36% (n = 19) believed that gym users are aware of the link between poor technique and injury. When questioned about how often they were sought to help with performing exercises by gym users, 9% (n = 5) of gym staff respondents stated they have never been asked for help, 85% (n = 45) reported sometimes being asked for help, and only 6% (n = 3) were often asked for help.

Table 3: Survey questions relating to technique.

How often do you see poor technique? (% of time)	Percent of respondents (%)	Number of respondents (n = 54)
Never (0%)	0	0
Very Rarely (0-20%)	0	0
Rarely (20-40%)	4	2
Moderate (40-60%)	39	21
Often (60-80%)	28	15
Very Often (80%+)	30	16
How often do you think gym users are aware they have poor technique?		
Rarely	43	23
Sometimes	57	31
Often	0	0
Very often	0	0
Do you think gym users link poor technique to injury?		
Yes	36	19
No	64	35
Do gym users ask for help with performing exercises?		
Never	9	5
Sometimes	85	46
Often	6	3
Very often	0	0

Gym Staff were asked about their confidence to approach someone performing poor technique who was at risk of injury. Of the 53 respondents who answered this question 47% (n = 25) felt confident to approach someone who is working out with poor technique and at risk of injury. Fifty-three percent (n = 28) of the respondents either did not feel confident, or sometimes felt confident to do so (Table 4). Of the 28 respondents that did not feel confident or sometimes felt confident to approach someone working out with poor technique at risk of injury, 13 were Group Fitness Instructors, eight were Personal Trainers, and seven were Gym Managers.

Moreover, 53% (n = 28) of gym staff respondents did not feel confident all or some of the time to approach someone who is exercising with poor technique and at risk of injury. They were asked the follow up question, "what additional education or training would be useful to enable you to feel confident to approach someone performing poor technique?" Seven of 28 respondents (25%) felt that approaching a gym user may not be well received.

Table 4: Confidence to approach gym users at risk of injury.

Do you feel confident to approach someone working out with poor technique at risk of injury?	Percentage of respondents (%)	Number of respondents (n = 53)
No	13	7
Sometimes	40	21
Yes	47	25

Nine respondents (32%) stated they need specific training or tools to feel confident to approach gym users, and/or felt that having a culture where any member of staff may approach a gym user for safety reasons would improve their confidence. Four gym staff respondents (14%) stated they felt unqualified or needed more personal knowledge to be able to feel confident to approach someone on the gym floor performing poor technique at risk of injury. Four gym staff respondents (14%) stated that it was not their job, or they did not have the time, three of these respondents identified their role as Group Fitness Instructor.

3.6. Behaviours towards musculoskeletal injuries and resistance training

Gym staff respondents (91%, n = 53) answered free text behaviour related questions regarding approaching gym users performing poor or unsafe technique. When observing a gym user performing *poor technique* 62% (n = 33) of respondents who answered these questions stated they would approach them, 17 of the respondents were Personal Trainers, eight were Gym Managers, and eight were Group Fitness Instructors. When observing *unsafe technique* 91% (n = 48) would approach, 23 of the respondents were Personal Trainers, 15 Gym Managers, and 10 Group Fitness Instructors. When asked what recommendations they would provide to someone exercising with unsafe technique and at risk of injury, 94% (n = 50) of gym staff responded. Fifty-eight percent (n = 29) of respondents stated they would approach to offer advice about correct form regressions, or alternative exercises, 12 of these respondents were Personal Trainers, 10 were Gym Managers, and seven were Group Fitness Instructors. Thirty-six percent (n = 18) stated they would approach to recommend a personal trainer, of these respondents, eight were Gym Managers, six were Personal Trainers, and four were Group Fitness Instructors.

4. Discussion

Whilst poor technique is not a sole trigger for injury, the recommendation to learn proper technique (Hume & Marshall, 1994) and to be supervised during resistance training is well established to prevent injuries (Jones et al., 2000; Risser, 1990).

This study highlighted resistance training exercises that are commonly performed with poor and unsafe technique, and those that are likely to cause shoulder and lower back injuries as perceived by gym staff, these results are to be intended to add to our findings from the ACC injury analysis (Cuthbertson-Moon et al., 2024).

When asked to think about poor and unsafe technique that can lead to resistance training injury, only 36% of all gym staff surveyed perceived that gym users actively link poor technique to injury. Gym staff respondents also identify that gym users are rarely or only sometimes aware that they have poor technique. The gym staff questioned revealed that they are only sometimes asked for help when performing an exercise. A brief evaluation of the literature uncovered some potential barriers that gym users may have when asking for help, the fear of being judged, weight stigma (Auster-Gussman et al., 2021), cultural norms in a highly male dominated environment can make particular gym users feel uncomfortable, often causing them avoiding certain areas and times of the day (Cowley & Schneider, 2025). Some gym users report they know they are doing something that might cause injury but carry on regardless (Pelters, 2024). Perceived obstacles can often result in gym users performing risky behaviours, unsafe exercise modification, unsupervised exercise, and a reluctance to ask for help.

Moving on to the point that gym staff do not always feel confident to approach someone exercising with poor or unsafe technique in the gymnasium, an interesting observation within this study was that respondents from all three groups felt this way. Common responses as to why this might be uncovered beliefs that this type of feedback might not be well received by the gym user, that it was not within their role, and that they would benefit from further training on how to approach gym users. Perceived barriers to teachers, coaches and instructors providing feedback reviewed in the literature included: workload (Paris, 2022), concern about negatively impacting the relationship; lack of knowledge or training to give feedback (Karimi Moonaghi et al., 2016) and how feedback was received (Mason et al., 2020). Fostering a culture where any staff member, may intervene for safety reasons could benefit the wider gym floor community, along with the provision of training and tools to aid observation, facilitate conversations, and offer effective feedback (Hattie & Timperley, 2007; Jug et al., 2018; Postal, 2019).

Gym staff identified deadlifts, squats, push ups, cleans/clean & press, and chest press as the exercises where they observe technique faults most frequently. The same exercises were also perceived to be the most likely to cause lower back or shoulder injuries. Improper exercise technique and unfavourable shoulder positioning in exercises like bench (chest) press and overhead pressing with repetition until failure increase the likelihood of shoulder injury (Kolber et al., 2010). The exercises highlighted in this survey are consistent with those from previous studies. For example, our retrospective epidemiological analysis of injury claims revealed injuries occurring through squats, deadlifts, and bench press to be some of the most frequent injuries amongst gym injuries in New Zealand (Cuthbertson-Moon et al., 2024), while a systematic review focused on injuries occurring in the weight training sports where squats, cleans, and deadlifts are performed (Keogh & Winwood, 2017).

Gym Managers gave rich and varied responses about staff training, stating that they train gym staff to observe unsafe exercise technique, and how to approach gym users and communicate with them effectively. Gym staff disclosed that they do not always have the confidence and knowledge to do so. The inclusion of Group Fitness Instructors and Personal Trainers in training sessions on observation of poor and unsafe technique and communication with gym users might be valuable to enable them

to have the knowledge and confidence to approach gym users. This could be delivered during staff onboarding or as part of continuing professional development. Future research might address the content and frequency of training needs to ensure that all gym staff and contractors have adequate knowledge and confidence to approach gym users who are exercising with poor technique and intervene where they are risk of injury.

Gym Managers ranked deadlifts, squats, and cleans/clean & press, as the most likely exercises to result in injury revealing an opportunity to train gym staff to focus on coaching technique in these specific exercises during gym user inductions and personal training sessions, and to run workshops in clubs for novice gym users to gain knowledge of proper technique.

All three groups of gym staff (Group Fitness Instructors, Gym Managers, Personal Trainers) consistently observed the same group of exercises to be performed with poor technique and to be at the highest risk of causing injury, giving weight to the design and implementation of an injury prevention strategy focussing on improving education and technique of deadlifts, squats, cleans/clean & press, push ups, and chest press. There is an opportunity to bridge the knowledge gap of gym users between poor technique and injury, through facilitating dialogue between gym staff and gym users, and fostering a culture where all gym staff may approach gym users for wellbeing and safety reasons. Gym inductions and coaching novice gym users to learn proper exercise technique during the early stages of resistance training is important, and providing the necessary training and tools to both gym users and gym staff may help to address this. Empowering gym users to ask for help to perform exercises when they need it, and empowering all gym staff to be confident to provide that help when asked or when they observe an opportunity for intervention.

4.1. Limitations

The survey was limited to staff from one gym chain, with potential sampling bias. Since the survey was distributed voluntarily by managers, and completed anonymously by respondents, it is not possible to know who or how many people received the survey or to calculate the overall response rate which may result in some participation or non-response bias. The exercises were provided as a list that included common resistance exercises that are performed in a gym, and those highlighted from the ACC gym injury analysis (Cuthbertson-Moon et al., 2024) the list was not extensive however the survey offered the opportunity for respondents to add exercises in an “other” free text entry field. Nonetheless, the study provides valuable insight into staff perceptions that complement injury data and inform intervention design.

4.2. Benefits

The value the current study brings is the focus on observations and perceptions of gym staff towards resistance training technique amongst gym users, giving a fresh perspective on resistance training exercise technique and injury prevention research. The perspectives of gym staff add to our ACC injury epidemiology study to enable us to appropriately design an intervention study aimed at reducing injury risk by focussing on technique coaching of deadlift, squat, chest press, clean/clean & press and push ups for gym users. The key findings were:

- Common injury-prone exercises identified: Gym staff perceive deadlifts, squats, cleans/clean & press, push ups, and chest press as exercises frequently performed with poor technique and most likely to cause shoulder and lower back injuries.
- Prevalence of poor technique observed: Ninety-six percent of respondents reported observing poor technique more than 40% of the time, with common faults including rounding of the back during deadlifts and knee misalignment during squats.
- Gym users' awareness and help-seeking behaviour: Staff perceive that gym users are rarely or only sometimes aware of their poor technique, with 64% believing users do not understand the injury risk. Furthermore, 85% of staff reported being only sometimes asked for help.
- Staff confidence and intervention behaviours: While 62% of staff would approach someone performing poor technique, only 47% felt confident doing so. Barriers to intervention include fear of negative reception and feeling unqualified. However, 91% would intervene when unsafe technique is observed.
- Training and upskilling needs: Gym managers emphasize the importance of staff education, communication skills, and specific training resources to improve observation and intervention capabilities among staff.
- Emerging fitness trends for injury: High complexity and high-volume training styles such as CrossFit® and HIIT are perceived as emerging trends contributing to injuries, particularly involving explosive and compound movements.
- Opportunities for injury prevention: There is scope for gym managers to enhance staff knowledge and confidence through targeted training, focusing on coaching proper technique in key exercises during inductions and workshops for novice gym users.

Conclusions

Understanding gym staff perceptions about resistance training technique is crucial to preventing injuries among gym users. This study surveyed New Zealand gym staff to assess their knowledge, attitudes, and behaviours regarding exercise technique, and its link to musculoskeletal injuries. The knowledge of gym staff toward resistance training exercise technique was consistent amongst the surveyed groups of Group Fitness Instructors, Gym Managers, and Personal Trainers regarding the exercises that they consider to be performed with poor or unsafe technique and those likely to result in shoulder and lower back injuries, and the technique faults typically observed in gym users. Gym staff attitudes indicated that they perceive gym users to only sometimes have an awareness that they have poor exercise technique, and that poor technique can lead to injury. Gym staff are sometimes asked for help by gym users whilst performing exercises. Generally, gym-staff behaviours showed that if they observe someone exercising unsafely, they are likely to intervene and offer

advice or recommend a personal trainer. However, some gym staff self-reported needing more knowledge and empowerment to approach and intervene with gym users performing exercises with poor technique and at risk of injury.

Deadlifts, squats, cleans/clean & press, push ups, and chest press were perceived by gym staff to be the exercises most frequently performed poorly and those most likely to result in lower back and shoulder injuries amongst recreational gym users and group fitness participants. There is an opportunity for Gym Managers to train their Group Fitness Instructors and Personal Trainers to focus on coaching technique of these specific exercises during gym user inductions and personal training sessions, and to schedule periodic workshops for novice gym users to improve their knowledge of resistance training and how to perform the exercises with proper technique.

Disclaimer

Les Mills New Zealand Personal Trainer and Group Fitness Instructor is contractor role and is not employed by the Les Mills organisation, some contractors may have additional employment roles at Les Mills New Zealand or Les Mills International. Gym Managers are employed by Les Mills New Zealand. The views expressed in this manuscript are the respondents own and do not represent those of Les Mills New Zealand or Les Mills International.

Contributors statement

According to the definition given by the International Committee of Medical Journal Editors (ICMJE), the authors listed qualify for authorship based on making one or more of the substantial contributions to the intellectual content of the manuscript: Conceptualization PH, MCM, HW, BH; Ethics PH, MCM, HW; Methodology MCM, PH; Data collection MCM; Data analysis MCM; Data interpretation MCM, PH, HW, BH; Writing—original draft preparation MCM; Writing—review and editing MCM, PH, HW, BH; Project administration MCM, PH. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

MCM is a Group Fitness Instructor contractor at Les Mills New Zealand, MCM started contracting for Les Mills New Zealand after the survey was distributed. BH is a contractor for Les Mills International. There was no financial compensation for conducting this research. There are no conflicts of interest for the other co-authors.

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Appendix

Supplementary Table 1: Survey questions.

Q1. Thank you for agreeing to take part in this survey. Your views are important to our project and will be kept in strict confidence. (Consent provided at this question – details deleted)

Demographics

Q2. Please select the gym at which you work (if you work at more than one location, please select the main gym at which you work).

1. Auckland City
2. Britomart
3. Christchurch
4. Dunedin
5. Hamilton
6. Howick
7. Hutt City
8. Lambton Quay
9. New Lynn
10. Newmarket
11. Takapuna
12. Taranaki Street

Q3. How long have you worked in the fitness industry in one capacity or another?

1. Up to 1 year
2. 1-2 years
3. 3-5 years
4. 6-10 years
5. 11-20 years
6. 21 years and over

Q4. Which of the following best describes your current role? If you have more than one role, please select the one that you spend the most time.

1. Group exercise instructor
2. Personal trainer
3. Gym manager

If Q4 - answer 1 (group exercise instructor).

Q4a. You selected that one of your roles is a group exercise instructor. What group exercise classes do you coach? (Please select all that apply).

1. Strength Training (e.g. BODYPUMP)
2. Functional Training (e.g. Crossfit, Ceremony)
3. HIIT (e.g. GRIT series)
4. Core training (e.g. Les Mills CORE and Les Mills TONE)
5. Cardio (e.g. BODYCOMBAT, BODYATTACK)
6. Cycling (e.g. RPM, SPRINT, THE TRIP)
7. Dance (e.g. BODYJAM, SHBAM, Barre)
8. Step Aerobics (e.g. BODYSTEP)
9. Yoga/Pilates (including BODYBALANCE)
10. Other (please describe)

(if Q4 1. group exercise instructor only selection, and Q4a only 3-9 selected)

Q4b. Have you ever coached strength based, weight training, resistance training, functional training classes or worked as a personal trainer / gym instructor prior to your current role?

1. Yes
2. No

(If no – end screen and thank for participation).

Personal trainer/Group exercise instructor/Gym manager

This part of the survey focusses on resistance training technique and injury. Please use any experience (past and present) in coaching to answer these questions.

Attitudes

Q5. Thinking about both the gym floor and group exercise classes, how often do you see a participant (either supervised or unsupervised) performing poor technique?

1. Never (0%)
2. Very Rarely (0-20%)
3. Rarely (20-40%)
4. Moderate 40-60%
5. Often (60-80%)
6. Very Often (80%+)

Knowledge

Q6. What exercises most commonly put people at risk of SHOULDER injury? (Please reorder the following exercises, 1 = most likely to result in injury, 7 = least likely to result in injury)

1. Chest press/chest fly
2. Lat pull down
3. Cleans/clean & press
4. Overhead shoulder press
5. Upright row
6. Triceps dip
7. Other (please name)

Knowledge

Q7. What exercises most commonly put people at risk of LOWER BACK injury? (Please reorder the following exercises, 1 = most likely to result in injury, 5 = least likely to result in injury)

1. Deadlift
2. Squats
3. Bent over row
4. Cleans/clean & press
5. Other (please name)

Knowledge

Q8. What exercises (including free weights and resistance machines) do you typically observe technique-based faults or unsafe technique?

For each selection, please indicate any specific faults or unsafe technique you observe.

1. Deadlift
2. Squats
3. Chest press
4. Chest Fly
5. Lateral raise
6. Lat Pull down
7. Overhead shoulder press
8. Bicep Curl (BB/DB)
9. Triceps extension (BB/DB)
10. Triceps dip
11. Bent over row
12. Upright row
13. I do not experience poor technique

Behaviours

Q9. When walking through the gym and you see someone exercising with POOR technique what do you do? (free text)

Behaviours

Q10. When walking through the gym and you see someone exercising with UNSAFE technique what do you do? (free text)

Behaviours
Q11. What are the recommendations that you would give to a participant that is exercising unsafely and in risk of injury? (free text)

Attitudes
Q12. If you see someone in the gym performing an exercise with poor technique and is at risk of injury, do you feel confident to approach them?
1. Yes
2. No
3. Sometimes

If yes/sometimes selected display question 12a

Attitudes
Q12a. You indicated that you do not always feel confident to approach someone who you see in the gym performing poor technique.

What additional education or training would be useful to enable you to feel confident to approach someone performing poor technique? (free text)

Attitudes
Q13. How often do you think gym participants are aware they have poor technique?
1. Rarely
2. Sometimes
3. Often
4. Very often

Attitudes
Q14. Do you think participants link poor technique to injury?
1. Yes
2. No

Attitudes
Q15. Do participants ask for help with performing exercises?
1. Never
2. Sometimes
3. Often
4. Very often

Gym manager additional questions

Knowledge
Q16. How do you train the staff to observe and approach gym users and class participants who are exercising with unsafe technique? (Please specify – free text)
1. Exercise specific
2. Injury prevention
3. Other

Knowledge
Q17. What additional information or resources, if any, do you need to train and assist staff to observe and intervene to prevent injury?
(free text)

Knowledge
Q18. Based on your experience, please reorder the following exercises to rank in terms of their contribution to gym user injuries. (1 = most likely to result in injury, 16 = least likely to result in injury).
1. Deadlift
2. Squat

3. Chest press
4. Chest fly
5. Lateral raise
6. Lat pull down
7. Cleans/clean & press
8. Push ups
9. Overhead shoulder press
10. Biceps Curl (DB/BB)
11. Triceps extension (DB/BB)
12. Triceps dip
13. Bent over row
14. Upright row
15. Pull ups/chin ups
16. Other (please name)

Knowledge

Q19. Are there any emerging fitness trends that are resulting in injuries? (free text)

Note: The coding for knowledge, attitudes and behaviours (KAB) and observation (O) did not appear for the survey respondents but is provided for the reader to show the analysis by KABO.

Supplementary Table 2: Checklist for Reporting Results of Internet E-Surveys (CHERRIES) (Eysenbach, 2004).

Item Category	Checklist Item	Explanation
Design		
	Describe survey design	The target population was Group Fitness Instructors, Personal Trainers and Gym Managers at Les Mills New Zealand.
IRB (Institutional Review Board) approval and informed consent process		
	Ethics Approval	The study was approved by Auckland University of Technology Ethics Committee (AUTEC) (#22/108).
	Informed consent	Informed consent was obtained prior to commencement of the survey. Participant information sheet and informed consent described in supplementary table 1.
	Data protection	The survey was anonymous.
Development and pre-testing		
	Development and testing	The survey questions were designed by the project team. Functionality of the electronic questionnaire was tested by the project team and third year students at AUT SPRINZ.
Recruitment process and description of the sample having access to the questionnaire		
	Open survey versus closed survey	The survey was an open survey where anyone with a direct link was able to participate.
	Contact mode	Initial contact of participants was made by BH sending the survey advertisement email to the National Fitness Manager of Les Mills New Zealand. This email was sent to the managers at the 12 Les Mills New Zealand gyms for distribution to their teams of Personal Trainers and Group Fitness Instructors. A reminder was sent
	Advertising the survey	The survey was not advertised, the survey was sent directly to staff at Les Mills New Zealand.
Survey administration		
	Web/E-mail	The survey was an electronic survey hosted by Qualtrics XM (Qualtrics, SAP, Seattle, WA, USA). The link to complete the survey was sent to potential respondents by email.
	Context	Not applicable.
	Mandatory/voluntary	The survey was voluntary. Participants chose whether or not to click the link on the email they received from their manager.
	Incentives	No incentives were offered.
	Time/Date	Responses were collected between 1st June 2022 until 15th September 2022.
	Randomization of items or questionnaires	No randomisation was used.
	Adaptive questioning	Adaptive questioning (logic) was used, certain questions were displayed based on previous responses, (e. g. *If yes/sometimes selected display question 12a)*

Supplementary Table 2 (continued)

Item Category	Checklist Item	Explanation
	Number of Items	The number of questions varied between one and three per page. The survey comprised of 21 questions although due to the adaptive nature of the survey not all questions were displayed.
	Number of screens (pages)	The survey consisted of a maximum of 16 pages.
	Completeness check	All survey questions were deemed to be mandatory, and respondents prompted to complete outstanding items before leaving the survey page (clicking next) on which the item was contained.
	Review step	Respondents were unable to change their responses due to the logic used to screen participants and display the relevant questions to their roles. Answers could be changed prior to clicking the next button to move to the next section. Respondents were unable to change their responses once submitted.
Response rates		
	Unique site visitor	Not applicable, we were unable to determine this.
	View rate (Ratio of unique survey visitors/unique site visitors)	Not applicable, respondents were invited to follow a link on an email.
	Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	We are unable to calculate the participation rate because we are unable to determine how many people were distributed the survey.
	Completion rate (Ratio of users who finished the survey/users who agreed to participate)	122 participants agreed to participate in the survey after reading the participant information sheet on the first page. 99 participants completed the survey either partially or fully, giving an 81.1% completion rate. 58 Participants answered all survey questions.
Preventing multiple entries from the same individual		
	Cookies used	None used.
	IP check	Due to the participants being from a single organisation, many responses came from the same IP address, (WiFi router).
	Log file analysis	Not used
	Registration	The survey was open to all that received the link.
Analysis		
	Handling of incomplete questionnaires	Partially completed responses were included in the analysis.
	Questionnaires submitted with an atypical timestamp	No respondents were removed for completing the survey too quickly, the shortest time taken to complete the survey was just over 6 mins.
	Statistical correction	A satisfactory number of responses was achieved for the sub-groups surveyed.

Supplementary Table 3: Respondent time working in the fitness industry.

How long have you worked in a gym in one capacity or another?	Count (*n*)	Percentage (%)
Up to 1 year	8	8
1-2 years	9	9
3-5 years	26	26
6-10 years	27	27
11-20 years	14	14
21 years and over	15	15
Total	99	100

Supplementary Table 4: Role descriptions.

Contractor	Role description
Group Fitness Instructor	Deliver group exercise classes as designed by Les Mills International in accordance with the choreography and instructions. Adhere to the health and safety requirements of the Les Mills New Zealand clubs.
Personal Trainer	Design and deliver bespoke workouts to clients. Adhere to the health and safety requirements of the Les Mills New Zealand clubs.

Supplementary Table 5: Rank order data for the question "What exercises most commonly put people at risk of SHOULDER injury?" (*n* = 58 respondents).

Rank order (1= most, 7= least)	1	2	3	4	5	6	7	Weighted average
Cleans (including clean & press)	23	11	5	15	1	2	1	2.7
Overhead shoulder press	10	25	12	6	5	0	0	2.7
Chest press/Chest fly	12	10	11	11	13	1	0	3.3
Upright row	6	9	12	11	14	6	0	3.9
Triceps dip	4	1	15	10	14	13	1	4.6
Lat pull down	0	2	3	4	11	36	2	5.8
Other (please describe)	3	0	0	1	0	0	54	7.0

Supplementary Table 6: Rank order data for the question "What exercises most commonly put people at risk of LOWER BACK injury?" (*n* = 58 respondents).

Rank order (1= most, 5= least)	1	2	3	4	5	Weighted average
Deadlift	32	19	6	1	0	1.6
Squats	14	18	18	8	0	2.3
Cleans (including clean & press)	8	10	14	24	2	3.0
Bent over row	3	11	18	25	1	3.2
Other (please describe)	1	0	2	0	55	4.9

Supplementary Table 7: Managers response to the exercises most to least likely to result in injury (*n* = 16 respondents).

Exercise	Mean	Median	Minimum	Maximum
Deadlift	1.75	1	1	5
Squats	2.81	2	1	7
Cleans / clean & press	5.00	4	1	15
Chest press	5.81	6.5	1	10
Overhead shoulder press	6.19	5.5	2	14
Chest fly	7.81	7	2	16
Push ups	8.63	8.5	2	14
Bent over row	8.81	9	3	14
Upright row	9.31	11.5	1	16
Lateral raise	9.38	10	4	14
Pull ups / chin ups	10.19	9.5	3	15
Lat pull down	10.50	10.5	7	15
Triceps dip	10.69	11	6	15
Biceps curl	12.25	12	10	15
Triceps extension	12.44	12.5	6	15
Other	14.44	16	3	16

Notes: Exercises were reordered in response to the question “Based on your experience, please reorder the following exercises to rank in terms of their contribution to gym user injuries. (1 = most likely to result in injury, 10 = least likely to result in injury).”

Supplementary Table 8: Selection of responses from Gym Managers (n = 17) related to staff training.

How do you train the staff to observe and approach gym users and class participants who are exercising with unsafe technique?

Exercise specific	Injury prevention	Other
C - Tell them the muscles targeted and the execution of the exercise.	**T -** Safety cues, range.	**T -** Do a demo of the exercise.
T - Our trainers know what correct technique looks like and will use the introduce, build rapport, offer advice funnel.	**C -** In these situations, it is important to explain WHY you are intervening and that it is totally for their benefit	**C -** Engaging with people around what they are training for is often the key to achieving a positive outcome.
C - Always introduce themselves to new group fitness participants and check in with them post class.	**C -** Be polite. If you start with the member's safety as the concern, you will get the best response.	**T -** Teach PTs and staff to screen client movement well.
T - 1 on 1 coaching through wide variety of exercises to gain confidence to approach and offer advice to members.	**O -** Open door policy to PT manager for PTs to speak about client issues/ share effective client approach techniques/ encourage networking with remedial specialists/ flag risk potential with PTs when I see it / teach-exercise regressions and alternatives.	**C -** Communication approach and turning it into positive situation of member interaction.
U - Short regular technique training sessions on problematic lifts / mentor training with senior staff or PTs /advise PTs of upcoming courses of all types / run workshops several times a year run by specialists' coaches / one on one talk when I see room for improvements / encourage culture of ongoing education and product improvement.	**U -** Upskill sessions and one-on-ones.	**T -** Group fitness instructors are trained to give cues to the entire class during a session that are prompted by seeing an individual doing something wrong to address it without singling out. PTs are just trained to coach safe technique and to use that knowledge to approach people if they are willing.

Key: **T** = Staff training, **C** = Communication, **U** = Upskill, **O** = Other

What additional information or resources, if any, do you need to train and assist staff to observe and intervene to prevent injury? Selection of Gym Managers responses (n = 17)

I would like to see the return of the gym instructor role (employed position) to assist with this.

Potentially a simplified "chart" of recommended exercises to correct certain exercise specific technique issues

Adding a more specific injury prevention component into the PT Module would raise the general awareness of risk in the gym and give more confidence for PTs to approach situations they see.

More available or practical education resources around injury management and preventive exercise.

Conversation techniques.

Most staff know what to do a lot of members don't want intervention even if they are doing something wrong.

Supplementary Figure 1: Summary of responses.

