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1 **When ‘just doing it’ is not enough: assessing the fidelity of player performance of an injury**
2 **prevention exercise program**

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16

17 **Abstract**

18 Objectives: To obtain benefits from sports injury prevention programs, players are instructed to
19 perform the exercises as prescribed. We developed an observational checklist to measure the quality
20 of exercise performance by players participating in FootyFirst, a coach-led, exercise-based, lower-
21 limb injury prevention program in community Australian football (AF).

22 Design: Observational

23 Method: The essential performance criteria for each FootyFirst exercise were described in terms of
24 the technique, volume and intensity required to perform each exercise. An observational checklist was
25 developed to evaluate each criterion through direct visual observation of players at training. The
26 checklist was trialled by two independent raters who observed the same 70 players completing the
27 exercises at eight clubs. Agreement between observers was assessed by Kappa-statistics. Exercise
28 fidelity was defined as the proportion of observed players who performed all aspects of their exercises
29 correctly.

30 Results: The raters agreed on 61/70 observations (87%) (Kappa=0.72, 95% CI:0.55;0.89). Of the
31 observations with agreed ratings, 41 (67%) players were judged as performing the exercises as
32 prescribed.

33 Conclusions: The observational checklist demonstrated high inter-rater reliability. Many players
34 observed did not perform the exercises as prescribed, raising concern as to whether they would be
35 receiving anticipated program benefits. Where quality of exercise performance is important,
36 evaluation and reporting of program fidelity should include direct observations of participants.

37 Keywords: Sport; Injury Prevention; Athletic Injury; Exercise Therapy; Football.

38

39 Introduction

40 Exercise-based programs to prevent injuries in team sport have gained considerable interest in the last
41 decade.¹⁻³ However, these programs can only be effective if they are delivered, and players complete
42 them, as they were originally intended.⁴ In implementation science, this is referred to as balancing
43 fidelity with adaptation; fidelity is the extent to which a program is followed as prescribed, and
44 adaptation is the extent to which a program is changed after implementation in a real-world setting.^{5,6}
45 Evaluation of fidelity provides insight into why a program succeeded and which components were of
46 value, or why it might have failed to change outcomes.^{7,8} Importantly, this evaluation also helps
47 prevent incorrect conclusions being drawn about the effect (positive or negative) of a program on a
48 given outcome.

49 Sports injury prevention programs (SIPPs) need to consider both exercise fidelity and program
50 fidelity. To obtain SIPP benefits, players are instructed to perform the exercises as prescribed, i.e.
51 with exercise fidelity. However, the extent to which exercise fidelity can be achieved is dependent on
52 a range of moderating factors for how the program is delivered, received and executed, i.e. program
53 fidelity (figure 1).^{7,9} In many exercise-based SIPPs, a detailed description of the exercise intervention,
54 often provided through training manuals, has been considered sufficient to enable coaches/trainers to
55 understand and subsequently deliver the intervention appropriately. Training manuals are generally
56 accompanied by education sessions.¹⁰⁻¹² It is assumed that with these resources, coaches/trainers can
57 deliver the exercises correctly and players can understand and execute the exercises accurately. These
58 exercise fidelity assumptions have rarely been evaluated or reported.

59 When reported, evaluation of program fidelity has generally been limited to self-reported measures of
60 frequency of exercise performance.^{7,13} These measures involve a researcher surveying participants
61 with a question such as ‘was the exercise program performed and, if so, how often?’. For example, in
62 a study of compliance with a training program in youth soccer, the coaches kept a record of whether:
63 [a] the team performed the warm-up program as part of their training session; and [b] individual
64 players participated in this team warm-up.¹⁴ Assessing participation through self-reported measures
65 can give rise to two forms of bias: (a) recall bias, if asking players/coaches to report events over an
66 extended prior period, e.g. month or season; or (b) social desirability, whereby respondents may
67 provide more favourable answers to satisfy the perceived researcher interest.¹⁵ To counter this, some
68 studies have engaged data collectors to independently record whether coaches deliver¹² or players
69 participate¹⁶ in a program fully, partially or not at all. While this improves monitoring of the extent of
70 participation, the data still gives no insight into how well the players perform the exercises, i.e.
71 exercise fidelity. To our knowledge, there has been no published direct observational assessment of
72 exercise fidelity prescribed as part of any exercise-based SIPP and, as such, there are no observational
73 audit tools published for this purpose.

74 The National Guidance for Australian football Partnerships and Safety (NoGAPS) project aims to
75 understand how sports injury research and prevention efforts can be better translated into community
76 sport settings.¹⁷ A major component of this project involves the development, implementation and
77 evaluation of an evidence-informed SIPP, “FootyFirst,” to prevent lower limb injuries in community
78 Australian Football (AF). To aid the evaluation of overall program fidelity for FootyFirst, a checklist
79 was required, and subsequently trialled, to objectively assess player exercise fidelity. The aim of this
80 paper is to report the development, trial and testing of the inter-rater reliability of this observational
81 fidelity assessment tool. Specifically, a checklist was designed to assess the degree to which observed
82 players performed each exercise component within FootyFirst compared to how it was originally
83 prescribed.

84 **Methods**

85 FootyFirst is an evidence-based and context-informed lower-limb SIPP that has been developed
86 specifically for community AF. The FootyFirst exercises were developed by the research team and
87 refined by content and context experts, and AF-industry partners. In short, FootyFirst begins with a
88 general, 10-minute warm-up program of 12 exercises, including run-throughs and dynamic stretches.
89 This is followed by lower-limb strength and conditioning exercises/drills to enhance balance, landing
90 and side-stepping techniques (e.g., hamstring lowers, planks and side-stepping evasion skills). Each
91 exercise has five levels of progression, with players encouraged to start at level 1 and progress to
92 subsequent levels as their strength, muscular endurance, balance and flexibility improve. FootyFirst
93 was designed to take 20 minutes and to be a replacement for, or accompaniment to, existing warm-ups
94 used in twice-weekly, training sessions. The program is presented in a manual, posters and videos,
95 (available from the authors on request). Performing all FootyFirst exercises with correct technique,
96 volume and intensity is considered essential to ensure the full program benefits are gained.

97 Using the FootyFirst program manual and videos as references, each individual exercise was
98 described according to essential performance criteria under exercise prescription categories of
99 technique, volume, and intensity, as described in American College of Sports Medicine guidelines.¹⁸
100 For example, in the hamstring lower exercise, the essential criteria were: technique -*lean forward*
101 *from knees, keep body as straight as possible*; intensity - *slowly lean forward*, because the player is
102 trying to resist gravity by using the hamstrings in an eccentric contraction; and volume - initially *6*
103 *repetitions* and increases through the levels to *2 sets of 12 repetitions*.

104 The descriptive criteria for each exercise were reviewed by the research team members who had
105 developed the original FootyFirst content (****). An iterative process continued until consensus was
106 achieved on the descriptions of the essential performance criteria for each exercise. The most frequent
107 points raised during this process were centred on making sure all details on correct performance were
108 explicit. For example, the second criteria of the hands to ground exercise in the warm-up started as
109 'reaches the ground at least four times' and was refined to 'both hands touch the ground in front of the
110 player at least four times' to include specific details relating to technique and volume.

111 Consensus on the full list of exercise criteria was reached after five drafting rounds. The number of
112 criteria for each exercise ranged from three to five (with the exception of the warm up 'jog,' which
113 was covered by the overarching instruction that all warm-up running based activities were to be
114 carried out at 'jogging pace'). Assessment of the criteria was then operationalised to an observational
115 checklist that required a yes/no answer be given for each criteria of each exercise.

116 The checklist, or FootyFirst Observational Tool (FOT), was prepared in a paper-based format for
117 observing on-field training sessions. Clear instructions in using the form and performance of the
118 exercises were included as prompts on the cover page and alongside each exercise. This was to allow
119 use by any person with an exercise physiology and/or strength and conditioning background. The
120 observer name, date, club and player identifier (e.g., red shoes) were recorded on cover page to allow
121 observations from multiple users to be matched. The FOT was pre-tested, observing a small number
122 of FootyFirst participants before the observation period began. The final version of the FOT is
123 provided as supplementary material.

124 The Monash University Human Research Ethics Committee approved this observational study that
125 was nested in the NoGAPS project. Players from community AF clubs from two regional leagues in

126 Victoria, Australia, were observed. The coaches of teams were informed of the study and provided
127 their written consent for their team's involvement.

128 Using the FOT, two accredited exercise physiologists observed and rated the exercise performance of
129 players. Both raters were familiar with the FootyFirst program and had contributed to the
130 development of the FOT. On eight separate occasions, both raters attended the same training session.
131 There was minimal interaction between the raters and the team, other than a short communication
132 with the coach to inform of their presence. No specific reason for why they were observing the
133 training session was given, other than a general observation of FootyFirst implementation.

134 One rater nominated a player for observation by indicating an easily identifiable feature such as the
135 colour of their shirt. This information was recorded on the FOT. Both raters then independently
136 recorded their observations of how that player performed their next exercise. If any essential
137 performance criteria were not performed as described, a 'no' was recorded and a reason noted against
138 the specific criteria, where applicable. The two raters were situated side-by-side, observing a player
139 from the same angle at a position on the field that enabled a clear view of the player. They did not
140 discuss their observations of players. Approximately ten players, each performing one exercise, were
141 observed at each session, taking approximately 15 minutes per session. Agreement on observations
142 between raters was compared with Cohen's Kappa statistic (K) with 95% confidence interval (95%
143 CI). Predetermined sample size was calculated as 58 observations. Analyses were performed using
144 IBM SPSS Statistics, version 21.

145 Exercise fidelity was assessed as being 'correctly' or 'incorrectly' performed by a player. If an
146 observer scored a player with yes on all criteria, the exercise was considered correctly performed.
147 Recording of 'no' on any criteria indicated incorrect performance of the exercise. The 'no' rating for
148 exercise fidelity was irrespective of how many criteria were determined as incorrect or if the raters
149 identified differing criteria within the exercise as incorrect. Where rater observations differed, there
150 was no way to determine which of the two was correct. Therefore, assessment of exercise fidelity was
151 based only on agreed observations. Descriptive data of agreed observations for the different exercises
152 are presented.

153 **Results**

154 The FOT was trialled at eight clubs across 70 individual player observations. Of the 70 observations,
155 the raters agreed on their yes/no answer 61 times (87%) (Kappa = 0.72, 95% CI: 0.55 ; 0.89, $p <$
156 0.001) indicating "substantial agreement."¹⁹ They disagreed on 9 observations.

157 Most players were observed to only be performing exercises from the warm-up component of
158 FootyFirst, not the progressive levels 1–5 of the program. Restricting analysis to observations from
159 the warm-up, the raters agreed on 54 observations out of 60 (90%).

160 Of the 61 players for whom both raters agreed on their observations, both raters scored all essential
161 criteria as 'yes' for 41 observations (67%), indicating that these players performed the observed
162 exercise correctly. Both raters scored at least one essential criteria contributing to an exercise as 'no'
163 in 20 exercises (33%), indicating the exercise was performed incorrectly by these players.

164 **Discussion**

165 This paper describes the development and reliability of a new observational tool, the FOT, to aid the
166 assessment of exercise fidelity in association with exercise-based lower limb SIPP. Performing each

167 SIPP exercise as prescribed, that is, with high exercise fidelity, is considered essential to ensure the
168 injury prevention benefits are gained. Yet, despite the inherent performance requirements and a
169 growing interest in SIPPs, no process to consistently assess the quality of performance after
170 implementation has been described in the literature.

171 Major strengths in developing the FOT, are the simple development stages that resulted in a tool with
172 substantial inter-rater agreement. However, it should be noted that both raters had backgrounds in
173 exercise physiology and were familiar with the program. This could mean they were more likely to
174 agree on their subjective observations than other raters. The primary use of the FOT is for
175 implementation evaluation by a research team. It is anticipated that any rater with a background in
176 exercise physiology or strength and conditioning would be reasonably familiar with the exercises and
177 therefore, also able to use the FOT.

178 Anecdotal feedback from the raters supported usability at a typical community AF training session.
179 The tick-box format was well matched to the exercises, and was quick and simple to complete. The
180 FOT could confidently be applied to other settings, providing there are observable criteria for correct
181 exercise performance. Although the checklist was developed retrospectively, by involving the original
182 expert program developers face and content validity of the FOT were ensured. Ideally, the essential
183 performance criteria for each exercise would be documented in the required format at the same time
184 as an intervention is first developed.

185 The criteria of volume, technique and intensity were chosen based on general exercise prescription
186 guidelines. In the FootyFirst program, the ‘intensity’ criteria were primarily focused on speed of
187 exercise performance, such as hamstring lowers, which are to be performed ‘slowly.’ The term
188 ‘intensity’ was preferred over ‘speed’ to enable the transfer of the design of the FOT to other SIPPs.
189 Intensity can be operationalised as speed in running, or the amount of force or resistance in resistance
190 training. In regard to running and jumping, speed is important as Newton’s 2nd law of motion states
191 that $\text{force} = \text{mass} \times \text{acceleration}$ or re-arranged, $\text{acceleration} = \text{force} / \text{mass}$. This means that the more
192 force a muscle produces, the more the acceleration and speed of movement, and greater the force of
193 contraction or intensity. However, in eccentric resistance training, faster greater muscular force can be
194 generated for a given level of activation and exertion. So intensity was assessed differently depending
195 on the task being performed. Although the assessment of intensity in our program was somewhat
196 subjective, it is important, as performing dynamic stretches too rapidly may reduce or remove the
197 benefit of targeted muscle contraction and even place a player at risk of injury while performing the
198 exercise.¹⁸

199 A strength of this study was the large number of observations performed across different clubs and
200 training sessions. Despite this, most observations were performed only on the warm-up level of
201 FootyFirst. One explanation for this is that the FootyFirst warm-up is similar to traditional AF training
202 warm-ups. Therefore, it may be more easily adopted into regular practice. This familiarity with the
203 warm-up exercises may have inadvertently resulted in a higher inter-rater reliability than would
204 otherwise be seen across the progressive program levels. It is possible that the more advanced
205 strength, conditioning and neuromuscular type exercises, being less familiar to coaches and players,
206 were considered more difficult to adopt and implement. This is in line with the ‘compatibility’
207 construct of the Diffusion of Innovations theory that suggests an innovation is more likely to be
208 adopted if it is consistent with the existing values, past experiences and needs of potential adopters.²⁰
209 This means that for the less familiar exercises, coaches and players will become more accustomed to
210 instructing and performing these over time. This could also mean that the observers may be better at
211 detecting the fidelity elements of the currently less familiar exercises, but this needs to be tested in the

212 future. Furthermore, future research could consider whether the FOT can be extended to use as a tool
213 for assessing change in exercise fidelity.

214 FootyFirst was designed as an exercise training program to be delivered by coaches to teams of
215 players during twice-weekly training sessions. The actual coach delivery of the program was not
216 assessed, nor were players asked if they thought they were performing the exercises correctly.
217 However, it is assumed that most coaches and players would self-report that the program was
218 delivered and performed as intended. Previous studies in sport and physical activity behaviours have
219 also found differences between self-reported outcomes compared to observed behaviours including
220 overestimating protective equipment use²¹ and both over- and under-estimating physical activity
221 levels.²² Direct observations have been advocated as a way to measure behaviour in relation to
222 intervention delivery in different injury contexts.²³⁻²⁵ Within sport and recreational injury research to
223 date, direct observational audits are rare, having been used only to record safety behaviours in golf,²⁶
224 squash,²¹ AF²⁷ and on the beach.¹⁵

225 From this first application of the FOT, it is clear that exercise fidelity is an important area to include
226 in SIPP research. The raters agreed that one third of players were not performing the FootyFirst
227 exercises exactly as prescribed. The written details of the warm-up observations described in Table 1,
228 show that only three of the twelve exercises were performed correctly on all components (jog; leg
229 swings forward; leg swings across body). The raters disagreed on all five assessments of the 'calf
230 stretch with straight leg' exercise. The remaining eight exercises had a mix of agreed observations.
231 Comments from the raters reported that volume was the most frequent cause of incorrect performance
232 and that players tended to perform an incorrect number of repetitions (too many or too few). This was
233 despite the leniency in volume that was built into the FootyFirst instructions ("as long as the player is
234 not overly fatigued, one or two repetitions over amount designated is okay"). The pre-program
235 demonstrations and resources of FootyFirst are aimed at the coaches who deliver the program. In
236 these, correct technique is strongly emphasised with the expectation that this component would be
237 most difficult to translate. Our results found that the exercises were mostly performed with correct
238 technique so perhaps the FootyFirst demonstrations/resources need to place equal emphasis on
239 performance of all essential criteria. An additional simple checklist could be provided to coaches to
240 take onto the field to remind them of the correct number of exercise repetitions. Although there was
241 no attempt to link exercise fidelity with injury outcomes in this study, our finding that exercise fidelity
242 is not achieved by all players, suggests this is an important and interesting area to explore. For
243 example, what degree of exercise fidelity will still result in a safe and effective program for injury
244 prevention?

245 A limitation of this study was that coaches knew the raters were observing the training session.
246 Although no reason for conducting the observations was given, it is possible that coaches specifically
247 instructed players to perform the exercises to a higher standard because the raters were present.
248 Similarly, players may have performed the exercises more conscientiously than usual because they
249 knew they were being observed. If so, our finding that one third of exercises were performed
250 incorrectly is an underestimate and fewer players might be expected to perform the exercises with
251 fidelity in normal, unobserved practice.

252 **Conclusion**

253 Use of an observational checklist to assess exercise fidelity can give useful insight when evaluating
254 program implementation. Where exercise technique, volume and intensity are important, evaluation of

255 SIPPs should consider using an observational assessment in place of self-report measures of
256 compliance.

257 **Practical Implications**

- 258 • The exercises included in injury prevention programs can be described according to essential
259 performance criteria of technique, intensity and volume.
- 260 • An observational checklist with high inter-rater reliability can be used to determine if
261 essential criteria of an exercise are performed correctly by players.
- 262 • When participating in exercised-based sports injury prevention programs, many players do
263 not perform the exercises as they are prescribed, which could negatively impact on injury
264 prevention benefits.

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283 **References**

- 284 1. Hübscher M, Refshauge KM. Neuromuscular training strategies for preventing lower limb
285 injuries: what's new and what are the practical implications of what we already know? *Br J*
286 *Sports Med.* 2013;47:939-940.
- 287 2. Lauersen JB, Bertelsen DM, Andersen LB. The effectiveness of exercise interventions to
288 prevent sports injuries: a systematic review and meta-analysis of randomised controlled trials.
289 *Br J Sports Med.* 2013. Online First doi:10.1136/bjsports-2013-092538
- 290 3. Herman K, Barton C, Malliaras P, et al. The effectiveness of neuromuscular warm-up
291 strategies, that require no additional equipment, for preventing lower limb injuries during
292 sports participation: a systematic review. *BMC Medicine.* 2012;10:75.
- 293 4. Finch CF, Donaldson A. A sports setting matrix for understanding the implementation context
294 for community sport. *Br J Sports Med.* 2010;44:973-978.
- 295 5. Hansen WB. Introduction to the special issue on adaptation and fidelity. *Health Education.*
296 2013;113:260.
- 297 6. Allen JBL, L.A.; Emmons, K.M. Fidelity and Its Relationship to Implementation
298 Effectiveness, Adaptation, and Dissemination. In: Brownson RCC, G.A.; Proctor, E.K., ed.
299 *Dissemination and Implementation Research in Health: Translating Science to Practice.* New
300 York: Oxford University Press; 2012:281-304.
- 301 7. Carroll C, Patterson M, Wood S, et al. A conceptual framework for implementation fidelity.
302 *Implement Sci.* 2007;2:40.
- 303 8. Leeuw M, Goossens ME, de Vet HC, et al. The fidelity of treatment delivery can be assessed
304 in treatment outcome studies: a successful illustration from behavioral medicine. *J Clin*
305 *Epidemiol.* 2009;62:81-90.
- 306 9. Resnick B, Michael K, Shaughnessy M, et al. Exercise intervention research in stroke:
307 optimizing outcomes through treatment fidelity. *Top Stroke Rehabil.* 2011;18 Suppl 1:611-
308 619.
- 309 10. Andrew N, Gabbe BJ, Cook J, et al. Could targeted exercise programmes prevent lower limb
310 injury in community Australian football? *Sports Med.* 2013;43:751-763.
- 311 11. Myklebust G, Skjolberg A, Bahr R. ACL injury incidence in female handball 10 years after
312 the Norwegian ACL prevention study: important lessons learned. *Br J Sports Med.*
313 2013;47:476-479.
- 314 12. LaBella CR, Huxford MR, Grissom J, et al. Effect of neuromuscular warm-up on injuries in
315 female soccer and basketball athletes in urban public high schools: cluster randomized
316 controlled trial. *Arch Ped Adolesc Med.* 2011;165:1033-1040.
- 317 13. de Vos AJ, Bakker TJ, de Vreede PL, et al. The Prevention and Reactivation Care Program:
318 intervention fidelity matters. *BMC Health Serv Res.* 2013;13:29.
- 319 14. Soligard T, Nilstad A, Steffen K, et al. Compliance with a comprehensive warm-up
320 programme to prevent injuries in youth football. *Br J Sports Med.* 2010;44:787-793.
- 321 15. Petrass LB, J., Finch, C.F. Self-reported supervisory behaviour and beliefs, validated against
322 actual observations of caregiver behaviour at beaches. *Int J Aq Res Ed* 2011;5:199-209.
- 323 16. Finch CF, Diamantopoulou K, Twomey DM, et al. The reach and adoption of a coach-led
324 exercise training programme in community football. *Br J Sports Med.* 2013.
- 325 17. Finch CF, Gabbe BJ, Lloyd DG, et al. Towards a national sports safety strategy: addressing
326 facilitators and barriers towards safety guideline uptake. *Inj Prev.* 2011;17:e4.
- 327 18. American College of Sports Medicine; Swain DP. *ACSM's resource manual for guidelines for*
328 *exercise testing and prescription.* Philadelphia: Wolters Kluwer Health/Lippincott Williams
329 & Wilkins; 2014.

- 330 **19.** Landis JR, Koch GG. The measurement of observer agreement for categorical data.
331 *Biometrics*. 1977;33:159-174.
- 332 **20.** Rogers E. *Diffusion of innovations*. 5th ed. New York: Free Press; 2003.
- 333 **21.** Eime R, Finch C, Owen N, et al. Do squash players accurately report use of appropriate
334 protective eyewear? *J Sci Med Sport*. 2005;8:352-356.
- 335 **22.** Prince SA, Adamo KB, Hamel ME, et al. A comparison of direct versus self-report measures
336 for assessing physical activity in adults: a systematic review. *Int J Behav Nutr Phys Act*.
337 2008;5:56.
- 338 **23.** Thompson RSS, J.J. Evaluating an injury intervention or program. In: Rivara FPC, P.;
339 Koepsell, T.D.; Gross, D.C.; Maier, R.V., ed. *Injury Control. A guide to research and*
340 *program evaluation*. Cambridge, UK: Cambridge University Press; 2001:196-216.
- 341 **24.** Gteller ES. *The psychology of safety handbook*. Florida: Lewis Publishers; 2001.
- 342 **25.** Finch CF. Implementing and evaluating interventions. In: Baker S, Li, G., ed. *Injury*
343 *research: theories, methods, and approaches*. New York: Springer; 2012:619-639.
- 344 **26.** Fradkin AJ, Finch CF, Sherman CA. Warm up practices of golfers: are they adequate? *Br J*
345 *Sports Med*. 2001;35:125-127.
- 346 **27.** Braham RA, Finch CF. Do community football players wear allocated protective equipment?
347 Descriptive results from a randomised controlled trial. *J Sci Med Sport*. 2004;7:216-220.

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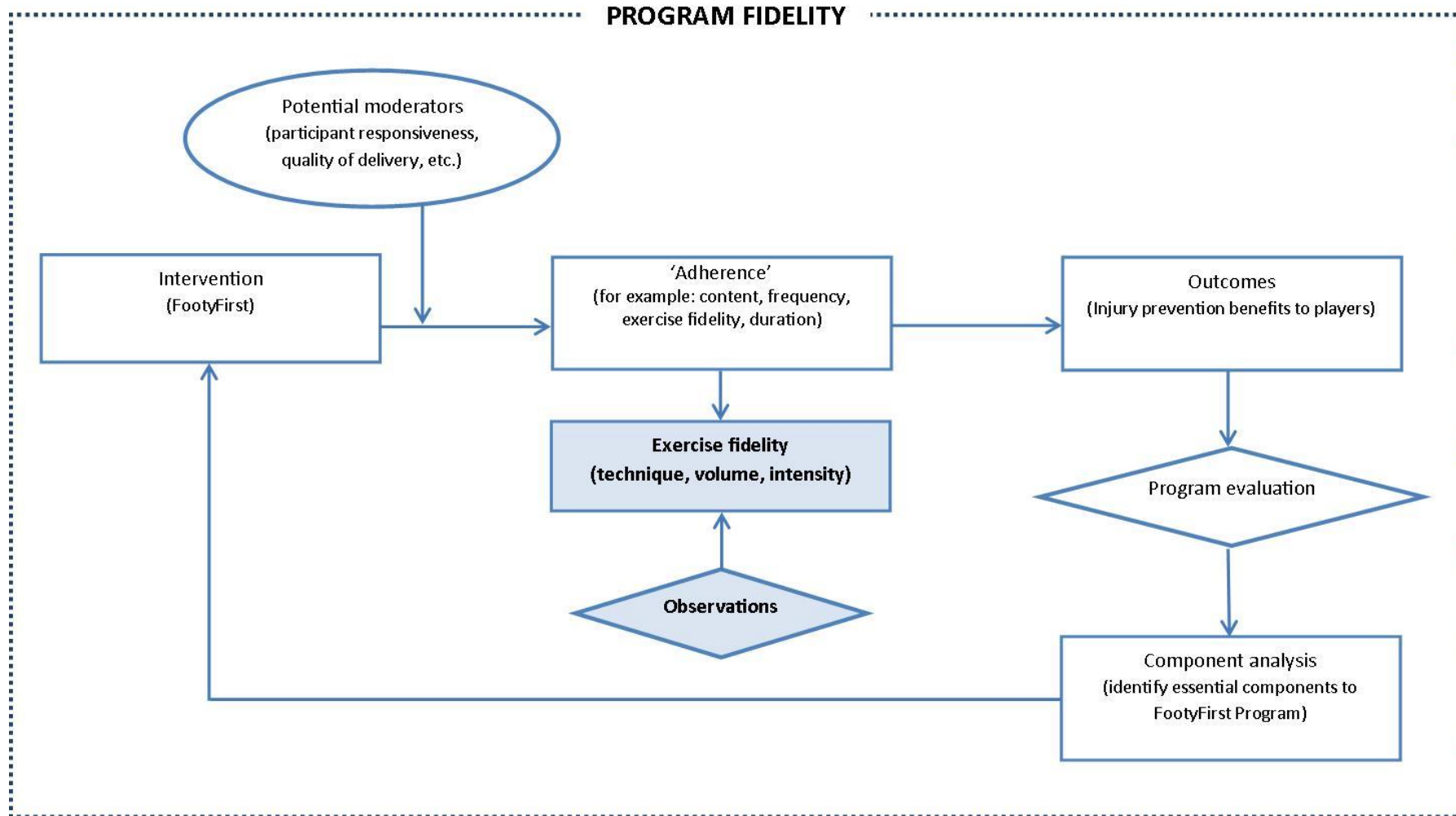
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Table 1: Description, observations and exercise fidelity agreement for the observed FootyFirst warm-up exercises

Exercise	Essential performance criteria of the exercise	Observations*	Number agreed [^]	Number agreed yes [#]
GROUP WARM-UP EXERCISES^π				
1. jog	1) One rep completed	6	6	6
2. side to side	1) Adequate step length to receive stretch 2) One rep through facing in each direction	7	7	6
3. carioca	1) Length of stride 2) Knee in high position in front of body 3) One rep through facing in each direction	5	5	3
4. running backwards with high feet	1) Raises high to buttocks before planting on ground 2) One rep through	4	4	2
5. butt kicks	1) Thighs are vertical 2) In 2 nd rep there is a clear attempt to make contact between heels and buttocks 3) Two reps through	9	8	5
6. hands to ground	1) Does not twist whilst bending over 2) Both hands touch the ground at least four times 3) One rep through	4	2	1
DYNAMIC STRETCHES				
7. calf stretch (straight leg)	1) Leg straightened as far as possible in an attempt to touch the ground 2) Performed slowly 3) At least five reps per leg	5	3	0
8. calf stretch (bent knee)	1) Knee is always bent when heel is pushed down as far as possible in an attempt to touch the ground 2) Exercise performed slowly 3) At least five reps per leg	5	4	1
9. hip rotation	1) Knee is lifted bent in front of the body 2) Slow and big circle outward 3) At least four reps per leg	3	3	2
10. leg swings forward	1) Uses kicking action 2) Keeps leg straight as possible 3) Swing controlled and challenging height for stretch reached 4) At least six reps per leg	7	7	7
11. leg swings across body	1) Swings leg across body 2) Swing controlled and challenging height for stretch reached 3) At least six reps per leg	3	3	3
12. walking lunges	1) Trunk is vertical 2) Heel of front foot stays on the ground 3) Knee finishes over the toes and the back knee is just off the ground 4) At least eight lunges in total	2	2	1
All observations		60	54	37
Agreement between raters			90%	
Warm up exercise fidelity				69%

351 *number of players observed performing exercise; [^] both raters agreed all criteria met or at least one criterion not met; [#] both raters
352 agreed all criteria met; ^π all group warm-up exercises were "to be carried out at 'jogging pace,'" this intensity was not included in
353 observations.

354 **Figure 1: Observations of exercise fidelity within the framework of evaluating FootyFirst program fidelity**
355 (based on the original implementation fidelity framework of Carroll⁷)



356

357

358 **Appendix 1:** FootyFirst Observational Tool (pdf)

359