

**The relationship between online coaching characteristics, lifter satisfaction and
performance in powerlifters**

Jason Clarke

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Primary Supervisor: Dr Alyssa-Joy Spence

Secondary Supervisor: Dr Eric Helms

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Abstract

With the sport of powerlifting growing rapidly, there is an increased demand for coaches. Currently, powerlifting coaches predominantly conduct their business online. Due to a lack of regulation, online coaching has a low barrier to entry, therefore, the likelihood of poor coaching practice occurring is increased. Additionally, to date, there is no research observing performance-based outcomes and remote coaching practices. Therefore, the aim of this dissertation was to observe current online powerlifting coaching practices and relationships between coaching characteristics, powerlifting performance and lifter satisfaction. Firstly, a literature review was done to develop an understanding of current remote coaching literature. As there have been no studies observing performance-based outcomes, research observing health-based outcomes was utilised. Based on themes within the literature, an anonymous online survey was designed and distributed to powerlifters ($n = 113$) who have or had been receiving online powerlifting coaching. The survey aimed to gain insight into current coaching practices and participants' communication structure with their coach and important powerlifting outcomes. Survey results showed that coaching relationships were, on average, 21.75 ± 14.5 months long, over 90% of lifters communicated with their coach at least once per week, and 40.7% received verbal feedback and 58.3% written. The strongest relationship observed in this study was between longer coach-lifter relationships and greater increases in powerlifting total. Additionally, higher coach education (within a field relevant to exercise) was associated with greater lifter satisfaction scores broadly, although there was complexity to this relationship, as well as increases in powerlifting total. These findings provide insight into current online powerlifting coach practices and suggest longer relationships between coach and lifter may be important for increasing powerlifting performance. Additionally, coaches may benefit from higher education within a field relevant to exercise.

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Attestation of authorship

“I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.”

Jason Clarke

Co-authored works

Submitted to *the Journal of Strength and Conditioning Research*:

Chapter 3: The relationship between online powerlifting coaching characteristics, lifter satisfaction and performance in powerlifters

Clarke: 80%

Spence: 10%

Helms: 8%

Cross: 2%

We, the undersigned, hereby agree to the percentages of participation to the chapters identified above.

Jason Clarke

Dr Alyssa-Joy Spence

Dr Eric Helms

Dr Matt Cross

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I guess my first acknowledgement should, oddly enough, be to the sport of powerlifting. It's been quite the journey over the last ten years, one that I did not anticipate. This sport has taken me all over the world, towards higher education, provided me with much-needed structure, and, most importantly, given me a medium to meet people who have added so much to my life.

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I first met Eric at my first official powerlifting competition back in 2014. I still remember enquiring with a fellow lifter about warm-up times, and they promptly said, "Follow what Eric does; he knows what he's doing". Naturally, I obliged and (unlike my novice competition) warmed up appropriately. I guess, in a way, I've been following him and his educational content ever since. Working on this project with someone with the knowledge, professionalism, and flat-out passion for lifting that Eric has been a pleasure.

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For my last acknowledgment, I will go a little off-brand and acknowledge myself, it's not something I'm good at, but I'll give it a crack. This last year has been one of the most eventful in my 32 and bit that I've been around causing trouble. I've headed a team of 30 odd coaches and 180 odd lifters into our commonwealth championships, I coached a client and friend to winning the most prestigious powerlifting competition to date, I was head coach of the most successful classic open powerlifting team NZ has ever had, I moved country, and, amongst many other things, I stuck it out with this dissertation. Those who know me well know that I generally don't do things that I don't want to do, and believe me, with everything going on this past year, there were many times when I did not want to finish this project. However, I am incredibly proud of myself for persevering and making it to the finish line. I have learnt lessons I will carry with me for the rest of my life.

Ethics approval

The Auckland University of Technology Ethics Committee (AUTC) granted ethical approval for this dissertation research on:

- 27 September 2022, AUTC reference number 22/280 (Appendix A)

Chapter 1 – Introduction

Background and rationale

Powerlifting (PL) is a strength sport where competitors aim to achieve the highest possible one repetition max (1RM) in the squat, bench press and deadlift. Competitors are given three attempts for each discipline to build their PL total (a combination of their heaviest successful squat, bench press and deadlift). Competitive success is then determined by the highest PL total within the competitor's respective age and weight categories. Additionally, competitors are given a Good Lift Points (GLP) score. GLP uses an equation factoring in bodyweight and PL total to compare competitors across multiple weight classes and determine a "best overall lifter" (21). PL has two main divisions: classic and equipped. Classic PL only allows competitors to wear a belt, knee sleeves and wrist wraps, whereas equipped lifting allows competitors to wear assistive squat, bench press and deadlift equipment. Of interest is the classic division, given its popularity and exponential growth. The International Powerlifting Federation (IPF) is the predominant international governing body in drug-tested PL. It was founded in 1972 (19) and currently has 141 member nations (20). Growth in the classic division within the IPF has seen competitor numbers increase more than seven-fold from 2011 to 2021 (28). With this increased number of competitors comes an increased demand for coaches.

Interestingly, PL coaching is largely conducted online. The prevalence of PL coaching being delivered remotely is likely due to the simplistic nature of the sport and a lack of coach availability. Remote coaching (RC) allows powerlifters to work with coaches they may not have geographical access to. Additionally, RC can allow coaches to work with a larger client load than they would if conducting coaching face-to-face (F2F). These factors mean that RC can alleviate some of the increased demand for coaching in PL. Unfortunately, there is no regulation when it comes to RC coaching for PL. This lack of regulation can lead to under-qualified and under-experienced coaches entering the field of

RC for PL. Furthermore, research within PL is limited to training strategies (2,15), biomechanical considerations (11), stretching practices (33), tapering (38), and injury prevalence (34). Due to the lack of research in PL coaching, there are minimal evidence-based recommendations a PL coach can follow when structuring their RC business.

Albeit not related directly to PL coaching, RC literature is available for assessing communication strategies for outcomes such as disease management (26), physical activity (PA)(39), weight loss (5,13), and mental health (25,27). As the concept of remotely delivering guidance to an individual or individuals to achieve a desired outcome is the same across all forms of RC, literature from other practices may help inform RC PL practice. RC has been shown to consistently outperform both wait-list (3,5,27), self-monitoring (1,18), and educational resource-only (9,12,36) based control groups. Additionally, some studies have shown no significant difference in outcomes between F2F and RC, with greater levels of adherence for RC (25,26). Conversely, one study observed movement competency scores in adolescents and found the group with the greater number of F2F sessions to have higher levels of adherence and greater movement competency scores (30). These findings suggest that RC coaching may be limited for movement-based coaching, which is an important consideration for the applicability of RC for PL. Unfortunately, a search of the RC literature yielded no results observing performance-based outcomes. Considering the increased prevalence of RC within all fields (7), research observing different RC-based communication strategies and their influence on performance-based outcomes would provide direction for PL RC.

Purpose of this research

This research aimed to develop an understanding of online coaching practices in PL. The specific research questions were:

1. How are different modes of online coaching delivery related to lifter satisfaction (LS) and change in PL total?

2. How are different frequencies of online coaching delivery related to LS and change in PL total?
3. How is the length of the lifter-coach relationship related to LS and change in PL total?

Significance of this thesis

As the sport of PL grows, so does the demand for coaches. With the eventual increase in PL coach numbers comes an increased importance for evidence-based practice. To this point, PL largely relies on unsubstantiated experience-based knowledge being shared between coaches. However, with the novelty of RC not only in PL but as a medium for conducting coaching, experience is also limited. Therefore, understanding current RC practices and their relationship with important outcomes for PL is valuable to the PL coach and competitor. Hopefully, this dissertation's findings can provide some framework for the RC PL coach and help them further understand current practices.

Structure of this dissertation

This dissertation follows the pathway two format and is organised into three sections. Section one introduces the dissertation (Chapter 1) and reviews the current literature on RC (Chapter 2). The second section presents the survey research conducted for this dissertation as a manuscript (Chapter 3). The final section discusses the dissertation, a general summary, limitations, practical applications and recommendations for further research (Chapter 4). Chapter 3 has been submitted to the *Journal of Strength and Conditioning Research* and is presented in the format of this journal.

Chapter 2 – literature review

Introduction

PL is a sport where combined (1RM) in the squat, bench press, and deadlift determines competitive success. The IPF is the predominant international governing body for drug-free PL; it was established in 1972 and has 141 member nations (20). PL within the IPF has grown rapidly over the last decade. Specifically, in the classic division (without assistive equipment), annual competitors have increased more than seven-fold, from 3311 in 2011 to 24536 in 2021 (28). This increase in competitors has also increased the demand for coaches, which, alongside the simplicity and individual nature of the sport and the progression of social media, has seen coaching in PL primarily conducted remotely and, most commonly, online.

Remote coaching (RC) allows competitors to communicate with a coach online or over the phone, making both parties more accessible. Unfortunately, there is no barrier to entry or regulation when delivering RC in PL. Given the lack of regulation, low-quality online coaching may occur due to the lack of a substantiated framework for RC delivery. Additionally, research within the sport is limited due to the niche nature of PL. Researchers in PL, to this point, have observed the effects of different training strategies (2,15), made biomechanical comparisons of different exercises (11), observed stretching practices (33), tapering practices (38), and assessed injury risk (34). Currently, no research has been conducted observing different RC delivery methods and PL performance outcomes. Furthermore, satisfaction scores, which have been shown to effect sport performance (10), have not been observed in the literature in relation to differing RC delivery methods.

Despite the lack of research directly on PL coaching and satisfaction with RC delivery, RC literature assessing outcomes related to disease management, physical activity (PA), weight loss, mental health, and well-being may help determine RC's application in PL. Conceptually, the role undertaken by the coach to aid the recipient in achieving a desired outcome is similar in these tasks; therefore,

the evidence from other coaching domains may be extrapolated to an online PL coaching context. Although PL RC is primarily done in an online context, online RC shares many features with text messaging-based and phone-based coaching, and therefore, this type of RC research may also be informative. Ultimately, for remote coaches to perform effectively, comparing different modes of delivery and different frequencies of contact is likely essential, as these variables may determine the influence a coach can have on the recipient's goal attainment (9). Therefore, this narrative review aims to understand effective practice for remote PL coaching by analysing peer-reviewed, English-language studies observing different deliveries of RC and comparisons of RC to in-person coaching obtained through PubMed, Scopus, EBSCO, and Google Scholar electronic database searches using the following phrases: remote coaching, online coaching, coaching, performance, strength, weight loss, and physical activity. Included papers were selected by screening abstracts and titles and additional papers by searching the selected papers' reference lists, these have been summarised in table 1. The forthcoming comparisons and discussion herein will allow the remote coach to develop a framework to conduct their coaching in the most effective manner possible, hopefully improving RC coaching practice in PL.

Overview of RC

Coaching as a concept can be defined as a collaborative process that is engaged in by the coach and recipient in which goals are set, and pathways are put in place to achieve these goals. Throughout this goal-attainment process, the coach facilitates the recipient's learning, growth, and progression (24). RC is a method in which coaches conduct their work without having face-to-face (F2F) interaction with the coaching recipient. Instead, coaching is done through phone calls (9), text messages (12), emails (36), video calls (27), and online platforms (6). RC allows coaches to work with people they may not have previously had geographical access to and because many modes of RC - such as emails and video/voice recordings - do not require a specific appointment time, coaching can be conducted more flexibly. Most importantly, a RC business can be operated from home, reducing

rental expenses (alongside others) and allowing coaches to charge the recipient a reduced rate. However, online coaching is not without its limitations. The lack of personal interaction can make it difficult for a coach to acquire the appropriate information needed to enhance the coaching process (7). Additionally, navigating certain technologies required for RC may pose a challenge for effective coaching (4). Regardless, the coach's abilities will likely be a significant determinant in the success of an RC relationship. If the coach has no previous F2F experience, a poorly conducted RC protocol may exacerbate their deficiencies. Therefore, understanding and implementing best practices for RC may be crucial to success.

Table 1 - Table of literature

Author	Length of intervention	Subjects	Health parameter	Groups	Feedback Mode	Communication Type	Frequency of contact	Results
Alencar et al. 2017 [19]	12 weeks	25 obese participants (12 male, 13 female)	Weight loss	Remote coaching Monitoring	Verbal	Video calls	1x per week with a registered dietitian 1x per month with doctor	Significantly greater weight loss in the coached group.
Beleigoli et al., 2020 [17]	24 weeks	1298 participants (998 female, 308 male) with a BMI of >25	Weight loss	Online platform Online platform + remote coaching Wait list	Written	Messaging through an online platform	Reactive	Platform and platform + coaching had greater weight loss than the wait-list control. No difference between platform and platform + coaching.
Blomfield et al., 2013 [14]	3 months	159 overweight and obese men	Weight loss	Online platform Online platform + remote coaching Wait list	Written	Email ,SMS	Month 1: 1x per week emails Month 2: fortnightly emails Month 3: SMS reminders	Coaching and online platform groups lost significantly more weight than the control at 3 and 6 months but had no significant differences between them.
Boratto et al., 2017 [26]	1 year	103 (62 male, 41 female) runners using an online training platform	Adherence and engagement with training	Remote coaching Online platform	Written	Messaging through an online platform	Reactive	Those working with a human coach performed more training sessions.
Fischer et al., 2019 [20]	6 months	288 people (197 female, 91 male) achieving less than 150min/week of MVPA	PA	Calls + SMS Calls Educational resource control	Verbal and written	Phone calls and SMS	Calls: biweekly SMS: 2x per week	SMS + calls and calls only produced similar results, both significantly greater levels of PA than the control.
Godino et al., 2019 [21]	1 year	298 overweight English and Spanish-speaking adults (228 female, 70 male)	Weight loss	SMS SMS + calls Educational resource control	Verbal and written	Personalised (but automated) SMS and phone calls	SMS: 2-4x per day Calls: monthly	No difference in weight loss between SMS and SMS + calls. SMS + calls had significantly greater weight loss than the control group.
Gold et al., 2007 [13]	12 months	124 obese individuals (101 female, 13 male)	Weight loss	Online platform Remote coaching + education	Verbal	Video calls	Months 1-6: 1x per week Months 6-12: 1x every 2 weeks	Weight loss was greater in the coaching group at 6 months and weight maintenance was better at 12 months. Both groups failed to lose weight from 6-12 months.
Hunter et al., 2008 [28]	6 months	446 (224 female, 222 male) overweight active-duty military personnel	Weight management	Remote coaching Usual military care	Written	Feedback on internet diaries	1x per week	The coaching group significantly managed their weight better.

Hutchesson et al., 2016 [18]	12 weeks	301 (176 female, 125 male) obese individuals	Weight loss	Remote coaching Online monitoring tool	Written and verbal	Email, SMS, phone calls	1x per week	Adherence to self-monitoring was better in coaching group but weight loss was not.
Kempf et al., 2018 [30]	12-weeks	180 overweight employees	Weight loss	Remote coaching Monitoring Routine care	Verbal	Phone calls	1x per week	Only the coached group had significantly greater weight loss than the control group.
Milgrom et al., 2021 [16]	12 weeks	116 women diagnosed with PND	Treatment of PND	Remote coaching F2F coaching Treatment as usual	Verbal	Phone calls	1x per week	Online at least as effective in achieving remission from PND. Online was superior at maintaining a reduction in symptoms in comparison to F2F.
Moin et al., 2018 [11]	12 months	268 obese and overweight veterans with prediabetes (82 female, 186 males)	Diabetes prevention	Remote coaching F2F coaching Standard of care (SOC) weight loss programme	Written	Online forums	Reactive	Online had better participation vs F2F. Online and F2F had more weight loss than SOC programme. No weight loss differences between online and F2F.
Okorie et al., 2022 [15]	9 weeks	109 school administrators (60 female, 49 male)	Well-being	Remote coaching Wait-list control	Verbal	Group video calls	1x per week for 2 hours	Significant improvement in well-being, sustained after a 3-month follow-up for the coaching group.
Rogers et al., 2020 [23]	16 weeks	39 high school student athletes (20 female, 19 male)	Movement competency	Remote coaching + F2F F2F	Verbal	F2F sessions, recorded online sessions	F2F: 1x F2F session per week, 1 online Online: 2x per week	Adherence was greater in the F2F group. Physical outcomes were better in F2F but non-significant.
Sarver et al., 2019 [29]	N/A	253 Diabetics (204 female, 49 male)	Weight loss and HbA1c	No comparison group	Written and Verbal	Forums, video calls	Forums: reactive Video calls: 2x per month	Significant weight loss compared to baseline.
Smart et al., 2022 [32]	8 weeks	30 inactive, overweight individuals (23 female, 7 male)	Walking	No comparison group	Written	SMS messages	1x per week (minimum 5 messages)	No significant change in group steps, although significant increase in steps was observed in 5/30 patients.
Tate et al., 2001 [22]	6 months	91 overweight adult hospital employees (81 female, 10 male)	Weight loss	Remote coaching + educational resource Educational resource alone	Written	Emails, online forum	Emails: 1x per week Forum: reactive	Greater weight loss in the coached group.
Tate et al., 2003 [31]	12 months	92 overweight individuals (83 female, 9 male) at risk of type 2 diabetes	Weight loss	Educational resource Educational resource + remote coaching	Written	Emails	Month 1: 5x per week Following 11 months: 1x per week	educational resource + coaching had significantly greater weight loss than educational resource alone.
Wang et al., 2015 [12]	6 weeks	67 overweight individuals not meeting current PA guidelines (61 female, 6 male)	PA	SMS prompts Monitoring	Written	SMS messages	3x automated messages per day	SMS prompts only elicited significant differences at week 1.

BMI: body mass index, SMS: short message service, MVPA: moderate to vigorous physical activity, PA: Physical activity, PND: post-natal depression, F2F: face to face

Frequency of coaching communication

When considering RC as an option for PL coaching, an important aspect is likely the frequency at which the coach and the recipient communicate. From the research surveyed, communication can be grouped into two categories: proactive, scheduled communication (9,17,36) and reactive, non-scheduled communication (3,6,31). Proactive communication implements a set 'check-in' point where the coach and recipient set aside a specific communication time. These 'check-ins' have been observed weekly (1,17,22,27,36), bi-weekly (9), and monthly (12) with favourable outcomes. Reactive communication does not assign a set point for contact and instead occurs when either the recipient or the coach deems it appropriate (9,17,36). An example of reactive communication is when the recipient of a weight-loss intervention reaches out to the coach because they are unsure whether a food choice is appropriate. Because reactive communication does not have a fixed frequency, assessing it alongside other pre-determined frequencies is not feasible. However, reactive communication can effectively produce desired coaching outcomes (6,26) and is worth consideration within an RC framework, possibly alongside proactive communication (31,36).

Mixed results are observed in studies where check-in frequency decreased gradually as the intervention progressed (5,13). In a three-month weight loss study by Blomfield et al. (5), communication was conducted weekly in the first month, bi-weekly in the second month, and only once in the third month. At the end of the third month, the coaching group lost significantly more weight (5.4 ± 4.1 kg) than the wait-list control (0.6 ± 2.6 kg [$p < 0.001$]), but not the educational-resource-only group (3.8 ± 3.9 kg). Contrastingly, Gold et al. (13) observed a significant difference in weight loss at six months in favour of a group receiving weekly coaching (8.3 ± 7.9 kg) when compared to a group using an online monitoring tool with educational support (4.1 ± 6.2 kg [$p = 0.005$]). In the following six months, when the coaching cohort's frequency of contact was reduced to biweekly, there was no significant difference in weight loss between groups. However, the coached cohort maintained significantly more weight loss than the monitoring group ($p = 0.034$). The

authors noted a significant decrease in both cohorts' engagement with their respective online weight monitoring tool during this 6–12-month period. This decrease in engagement over time has been noted in previous studies to blunt weight loss (35,36). One 12-month study involving individuals at risk of type 2 diabetes used an initially high communication frequency in the first month (five emails per week), which decreased to one email per week for the following 11 months (35). At the end of the intervention, the cohort receiving coaching lost significantly more weight than the group only receiving an educational resource ($4.4 \pm 6.2\text{kg}$ vs $2.0 \pm 5.7\text{kg}$ [$p = 0.03$]). However, significant between-group differences in blood glucose levels and energy expenditure were only observed at three months. Collectively, these findings suggest that if frequency does need to taper, there may be a threshold to how drastic the reduction can be before impacting outcomes. Overall, weekly (17,27,36), biweekly (9) and monthly (12) contact are all viable; however, weekly communication has the strongest support.

Modes of RC

Numerous modes of communication can be utilised to conduct RC (36). Therefore, it is important to understand how different modes might influence RC outcomes. While there are many modes of communication observed in the RC literature, for the sake of this review they will be grouped into two main categories of communication: written (SMS messages, emails, and online forums) and verbal (video call, video recording, voice call, and voice recording). Verbal communication involves more personal interaction than written communication and should, theoretically, more closely mimic that of F2F coaching. Whether this greater level of personability is integral to achieving coaching outcomes is of interest.

Written Communication

Researchers have investigated the effectiveness of written communication with positive results in several studies (17,26,36). In a six-month weight loss intervention, weekly individualised email

communication from a coach led to significantly greater weight loss in overweight hospital employees when compared to a minimal guidance control group (intervention: $4.1 \pm 4.5\text{kg}$, control: $1.6 \pm 3.3\text{kg}$ [$p = 0.05$])(36). Similarly, in another six-month study, weight loss coaches provided overweight military personnel weekly written feedback on their online exercise and nutrition diaries. At six months, the coached cohort had significantly greater weight loss than those receiving a standard-of-care (SOC) (annual health check and fitness test) weight loss programme (intervention: $1.3 \pm 4.1\text{kg}$, SOC: $+0.6 \pm 3.4\text{kg}$ [$p = <0.001$]) (17). Furthermore, in a 12-month diabetes prevention programme, Moin et al. (26) reported significantly greater weight loss for those who received written feedback through an online forum when compared to a SOC weight loss programme (8-12 healthy lifestyle sessions) at six months (coaching: 4.8kg , SOC: -1.1kg [$p = 0.002$]) and 12 months (coaching: 4.1kg , SOC: 0.10kg $p = <0.001$) (26). Additionally, the online group was more likely to complete eight or more educational modules than those who completed the programme with an F2F coach (online mean: 87%, F2F mean: 59% [$p < 0.001$]) (26). Moving from the scope of weight loss, positive results were also observed for adherence to a running-based programme. In a study by Boratto et al. (6), all participants received an algorithm-based running programme, while one group received additional online coaching. Those receiving coaching completed more total workout sessions than those who received algorithm-based training alone ($p = <0.01$) (6). Whilst the previously stated research indicates positive trends for written feedback, it is worth noting that the interventions are all at least six months long. In comparison, shorter-term interventions seem less successful. For example, in a six-week study by Wang et al. (39), researchers sent three daily SMS prompts to participants wearing Fitbit devices to help increase PA. Despite the high frequency of prompts, no significant changes in PA occurred by the end of the intervention. The one-way method of communication (coach to the recipient only) could be seen as a limitation, as participants could not reply to messages from the coach. However, similar results were observed in an eight-week walking intervention using Fitbit devices, where health coaches used a two-way SMS messaging system with a minimum of five messages per week (32). Specifically, no significant group changes

occurred for average weekly steps from week one to week eight (mean difference: 7.26, $p = 0.99$). These results highlight the importance of the length of intervention and the mode of communication. The shorter interventions by Wang et al. (39) and Smart et al. (32) also used SMS messages as their sole form of communication, which likely contributed to the lack of increase in PA and steps from baseline. Whereas the previously mentioned longer interventions used a variety of modes: emails (36), feedback on online journals (17), and communication through forums (3,26), all of which were effective at helping achieve desired outcomes. Therefore, solely using SMS messages with interventions eight weeks or less for RC may not be viable. Overall, written communication is an effective means of communication when conducting RC. Considering the arguably less personal nature of written communication, it may be that it takes longer to develop an impactful relationship between coach and client when compared to F2F coaching. Additionally, due to the lack of evidence for SMS-based RC, it is likely only effective as an adjunct to other modes of communication.

Verbal Communication

Verbal communication allows the coach to convey nuanced messages more effectively due to the ability to change their tone, utilise non-verbal communication cues, and emphasise specific messages, allowing for closer parallels to F2F coaching. In a 12-week weight loss intervention, researchers observed significantly greater weight loss in the participants who received video calls plus monitoring (7.3 ± 5.2 kg) compared to the monitoring-only group (1.2 ± 3.8 kg [$p = < 0.05$]) (1). Both groups were provided with tools to monitor their activity, nutrition, and body weight, but the coaching group also received weekly video calls with a coach. In a similar 12-week weight loss study where participants received weekly phone calls from coaches, both the coaching (3.1 ± 4.8 kg [$p = < 0.001$]) and monitoring group (1.9 ± 4 kg [$p = 0.0012$]) significantly reduced body weight from baseline and sustained it at a 12-month follow-up (22). However, only the group that received coaching calls had significantly higher levels of weight loss when compared to the control group at 12 months ($p = < 0.001$) (22). These positive verbal coaching communication findings for weight loss

were mirrored in a Zoom-based video calling intervention to improve the well-being of school administrators (27). Those who attended the nine-week Zoom-based coaching intervention had significantly higher scores of well-being when compared to a wait-list control at the end of the nine weeks and a three-month follow-up (27). Interestingly, this intervention undertook a group-based approach to verbal communication coaching. The coaching sessions were delivered over 2 hours to the entire cohort of 55 participants. The ability to deliver RC in real-time to a group is logistically unique to verbal communication as it is not as feasible for written communication.

With that said, not all studies show a unanimous benefit to verbal communication, as one study that involved verbal communication as part of their coaching intervention failed to yield significantly greater weight loss than the comparison group (18). However, the use of verbal communication was minimal throughout this study. The cohort that received coaching was predominantly provided with written communication and only utilised phone calls when participants were unresponsive to SMS messages or emails. Despite the coaching group having only occasional access to verbal communication, they had significantly higher engagement when logging food ($p = <0.001$) and exercise ($p = <0.003$) (18) throughout the 12-week intervention.

Verbal communication coaching protocols have produced positive results in as few as nine weeks (27) and consistently after 12 weeks (1,22,25). Additionally, three of the studies conducted post-intervention follow-ups. In each of the follow-up periods (21 weeks (25), three months (27), and nine months (22) post-intervention), the cohort that received verbal communication-based coaching maintained better outcomes than their respective control (22,25,27). Considering the evidence, verbal communication-based coaching may benefit various outcomes within 12 weeks that can be sustained for up to nine months after coaching ceases. Verbal communication may be best conducted via telephone or video calls, but video calls provide potential utility in group settings.

Written and verbal communication

Unsurprisingly, when verbal feedback attempts to replicate F2F coaching, it consistently provides better results than controls (1,22,27). Written feedback also tends to produce positive results (17,26,36); however, not as consistently in the short term (3,32,39). These findings seem logical, given the nature of the two feedback methods. Considering this, a comparison between verbal and written communication would be of interest. Unfortunately, no direct comparisons have been made. However, two studies [9, 11] utilised verbal and written communication concurrently and compared them to a singular mode of communication. In a 12-month weight loss intervention, Godino et al. (12) observed no significant differences in weight loss between groups that received either 2-4 personalised SMS messages per day (-1.68kg) and a group that received the same SMS protocol plus a 5–10-minute coaching call each month (-3.30kg [p = 0.09]). However, there was a significant difference between the SMS + calls group and the control group (-0.73kg [p = 0.01]) but not between the SMS-only group and the control group (p = 0.31). In a similar study, Fischer et al. (9) compared the effects of coaching calls (12 bi-weekly calls for 20 minutes) with and without additional SMS prompts (four every 2 weeks) on PA. They reported that coaching calls (+ 32 min/week [95% CI 0.1 to 63]) and coaching calls with SMS prompts (+34 min/week [95% CI 1.6 to 66]) produced similar increases in PA. It's possible that the additional four SMS prompts on top of the verbal communication were not intensive enough to elicit a between-group difference. However, considering the favourable evidence for verbal communication, additional written prompts may not add further benefit. The findings from Fischer et al. [9] and Godino et al. [11] correspond with the bulk of the RC literature, suggesting that written and verbal-based coaching interventions can result in significantly better outcomes than a control group. However, verbal communication-based interventions may outperform controls more consistently and in a shorter timeframe than written communication interventions.

Therefore, while the two methods have not been directly compared, the totality of evidence suggests that both verbal and written communication are viable RC options. Remote coaches should consider both methods' time-cost, feasibility and practical implementation. Regardless, research directly comparing the two methods is warranted.

RC versus face-to-face coaching

Considering that RC is a cost-effective alternative to F2F coaching, the comparison of the two seems pertinent to understanding the potential of RC. Unfortunately, the literature comparing RC and F2F is limited, yielding three studies (25,26,30). One study compared F2F and RC cognitive behavioural therapy (CBT) programmes for post-natal depression (25). Women with a clinical diagnosis of major or minor depression were assigned to either a 9-week F2F CBT programme with an assigned psychologist, a 9-week online CBT programme that included weekly coaching calls, or a SOC (referral to GP) control group. At the 21-week follow-up, RC and F2F groups were 47.7% ($p = <0.001$) and 56.6% ($p = <0.001$) less likely to have a diagnosis of major or minor depression when compared to the control group, respectively. Remission rates were not significantly different between the F2F and RC group ($p = 0.81$); however, greater reduction in depression symptoms ($p = 0.001$) [$d = -0.98$] and perceived stress ($p = <0.001$ [$d = 0.89$]) were observed in the RC group compared to the F2F group (25). Additionally, 85% of the women in the RC cohort completed more than three sessions compared to 62% in the F2F group. When examining physiological outcomes, online (a virtual group that involved coaches and weekly modules) and F2F (group-based sessions) 12-month diabetes prevention programmes produced similar weight loss at six months (online: 4.8kg, F2F: 4kg; $p = 0.53$) and 12 months (online: 4.1kg, F2F: 3.9kg; $p = 0.84$) (26). However, both groups lost significantly more weight than the control group ($p = <0.001$) (26). Interestingly, once again, the group receiving the online protocol completed a higher number of sessions (online = 87%, F2F = 59% [$p = <0.001$]). Due

to the ease of access, RC has the potential to replicate the impact of F2F interventions whilst increasing engagement. However, the potential superiority of RC compared to F2F coaching may depend on the desired outcome. In a 16-week study of high school students with an average age of <15 years (males = 14.5 ± 0.3 years, females = 14.6 ± 0.3 years), students receiving two F2F movement coaching sessions had higher movement competency scores than those receiving online sessions and mean completion rates in the online group were lower (12% versus 60%) (30). Notably, the F2F group in this study also utilised an online session, so the specific inclusion of F2F sessions may have driven these differences, which highlights some possible limitations of RC. Specifically, this study aimed to improve a movement-based skill in adolescents, indicating that RC may be limited when improving skill acquisition in novice populations. This finding is important when considering the use of RC in a PL context (i.e., PL RC may be as effective as F2F for nutrition and exercise programming, motivational interviewing, and athlete-life coaching, but less effective for technique coaching). However, it is difficult to ascertain whether the advantage of F2F coaching for movement competency would also be apparent in PL-specific movement coaching among experienced adult powerlifters.

Despite the limited nature of the literature comparing RC to F2F coaching, RC may be a viable option for PL coaches. RC is likely to elicit similar outcomes, at least in some domains, with the potential for increased adherence. However, more research on performance and movement-based outcomes is warranted with different age groups.

Conclusion

As with most industries, RC technology is becoming more prevalent. Considering the aim of this review is to extrapolate and apply the RC research to PL, the constraints of the sport should be considered. Although PL requires some movement-based coaching, it is arguably a relatively simple skill set, with only three common gym-based movements making up the competitive disciplines.

Without direct research, however, PL coaches are left to speculate as to the applications and limitations of RC in their sport. Regardless, this review highlighted three main considerations when assessing RC for PL: RC frequency, RC mode, and in what contexts RC can provide similar, better, or worse results compared to F2F coaching.

Regarding communication frequency, monthly, fortnightly, and weekly check-ins may be utilised; however, tapering communication frequency may inhibit results, and weekly check-ins may provide more consistent results. As for mode, both written and verbal communication can provide effective results. Although there has been no direct comparison of verbal and written communication, verbal communication may prove more consistently effective in a shorter timeframe than written communication. Additionally, SMS messages should not be used as a sole mode of communication. Finally, although RC to F2F comparisons is scant, the available research suggests the two produce similar results with the possibility of higher engagement with RC, possibly due to fewer logistical barriers. However, this may not be the case where complex movement-based outcomes are desired or in novices learning new movements.

Foremost, PL coaches should assess and discuss communication options with their clients. Research suggests a protocol incorporating consistently delivered verbal feedback will likely produce results and increase adherence within the first three months. However, developing a protocol that caters to the coach's strengths and the client's needs while considering the coach's time availability should be paramount.

Chapter 3 – The relationship between online powerlifting coaching characteristics, lifter satisfaction and performance in powerlifters

Preface

A search and review of the literature highlighted the lack of research within online coaching, not only for PL but also for performance-based outcomes. RC research for other outcomes did, however, highlight some potential communication structures that may be more beneficial than others. Due to a lack of research, we had PL competitors undertake a survey outlining their current coaching structure, their competitive demographics, key demographics of their coaches, and the progression of their PL total and satisfaction in their online coaching experience since working with their coach. This survey aimed to gain insight into current PL coaching practices and the relationship between those practices and important PL outcomes.

Introduction

PL is a strength sport where 1RM strength determines competitive success. Competitors are allowed three attempts of three barbell lifts: the squat, bench press, and deadlift. Their heaviest successful lift from each discipline contributes to their total, and the competitor within their respective age and weight category with the highest total wins. There are numerous formats in PL, the most common being the classic division (28). In this division, competitors may only wear knee sleeves, a belt, and wrist wraps as supportive equipment. Drug-tested PL within the IPF has seen competitors increase by more than seven-fold in the past ten years (2011-2021) (28). With this increased number of competitors comes higher demand for coaches.

PL competitors work with coaches to develop training and recovery regimes to achieve a higher competition total. Coaching is frequently conducted remotely due to the sport's niche and simplistic nature. RC allows PL competitors access to coaches worldwide. Importantly, there is little to no barrier to becoming a coach, leading to a lack of regulation of coaching practices, allowing low-quality PL coaching services to occur. With most PL literature focusing on performance-based outcomes (11,15,33) and RC literature focusing on health-based outcomes (9,13,23), no evidence-based guidelines for online PL coaching practices are currently available.

When considering coaching, communication is an integral component of the process that heavily impacts success (8). Different communication methods of RC influence desired outcomes (9,14,26); therefore, coaches must understand how these methods may influence PL outcomes. RC research focusing on health outcomes has shown both verbal (1,22,27) and written (6,26,36) forms of communication to be effective, yet SMS-based coaching has seen less success (32,39). Frequencies of communication ranging from once per week to once per month have also shown positive results (9,12,36). However, when communication frequency is reduced throughout an intervention, outcomes and engagement diminish (5,13). Furthermore, RC protocols, in some studies, were equally as effective as in-person coaching and resulted in greater participation (25,26). While there is no RC research for sports performance-based outcomes, one study on high school students observed changes in movement competency scores with poorer results for the RC cohort (30). Considering the sparse sports-specific research, only limited inferences can be made about the role of RC in sports coaching generally and in PL specifically. Thus, research providing a framework for RC interventions in PL is needed. Therefore, the present cross-sectional survey aims to gather insight into current online PL coaching delivery methods and their associations with increases in PL total and lifters' satisfaction with the online coaching experience.

Methods

Experimental approach to the problem

A cross-sectional anonymous online survey was conducted on competitive powerlifters working with an online coach. The purpose was to explore the association between coaching characteristics (mode and frequency of communication) and coaching duration with PL performance (change in PL total) and LS. Participants were prompted to partake in the survey through emails sent to members of the New Zealand Powerlifting Federation, social media, and posters at PL competitions. The survey was available from 27/9/2022 to 6/12/2022. We anticipated that a higher frequency of communication, verbal feedback, and longer coaching relationships would result in greater increases in PL total and higher LS.

Subjects

A total of 113 competitive powerlifters (age: 31.1 ± 10.6 years), with 59 participants competing in the male category (age: 27.1 ± 8.9 ; GLP: 81.8 ± 9.6) and 54 competing in the female category (age: 35.5 ± 10.1 ; GLP: 77.5 ± 13.3) volunteered for this study. Participant inclusion criteria were powerlifters who had received at least six months of ongoing online coaching or had ended coaching less than six months before they completed the survey. Additionally, participants must have competed in at least two IPF-sanctioned PL competitions, one before starting with their current coach (or their first competition if it was with their current coach) and one between January 1, 2020, and December 2022, with results registered on Open IPF (PL results database). Participants acknowledged that participation in the survey would be their provision of consent. The Auckland University of Technology Ethics Committee approved the study #22/280.

Procedures

The survey was delivered online via Qualtrics, comprising three sections and 27 questions. Initially, the survey was tested amongst research peers who both compete in and coach PL to determine its

relevance to the research aims and questions. Section one asked for demographic data related to PL. These questions included the participant's age, highest GLP (coefficient score to determine strength relative to body weight), category they compete in (male or female), and most recent weight class. Section two provided more screening questions to ensure the participants had met the inclusion criteria. These questions confirmed the participant was currently being coached and had been for more than six months. If they weren't currently being coaching they must have received coaching within the last six months for a period longer than six months. Participants then stated how many months their coaching relationship lasted. Participants were asked about their current or most recent coaching relationship in the final section. These questions concerned the participants' injuries, PL totals, GLP, weight classes, and their coaches' education. Importantly, participants noted their level of satisfaction with their RC coaching experience on a scale of 1-5 (1 = extremely dissatisfied, 2 = somewhat dissatisfied, 3 = neither satisfied or dissatisfied, 4 = somewhat satisfied, 5 = extremely satisfied), how often they communicated with their coach (options ranged from "every session" to "less than once per month") and in what mode they predominantly communicated (verbal or written). Change in PL total was then calculated using participants' most recent PL total and their total before coaching ($[(\text{most recent total} - \text{prior total}) / \text{prior total} \times 100]$). Similarly, change in GLP was calculated ($[(\text{most recent GLP} - \text{prior GLP}) / \text{prior GLP} \times 100]$). The data collected was then exported to Microsoft Excel, where it was screened. Firstly, responses that did not meet the inclusion criteria were removed. Secondly, those who failed to complete more than 85% of the survey were also removed.

Statistical analyses

Data were screened for incomplete, duplicate, and false answers. All statistical analyses were performed in R language and environment for statistical computing (37). The *performance* package was used to assess model diagnostics with *robustbase* and *ordinal* packages for the final analyses.

Mean and standard deviations were calculated for change in PL total, length of coaching relationships, and LS scores. Frequencies of responses were calculated for current coaching relationships, communication frequency, mode of communication, and coach education (within a field relevant to exercise). To address our aim of detecting associations between coaching delivery characteristics and success of an online PL coaching relationship, LS and Change in PL total were set as the dependent variables in two regression models. Both models included mode, frequency, and length of online coaching delivery as predictor variables. The PL total change model also included age, coach education level, and injury status. The LS model also included GLP (bodyweight strength coefficient score), coach education, and injury status.

For the PL total robust linear regression was deemed appropriate due to the presence of heteroscedasticity and outliers. For PL total, regression outputs included the statistical significance (p) and variance explained by the model (R^2), with beta-coefficients and their associated 95% confidence intervals and p -values for individual factors within the model. For LS, ordinal regression was selected to retain the ordered nature of the dependent variable. However, due to violations of the proportional odds assumption, a partial ordinal regression was adopted, with the offending variable (coach education) analyzed as a nominal variable. For satisfaction, regression outputs included the statistical significance (p) and variance explained by the model (R^2 Nagelkerke), with odds ratios and their associated 95% confidence intervals and p -values for individual factors within the model. For all tests, significance was accepted at the $p \leq 0.05$ level.

Results

Demographics

The anonymous online survey received 275 responses. After screening for incomplete and false answers, 113 were recorded. Of those who responded, 99 (87.61%) participants were currently working with a coach, and 14 (12.39%) were within the last six months. Male participants had a

mean PL total of 621kg \pm 111kg and females 382kg \pm 77kg. Male GLP scores were, on average, 81.7 \pm 9.7 and females were 77.53 \pm 13. Coaching relationships were, on average, 21.75 \pm 14.5 months long (21.2 \pm 15.6 for females and 22.3 \pm 13.6 for males). When asked to rank their level of satisfaction with online coaching on a 1-5 scale (extremely satisfied to extremely dissatisfied), participants, on average, scored their experience as 4.4 \pm 1.07 (4.4 \pm 1 for males and 4.4 \pm 1.2 for females). Of all respondents, a mean increase of 14.6% \pm 15.5% (14.01% \pm 12.43% for males and 15.3% \pm 18.5% for females) in their PL total during their time spent with their most recent coach was calculated. Table 2 provides further information on coaching characteristics.

Table 2 - Coaching characteristics

	All (n = 113)	Male (n = 59)	Female (n = 54)
Communication Frequency			
Every session	42 (37.1)	24 (40.68)	18 (33.33)
Once per week	63 (55.8)	31 (52.54)	32 (59.26)
Once every two weeks	3 (2.7)	2 (3.39)	1 (1.85)
Once per month	4 (3.5)	2 (3.39)	2 (3.7)
Less than once per month	1 (0.9)	0	1 (1.85)
Mode of Communication			
Verbal	46 (40.7)	21 (35.59)	25 (46.3)
Written	67 (59.3)	38 (64.4)	29 (53.7)
Lifter satisfaction with the coach			
Extremely satisfied	73 (64.6)	38 (64.4)	35 (64.82)
Somewhat satisfied	28 (24.78)	16 (27.12)	12 (22.22)
Neither satisfied or dissatisfied	3 (2.66)	1 (1.7)	2 (3.70)
Somewhat dissatisfied	2 (1.77)	1 (1.7)	1 (1.85)
Extremely dissatisfied	7 (6.2)	3 (5.09)	4 (7.41)
Coach education			
Unsure	33 (29.2)	18 (30.5)	15 (27.7)
No formal education	15 (13.27)	9 (15.25)	6 (11.11)
Personal training certificate	7 (6.2)	2 (3.4)	5 (9.23)
Strength and conditioning certificate	11 (9.73)	6 (10.2)	5 (9.23)
Undergraduate degree	35 (30.97)	19 (32.2)	16 (29.63)
Postgraduate degree	12 (10.62)	5 (8.47)	7 (12.96)
Percentage in parentheses			

Change in PL total

The model results for change in PL total are shown in Table 3. The model explained 51.9% of the variance in the change in PL total ($p < 0.001$). A significant positive relationship was found between percentage change in PL total and the length of lifter-coach relationships ($p < 0.001$). Furthermore, a positive relationship was found between change in PL total and coach education ($p = 0.024$). Finally, a negative relationship was found between change in PL total and age ($p = 0.007$).

Table 3 - Association between coaching characteristics to change in powerlifting total.

Variable	Unit	B	CI	Beta	p
Age	Years	-0.21	-0.36 – -0.06	-0.14	.007
Coach education	No formal education < personal training cert < strength and conditioning cert < undergraduate degree < postgraduate degree	1.42	0.19 – 2.64	0.12	.024
Communication frequency	Less than once p/month < once p/month < once p/two weeks < once p/week < every session	-0.58	-3.34 – 2.18	-0.03	.677
Time with coach	Months	0.57	0.46 – 0.69	0.49	<.001
Communication mode	written = 1 verbal = 0	-2.80	-6.63 – 1.02	-0.17	.148
Injured during coaching period	yes = 1 no = 0	-0.43	-4.77 – 3.91	-0.03	.843

B = unstandardized coefficients; CI = 95% confidence intervals; *Beta* = standardised coefficient; p = p-value; note: dependent variable is change in power lifting total, in kg; cert = certificate; p/month = per month, p/week = per week. Adjusted R2 = .52, p<.001, N=73, dependent variable is change in powerlifting total

Lifter Satisfaction

The model results for LS are presented in Table 4. The model explained 18.6% of the variance in LS ($p < 0.001$). A significant positive relationship was found between LS and highest GLP ($p = 0.041$). The overall effect of coach education was negative ($p=0.045$), however the odds tended to vary across thresholds of satisfaction. Specifically, the odds of being in a higher satisfaction category (relative to the combined lower categories) increased with coach education for the 1|2 and 2|3 thresholds but decreased for the 3|4 and 4|5 thresholds

Table 4 - Association between coaching characteristics and lifter satisfaction

Variable	Units	OR	CI	p
1 2 Coach education	No formal education < personal training cert < strength	4.14	1.76 – 9.78	.001
2 3 Coach education	and conditioning cert <	3.94	1.53 – 10.11	.004
3 4 Coach education	undergraduate degree < postgraduate degree	0.22	0.09 – 0.56	.001
4 5 Coach education	**	0.45	0.26 – 0.79	.005
Coach education [#]		0.56	0.32 – 0.99	.045
GLP		1.05	1.00 – 1.10	.041
Communication frequency	Less than once p/month < once p/month < once p/two weeks < once p/week < every session	1.22	0.60 – 2.48	.591
Time spent with coach	Months	1.04	1.00 – 1.09	.063
Communication mode (written)	written = 1 verbal = 0	1.23	0.39 – 3.88	.730
Injured during coaching period	yes = 1 no = 0	1.33	0.45 – 3.94	.608

B = unstandardized beta, CI = 95% confidence interval; GLP = Good lift points (arbitrary units), S&C = strength and conditioning; dependent variable is lifter satisfaction, in likert scale values (1=extremely dissatisfied, to 5=extremely satisfied); cert = certificate; p/month = per month, p/week = per week; R²=.19, p<001, N=77. **Note, the effect of coach education was not consistent over levels of the dependent. In the table, # represents the overall effect, with thresholds denoting the comparison of the odds of being in higher categories of satisfaction versus lower categories, given a change in education, relative to the comparison point (e.g., 2 | 3, corresponds to the odds of rating satisfaction as 3 or higher versus 2 or lower).

Discussion

This study aimed to understand how coaching characteristics and different delivery methods of online coaching may be associated with important PL outcomes. Specifically, the relationship of length, mode, and frequency of online coaching delivery on LS and change in PL total was of primary importance, with a secondary emphasis on relationships with coach characteristics. We hypothesized a greater percentage increase in PL total and higher LS would be strongly associated with more frequent communication, verbal feedback, and longer coaching relationships. A strong positive association between the length of the coaching relationship and change in PL total was observed. Additionally, coach education was also positively associated with change in PL total as well as LS; however, the relationship with LS was complex. No significant relationship was observed between communication frequency and LS or change in PL total. Similarly, we observed no significant relationship between communication mode (verbal or written feedback) and LS or change in PL total. Alongside these associations, the results from the survey provide an understanding of how online PL coaches communicate with their clients.

A clear finding was an association between greater change in PL total and longer coaching relationships ($p < 0.001$). Specifically, our model suggested that for every extra month of coaching received lifters had an increase in their PL total of 0.57%. Considering this finding, a longer time spent participating in PL may seem a logical explanation for this association. However, alongside age being controlled for within the model, lower ages also predicted greater increases in PL total ($p = 0.007$). Considering that younger individuals probably have accrued less training time in PL, the relationship between higher increases in PL total and the time spent with a coach may indicate that coaching positively influences performance over time. It is likely that when a coach and lifter spend more time working together, they develop a stronger relationship, leading to better performances in competition. Furthermore, the LS model produced a non-significant relationship ($p = 0.063$) between longer lifter-coach relationships and higher LS. A wide variety of approaches are available to the

coach to develop a lifter's 1RM (2,40); therefore, time to implement sufficient trial and error is likely necessary. In support of this supposition – although not in sport-coaching environments - longer RC interventions (18) tend to outperform their controls at a greater rate than shorter interventions (36). Over 90% (105/113) of powerlifters reported communicating with their coach at least once per week. While we hypothesized that more frequent communication between the lifter and coach would result in a greater increase in PL total and higher LS, the data collected are insufficient to draw conclusions. In previous RC studies, communication frequencies ranging from once per week to once per month outperformed controls at achieving desired outcomes (9,12,17,36). However, due to the lack of participants receiving lower communication frequencies, our results can only suggest that both a weekly and per-session communication frequency are unlikely to provide differing results for PL total and LS. Unfortunately, the lack of data makes it hard to draw inferences regarding lower communication frequencies and their influence on PL total change and LS. Yet, most respondents noting higher communication frequencies is an interesting finding as it highlights coaches and lifters current need/desire to communicate at least once per week. More research on lower communications frequencies, such as once per month and every two weeks, is warranted.

When we asked powerlifters whether they predominantly communicated with their coach verbally or in written format, 40.7% (46/113) noted they received verbal feedback, and 59.3% said they received written feedback (67/113). We predicted verbal feedback would have a stronger relationship with desirable results due to its likeness to in-person coaching. However, our analyses showed no significant relationship between the mode of communication and change in PL total ($p = 0.148$) or LS ($p = 0.730$). When comparing our results to those in the RC literature, it is difficult to draw a direct comparison as no studies have compared different modes of communication. However, written (17,26,35,36) and verbal (1,22,27) communication modes have outperformed controls in various studies. Some studies compared multi-modal communication to a singular mode (i.e., messages and calls vs. calls alone). In one study, the group receiving SMS and calls from their

coach had more significant weight loss than the control group, whereas the cohort receiving only SMS coaching did not (12); however, there was no significant difference between the two groups. Ultimately, given the multifaceted nature of PL coaching (nutrition for weight cutting, technique assessment and correction, resistance training programming, and coaching psychology), more research is needed on coaching communication modes for PL to determine what modes are ideal, in what circumstances, and in what combination.

A secondary finding was the significant relationship that coach education had with LS and the change in PL total. Due to the lack of regulation surrounding online PL coaching, coaches can begin practicing remotely without formal education. No previous literature has explicitly compared different levels of coach education to important outcomes, yet it typically features educated coaches. From our survey data, we found a significant positive relationship between coach education and change in PL total ($p=.024$), suggesting that, within the cohort we surveyed, those who employed coaches with a higher level of education saw greater increases in their total. Specifically, for an increase in education (e.g., strength and conditioning cert → undergraduate degree), totals increased by 1.4%. The relationship between LS and education was more complicated, with the relationship inconsistent across levels. Specifically, higher coach education appears associated with 3.9 to 4.1 times higher odds ($p<.004$) of being at least somewhat dissatisfied or neither satisfied nor dissatisfied (rating of 2 or 3, respectively), as opposed to being extremely dissatisfied (rating of 1). However, at higher thresholds, an increase in coach education is associated with a lower likelihood of being in the higher satisfaction categories. Specifically, individuals are 4.6 times and 2.2 times less likely to be somewhat satisfied (4) or more, or extremely satisfied (5) as the level of coach education increases (respectively; $p<.005$), compared to being in the combined lower categories. At face value, it would seem more coach education might be helpful up to a point, but after that, it may not necessarily lead to greater satisfaction – or may indeed detract from it.

The novelty of the results leaves them open to interpretation. The relationship between higher education and greater total increases intuitively makes sense as coaches with more domain-specific knowledge might better understand strategies to elicit strength gain. Additionally, it is possible that more educated coaches possess greater critical thinking skills and can problem solve more efficiently, an important tool for coaching. However, when considering LS, the inflection point observed where coach education was lower in those with the highest LS scores is intriguing. While we can speculate as to the cause of this relationship, it is important to note that the regression model explained only ~20% of the variance in LS. With that caveat in mind, the transition point between positive and negative associations with satisfaction around moderate levels suggests that while education has a more direct association with strength development, the association with relationship dynamics is more complicated. For example, the “soft skills” of coaching required to produce very high levels of LS may require time and experience to develop, which might conflict with the necessities of engaging in prolonged studies. With that said, due to the novelty of this finding, more trial-based research regarding coach education is warranted before definitive conclusions on this topic should be made.

Another secondary finding we observed was the significant relationship between GLP and LS ($p = 0.041$). Our results suggest that lifters with a higher bodyweight strength coefficient score tended to have a higher LS score. This relationship is logical given that those with a higher GLP have likely progressed successfully with their coach since working with them, causing greater LS. However, it is also possible that stronger lifters have spent more time in the sport and are more likely to understand their preferences when it comes to choosing a coach. Therefore, they may be more likely to pick someone that they know they will be satisfied with.

The authors acknowledge the limitations within this research. Firstly, the survey data collected was self-reported. Although participants were directed to a PL results database for competition-related questions, it is possible that, in some cases, participants did not use the database. Secondly, the

questionnaire was conducted online and anyone with access to social media could partake, meaning we cannot be sure that in every case our participants were truthful or met all inclusion criteria. Thirdly, our cross-sectional survey and correlational data are subject to the limitations present in all such observational designs; causality cannot be determined or assumed, and in cases where there may be a causative relationship between variables, its directionality is also unknown. Lastly, our sample size was only 113 after screening for incomplete and inclusion criteria-violating responses. This small sample size may not be large enough to accurately represent the larger population of competitive powerlifters.

Practical applications

This survey provides insight into how coaches communicate with their lifters. Our main finding was the positive relationship between the time a lifter spent with their coach and the increase in their PL total. Coaches should aim to work with lifters long-term as understanding a lifter and what works for them may take time. Communicating with a lifter via written and verbal feedback provides similar outcomes; therefore, coaches may utilise one or both modes of communication. Additionally, coaches may provide feedback weekly or on a per-session basis, both are viable options and common practice amongst PL coaches. Higher coach education had a notable relationship with greater increases in PL total and, to an extent, LS. Therefore, acquiring formal education in a field relevant to exercise or coaching may benefit coaches.

Chapter 5 – General Discussion

Summary

A search of the RC literature revealed distinct gaps for performance-based outcomes. Additionally, the research on coaching practices in PL is limited to programming considerations, injury risk, and biomechanics. Therefore, RC literature for health-based outcomes was reviewed to develop an understanding of effective RC structures in other fields. The findings from this literature review (chapter two) helped create an understanding of the remote communication strategies that can influence a desired outcome. Based on key themes in the RC literature, we developed an anonymous self-reported online survey to understand current PL RC coaching practices and their relationship with important PL outcomes.

The survey was comprised of 27 questions regarding participants' PL results and their RC experience. After screening for incomplete and inclusion criteria-violating submissions, 113 participants' answers were recorded and analysed. Participants, on average, had worked with their most recent coach for 21.75 ± 14.5 months and increased their PL total by $14.6\% \pm 15.5\%$ during that period. No significant relationship was evident between the mode or frequency of communication and either LS or change in PL total. However, we observed a notable association between longer coaching relationships and higher PL totals ($p < 0.001$). There was also a significant relationship between higher coach education and higher PL totals ($p = 0.024$) and LS; however, the relationship with LS was complex.

The robust linear regression model (shown in chapter 3) explained 51.9% of the variance in change in PL total. The predominant finding was the relationship between higher PL totals and longer coach-lifter relationships ($p < 0.001$). Interestingly, a significant relationship between younger ages and higher PL totals was also observed ($p = 0.007$). Importantly, these concurrent findings strengthen the importance of working with a coach for longer. The relationship between lower ages and higher PL totals weakens the argument that the relationship between longer coaching relationships and higher

PL totals may have been observed irrespective of coach influence due to greater participation hours within the sport. Unfortunately, we cannot wholly negate this argument as we did not attain participants' training age and time spent competing in PL. These findings are somewhat supported in the literature. Although there is currently no literature comparing different lengths of coaching interventions, we can draw inter-study comparisons. The literature review in chapter two highlighted two studies that were eight weeks or less in length. In both cases, no significant increases in PA were observed (32,39). Notably, both Wang et al. (39) and Smart et al. (32) used SMS as their primary form of communication, which has previously provided mixed results in other RC research (5,9,12). One study that ran for only nine weeks did, however, manage to increase well-being scores among school administrators (27). Due to the subjective nature of well-being scores, compared to physiological changes, like weight loss, it is possible that an RC intervention may have a more immediate impact on well-being scores. A commonly observed intervention length was three months (or 12 weeks) in which multiple studies noted statistically significant levels of weight loss (1,5,22). Considering this three-month timeframe for eliciting significant change with an RC intervention, alongside the 8-12 weeks necessary for strength increases (16), our inclusion criteria requiring participants to have worked with their coach for at least six months was appropriate.

Given the nature of PL and the movement and performance-based outcomes desired from coach and lifter, the finding that longer coaching relationships are related to produce higher PL totals seems logical. The longer a coach has to develop an understanding of the lifter, observe their physical and mental tendencies, and collect training-based data, the greater capacity the coach has to make informed decisions. This finding poses an interesting consideration for both coach and lifter as it may be valuable to be patient with their relationship as long as the level of satisfaction from both parties is appropriate. However, these findings may suggest the importance of emphasizing the early development of the coach-client relationship to elicit longer-term results. Another significant finding within the model was the relationship between higher PL totals and higher coach education (within a field relevant to exercise) ($p = 0.024$). This finding is novel, as no RC studies have observed

the relationship between education levels and desired RC outcomes. Notably, the majority of previous research utilises professionals with formal education such as weight loss coaches (12,13,22,35), dietitians (1), running coaches (6), and health coaches (32). Therefore, most outcomes observed within the RC literature are gained via the guidance of professionals with formal education in a relevant field. Yet, this relationship may speak to the importance of a baseline level of anatomical, physiological and sports performance knowledge. Additionally, as formal education fosters critical thinking (29), this skill may be transferable to coaching PL.

The partial ordinal regression model (shown in chapter three) explained 18.6% of the variance in LS. When considering the lack of relationship between communication frequency and LS, it is essential to understand that over 90% (105/113) of participants communicated with their coach weekly or per session. Because of the lack of participants noting lower communication frequencies, our analysis compared weekly and per-session communication, more or less. However, the prevalence of weekly and per-session feedback alongside a high mean LS score (4.4 ± 1.07) suggests that both frequencies may be used successfully. Our model also highlighted a significant relationship between LS and coach education. However, because of assumption violations, the relationship between LS and education had to be assessed nominally. Our analysis showed that those with a satisfaction score of two (somewhat dissatisfied) or higher, or three (neither satisfied or dissatisfied) or higher, were roughly four times more likely to have a coach with a higher level of education ($p = 0.004$) than those with LS scores of one (extremely dissatisfied) or two or lower, respectively. However, the relationship between education and LS had an inflection point as those with a satisfaction score of four (somewhat satisfied) or higher (extremely satisfied) were more likely to have a coach with a lower education level than those whose LS was three or lower or four or lower, respectively. As no literature has observed satisfaction scores within an RC protocol, the novelty of these results leaves them open to interpretation. The observation that participants with the highest LS scores were more likely to have a coach with a lower level of education is intriguing. It is possible that the “soft skills” required for coaching that are often gained through practical experience may be less developed in

those pursuing higher education due to less time available to accrue coaching experience. Another finding within the model was the relationship between higher GLP and higher LS ($p = 0.041$). Intuitively, it is understandable that more successful lifters are likely to note higher LS. It is also possible that higher levels of satisfaction with their coach led to a longer-term relationship, which, as previously mentioned, has a strong relationship with higher increases in PL total. Notably, our model only explained ~20% of the variance within LS; therefore, the significant relationships observed are likely of minor influence.

Limitations and future research

Due to the nature of the research conducted, there are some limitations that should be considered. The data collected via the online survey was self-reported. Although participants were asked to report their PL results from a database of official results, it is possible that participants responded based on their memory and may have recalled results incorrectly. Additionally, the survey was advertised via social media and conducted online, opening the survey to fake responses; however, inclusion criteria-based questions were entered at the start of the survey to mitigate this. Our research is also subject to the limitations of all observational research; the findings are merely correlational, and causation cannot be determined or assumed. Lastly, our survey only had 113 valid responses, which may not be enough to represent the larger population of powerlifters receiving online coaching accurately.

Practical applications

Considering the RC literature and the research conducted in this dissertation, the following recommendations are for remote PL coaches:

- PL coaching should be a long-term commitment. Understanding what works for a lifter may take time.

- Both verbal and written feedback are viable. Coaches can use one or both modes.
- Coaches can provide communication once per week or on a per-session basis. Both are feasible and common practices among PL coaches.
- PL coaches should consider formal education in a field relevant to exercise or coaching.

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Appendices

Appendix A – Ethics approval (chapter 3)



Auckland University of Technology Ethics Committee (AUTEC)

Auckland University of Technology
D-88, Private Bag 92006, Auckland 1142, NZ
T: +64 9 921 9999 ext. 8316
E: ethics@aut.ac.nz
www.aut.ac.nz/researchethics

27 September 2022

Alyssa-Joy Spence
Faculty of Health and Environmental Sciences

Dear Alyssa-Joy

Re Ethics Application: **22/280 Understanding the relationship of mode and frequency of online powerlifting coaching with lifter satisfaction, change in powerlifting total, and length of lifter-coach relationship.**

Thank you for providing evidence as requested, which satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC).

Your ethics application has been approved for three years until 27 September 2025.

Non-Standard Conditions of Approval

NSC - Please ensure that the URL link is at the end of the survey and ask participants to bookmark it.

1.

Non-standard conditions must be completed before commencing your study. Non-standard conditions do not need to be submitted to or reviewed by AUTEC before commencing your study.

Standard Conditions of Approval

1. The research is to be undertaken in accordance with the [Auckland University of Technology Code of Conduct for Research](#) and as approved by AUTEC in this application.
2. A progress report is due annually on the anniversary of the approval date, using the EA2 form.
3. A final report is due at the expiration of the approval period, or, upon completion of project, using the EA3 form.
4. Any amendments to the project must be approved by AUTEC prior to being implemented. Amendments can be requested using the EA2 form.
5. Any serious or unexpected adverse events must be reported to AUTEC Secretariat as a matter of priority.
6. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEC Secretariat as a matter of priority.
7. It is your responsibility to ensure that the spelling and grammar of documents being provided to participants or external organisations is of a high standard and that all the dates on the documents are updated.
8. AUTEC grants ethical approval only. You are responsible for obtaining management approval for access for your research from any institution or organisation at which your research is being conducted and you need to meet all ethical, legal, public health, and locality obligations or requirements for the jurisdictions in which the research is being undertaken.

Please quote the application number and title on all future correspondence related to this project.

For any enquiries please contact ethics@aut.ac.nz. The forms mentioned above are available online through <http://www.aut.ac.nz/research/researchethics>

(This is a computer-generated letter for which no signature is required)

The AUTEC Secretariat

Appendix B – Survey

Online powerlifting coaching survey

Start of Block: Acknowledgement of participation and consent

Q26

Participant Information Sheet

Date Information Sheet Produced: 09/09/2022

Project Title: Understanding the relationship of mode and frequency of online powerlifting coaching with lifter satisfaction, change in powerlifting total, and length of lifter-coach relationship.

An Invitation

My name is Jason Clarke, I am a student in the Master of Sport, Exercise, and Health programme at AUT. I would like to invite you to participate in this survey on online coaching for powerlifting.

What is the purpose of this research?

The purpose of this research is to develop a greater understanding of online coaching. Specifically, understanding how different modes and frequencies of communication are associated with important outcomes for powerlifters. The findings of this research may be used for academic publications and presentations.

How was I identified and why am I being invited to participate in this research?

If you are reading this sheet, you clicked on a survey link from a social media advertisement or in an email. To partake in this survey, you must have competed in a classic (unequipped) full power (3-lift) powerlifting competition between January 1, 2020, and the present day in the IPF or an IPF affiliate. You will also need to be currently receiving online powerlifting coaching or will have received online powerlifting coaching within the last 6 months. That coaching relationship must have also lasted at least 6 months.

How do I agree to participate in this research?

Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. By submitting the survey, you will have consented to participate.

What will happen in this research?

This survey will be completed online, it consists of 26 questions and should take no more than 15 minutes to complete.

What are the benefits?

By participating in this survey, you will help improve the understanding of online powerlifting coaching. This research will also be used to assist me in acquiring my Master of Sport, Exercise, and Health qualification at AUT.

How will my privacy be protected?

This survey is anonymous, and you will not be identifiable.

What opportunity do I have to consider this invitation?

This survey will be available to participate in until December 5.

Will I receive feedback on the results of this research?

Yes, a URL where you will be able to access the results of the survey will be available to you once you have completed it.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Alyssa-Joy Spence; email: Alyssa-joy.spence@aut.ac.nz phone: +64 21 025 93012

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEK, ethics@aut.ac.nz , (+649) 921 9999 ext 6038.

Whom do I contact for further information about this research?

Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:

Researcher

Contact

Details:

Jason Clarke; email: jason@precisepowerliftingsystems.com mobile: +64 21 202 5662

Project Supervisor Contact Details:

Alyssa-Joy Spence; email: Alyssa-joy.spence@aut.ac.nz mobile: +64 21 025 93012

Approved by the Auckland University of Technology Ethics Committee on September 27 2022,
AUTEK Reference number 22/280.

I acknowledge the information above

End of Block: Acknowledgement of participation and consent

Start of Block: General information

Q1 Age

Q2 What powerlifting category do you compete in?

Male

Female

Q28 Do you have a powerlifting total registered on www.openipf.org between Jan 1 2020 and today?

On the Open IPF home page please search your name (first and last) in the search bar in the top

right-hand corner. If there are multiple people with the same name as you, you will need to hit the search button until your results are shown. Click on your name to see your powerlifting results.

Yes

No

Q3 What weight class did you most recently compete in?

- 43
- 47
- 52
- 57
- 63
- 69
- 72
- 76
- 84
- 84+
- 53
- 59
- 66
- 74
- 83
- 93
- 105
- 120
- 120+

Q29 Please state your highest classic goodlift points (GLP) recorded on <https://www.openipf.org/>

GLP are points given to lifters in the IPF and IPF affiliates that is relative to their bodyweight.

These must be achieved in the "classic" and "full power" division.

Q8 What year was the above classic GLP achieved?

Q9 In what weight class was the above GLP achieved?

- 43
- 47
- 52
- 57
- 63
- 69
- 72
- 76
- 84
- 84+
- 53
- 59
- 66
- 74
- 83
- 93
- 105
- 120
- 120+

End of Block: General information

Start of Block: Online Powerlifting Coaching

Q10 Are you currently receiving online powerlifting coaching?

Yes

No

Q11 Have you been receiving powerlifting coaching for more than 6 months?

Yes

No

Not currently receiving online powerlifting coaching

Q12 If you are not currently receiving online coaching - how long ago did you stop receiving coaching?

Less than 6 months ago

More than 6 months ago

Currently receiving online powerlifting coaching

Q13 Were you receiving coaching for more than 6 months?

- Yes
- No
- Currently receiving online powerlifting coaching
-

Q14 How long have you currently been receiving online coaching for? If you are not currently receiving online coaching but have within the last 6 months, how long did you work with your previous coach for?

Please provide answer in number of months.

End of Block: Online Powerlifting Coaching

Start of Block: Most Recent Coaching Experience

Q30 The following questions will relate to your most recent coaching relationship.

- I understand
-

Q16 When you started receiving coaching from this coach, were you injured?

Injury definition: a condition that forces the lifter to refrain from or significantly modify training or competition.

- Yes
- No
- Unsure
-

Q17 During the period of coaching have you been injured?

Injury definition: a condition that forces the lifter to refrain from or significantly modify training or competition.

- Yes
- No
- Unsure
-

Q18 What was your highest classic powerlifting total (in KG) before you started receiving coaching?

If you were coached by your coach for your first competition, please provide that total.

Please only provide a total that is recorded on <https://www.openipf.org/> in the "classic" and "full power" divisions.

Q19 In what weight class was the above classic powerlifting total achieved?

- 43
- 47
- 52
- 57
- 63
- 69
- 72
- 76
- 84
- 84+
- 53
- 59
- 66
- 74
- 83
- 93
- 105
- 120
- 120+

Q20 What is your highest classic powerlifting total (in KG) since working with your coach?

Please only provide a total that is recorded on <https://www.openipf.org/> in the "classic" and "full power" divisions.

Q21 In what weight class was the above classic powerlifting total achieved?

- 43
- 47
- 52
- 57
- 63
- 69
- 72
- 76
- 84
- 84+
- 53
- 59
- 66
- 74
- 83
- 93
- 105
- 120
- 120+

Q22 What was your highest classic GLP before you started receiving coaching?

If you were coached by your coach for your first competition, please provide those GLP.

Please only provide a total that is recorded on <https://www.openipf.org/> in the "classic" and "full power" divisions.

Q23 In what weight class was the above classic GLP achieved?

- 43
- 47
- 52
- 57
- 63
- 69
- 72
- 76
- 84
- 84+
- 53
- 59
- 66
- 74
- 83
- 93
- 105
- 120
- 120+

Q24 What is your highest classic GLP since you started working with your coach?

Please only provide a total that is recorded on <https://www.openipf.org/> in the "classic" and "full power" divisions.

Q25 In what weight class was the above classic GLP achieved?

- 43
- 47
- 52
- 57
- 63
- 69
- 72
- 76
- 84
- 84+
- 53
- 59
- 66
- 74
- 83
- 93
- 105
- 120
- 120+

Q26 How satisfied are/were you with your coaching experience?

- Extremely dissatisfied
 - Somewhat dissatisfied
 - Neither satisfied nor dissatisfied
 - Somewhat satisfied
 - Extremely satisfied
-

Q27 How often do/did you communicate with your coach?

Please choose the best possible answer

- Every session (before, during or after)
 - Once per week
 - Once every two weeks
 - Once per month
 - Less than once per month
-

Q28 What is the most frequent medium that your coach uses/used to communicate with you online?

This refers to your coach contacting you, not you contacting them.

- Verbal (video recording, calls, voice message)
 - Written (email, messenger, WhatsApp)
-

Q29 What level of formal education/qualification did the coach have at the time you started working with them?

- Unsure
- No formal education
- Personal training certificate
- Strength and conditioning certification (such as NSCA or ASCA)
- Undergraduate degree in the relevant field (kinesiology, exercise physiology, sports science, etc.)
- Postgraduate degree in the relevant field (masters, PhD, postgraduate diploma)

End of Block: Most Recent Coaching Experience

Start of Block: [Link to results](#)

Q27 Copy and paste the following link to see the results of the survey. Bookmark the link to follow the results as they come in.

<https://docs.google.com/spreadsheets/d/1l-a1uCYHqSzKafSYGLYKaxVPQIHkU-O4KSPdZlhHoi8/edit?usp=sharing>

I acknowledge that the results can be found via following the above link

End of Block: Link to results
