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Adherence to an injury prevention program in male amateur football players is affected by players' age, experience and perceptions

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ABSTRACT

Objectives Adherence to injury prevention programmes in football remains low, which is thought to drastically reduce the effects of injury prevention programmes. Reasons why (medical) staff and players implement injury prevention programmes, have been investigated, but player's characteristics and perceptions about these programmes might influence their adherence. Therefore, this study investigated the relationships between player's characteristics and adherence and between player's perceptions and adherence following an implemented injury prevention programme.

Methods Data from 98 of 221 football players from the intervention group of a cluster randomised controlled trial concerning hamstring injury prevention were analysed.

Results Adherence was better among older and more experienced football players, and players considered the programme more useful, less intense, more functional and less time-consuming. Previous hamstring injuries, educational level, the programme's difficulty and intention to continue the exercises were not significantly associated with adherence.

Conclusion These player's characteristics and perceptions should be considered when implementing injury prevention programmes.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Implementing injury prevention programmes in football remains difficult.

⇒ Educating coaches about injury prevention programmes can increase adherence.

WHAT THIS STUDY ADDS

⇒ Players' age and years of football experience and player's perceptions such as usefulness, functionality, intensity and time investment were related to the adherence to the bounding exercise programme.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Player's characteristics and perception may be important to take into account when designing and implementing injury prevention exercise programmes.

INTRODUCTION

The effectiveness of injury prevention exercise programmes (IPEP) depends on both the efficacy of the programme itself and on players' adherence to the programme.[1 2] For the Nordic hamstring exercise, for instance, it is known that football players do not adhere sufficiently to this exercise, and this reduces its potential preventive effects.[3 4] To increase adherence, the bounding exercise programme (BEP) was developed.[5] BEP consists of plyometric exercises that can be easily integrated into the warming-up or regular training session and enhance football-specific performance.[6 7] Nevertheless, the cluster randomised controlled trial (RCT) studying the efficacy of this programme revealed that adherence decreased during the football season.[8]

Implementing injury prevention programmes in the real world remains difficult and depends on many components.[9 10] The SETTING (Setting-Exploration-Treasure-Trail-to-Inform-implementatioN-strateGies) tool used to implement health interventions states that implementation strategies start with knowing the context.[11] Therefore, in (amateur) football, some studies focused on coaches' beliefs as the deliverers of IPEPs in various sports. These studies showed that educating coaches about IPEPs and their role in injury prevention benefits adherence.[12 13] However, little is known about other stakeholders, such as players themselves and their role in implementing IPEPs.[14]

Several models for health behaviour have been developed and investigated. The Health Beliefs Model (HBM) describes six constructs about individual motivation and perceptions that influence health-related behaviour, which is directly related to adherence to IPEPs: (1) perceived susceptibility,

(2) perceived seriousness, (3) perceived benefits, (4) perceived barriers, (5) cues to action and (6) self-efficacy.[15–17] Although many other factors can be added to these constructs (ie, external factors), these constructs might (partly) explain why players' perceptions of IPEPs change when they have insight into their risks.[18 19]

Previous studies indicated that personal characteristics (ie, age, education level) and players' perceptions about the preventive measure are important for good adherence, but further knowledge about these relationships is needed.[14 16] Therefore, this study aimed to gain insight into the context of football players and provide directions for implementation strategies by determining (1) relations between player's characteristics and adherence and (2) between player's perceptions of the BEP and adherence.

METHODS

This study was part of a large nationwide cluster RCT investigating the effectiveness of BEP.[5 8] The trial was registered in the Dutch trial registry (NTR6129). The study protocol has been described elsewhere.[5]

Participants

Adult male football players competing in the Dutch first-class amateur season and allocated to the intervention group of the cluster RCT were included in this study.

Procedures and data collection

All players gave written informed consent before the study. The BEP was introduced to the technical and medical staff through workshops. The staff members were instructed to implement the BEP at the end of the warm-up in the training sessions (two times per week). The BEP consists of a 12-week build-up and maintenance programme for the rest of the season (10 months).[5] The built-up programme consisted of (1) 4weeks walking lunges over a 30 m distance, (2) triplings and drop lunges over a 30 m distance and (3) the bounding exercise over 30 m distance.

Players completed a baseline questionnaire consisting of personal characteristics such as age, work/education level, years of football experience and number of previous hamstring injuries during the last football season. Education level was dichotomised as high (studying at the university or university of applied sciences and professions related to that level) and low (all other professions and studies). During the subsequent football season, the players weekly registered whether they had a hamstring injury and the number of metres BEP they performed. Players were instructed to register 0 m when they were injured. The baseline questionnaire was used to construct 'perceived susceptibility' of the HBM.

Adherence was calculated as the number of metres BEP performed divided by the metres of BEP prescribed times 100%. Hamstring injuries were self-reported by the players and validated by the medical staff. At the end of the study, players completed the evaluation questionnaire. The evaluation questionnaire consisted of questions about the player's perceptions of the BEP and focused on the constructs 'perceived benefits' and 'perceived barriers' to executing the programme. This questionnaire (online supplemental material 1) consisted of questions scored on a scale from 1 to 5 about the usefulness of the programme, its intensity, difficulty, functionality, the time investment and the intention to continue the programme in the following season.

Statistical analysis

SPSS V.25 was used for the analysis.[20] About 50% of the weekly data points (training minutes, match play minutes and adherence to bounding) were missing. Missing weekly registrations and validated injury periods were assumed to be non-adherent. Pearson's product-moment correlations were calculated between adherence and age and years of football experience for the first aim. Analyses of variance (F tests) were executed to calculate the differences in average adherence between players with and without previous hamstring injuries and high or low education levels. For the second aim, analyses of variance (F tests) were executed to calculate the differences in perception about the BEP concerning adherence.

RESULTS

Ninety-eight male amateur football players were included (mean age: 24.6; mean football experience: 18.5 years). Fifteen players had one hamstring injury, and five players had two hamstring injuries in the previous season. Twelve players sustained a hamstring injury during the study period (table 1). The mean adherence was 54% and ranged from 0% to 100%. Adherence might be underestimated since players reported 0 m when absent or injured.

Table 1 Player's characteristics (N=98)

Characteristics	Mean (SD)
Age (years)	24.6 (4.03)
Weight (kg)	78.16 (7.45)
Height (cm)	183.93 (5.46)
Experience (years)	18.48 (4.56)
Previous injuries	**N**
0	78
1	15
2	5
Injuries during the study period	**N**
0	86
1	12
Education level	**N**
Low	33
High	63
Unknown	2

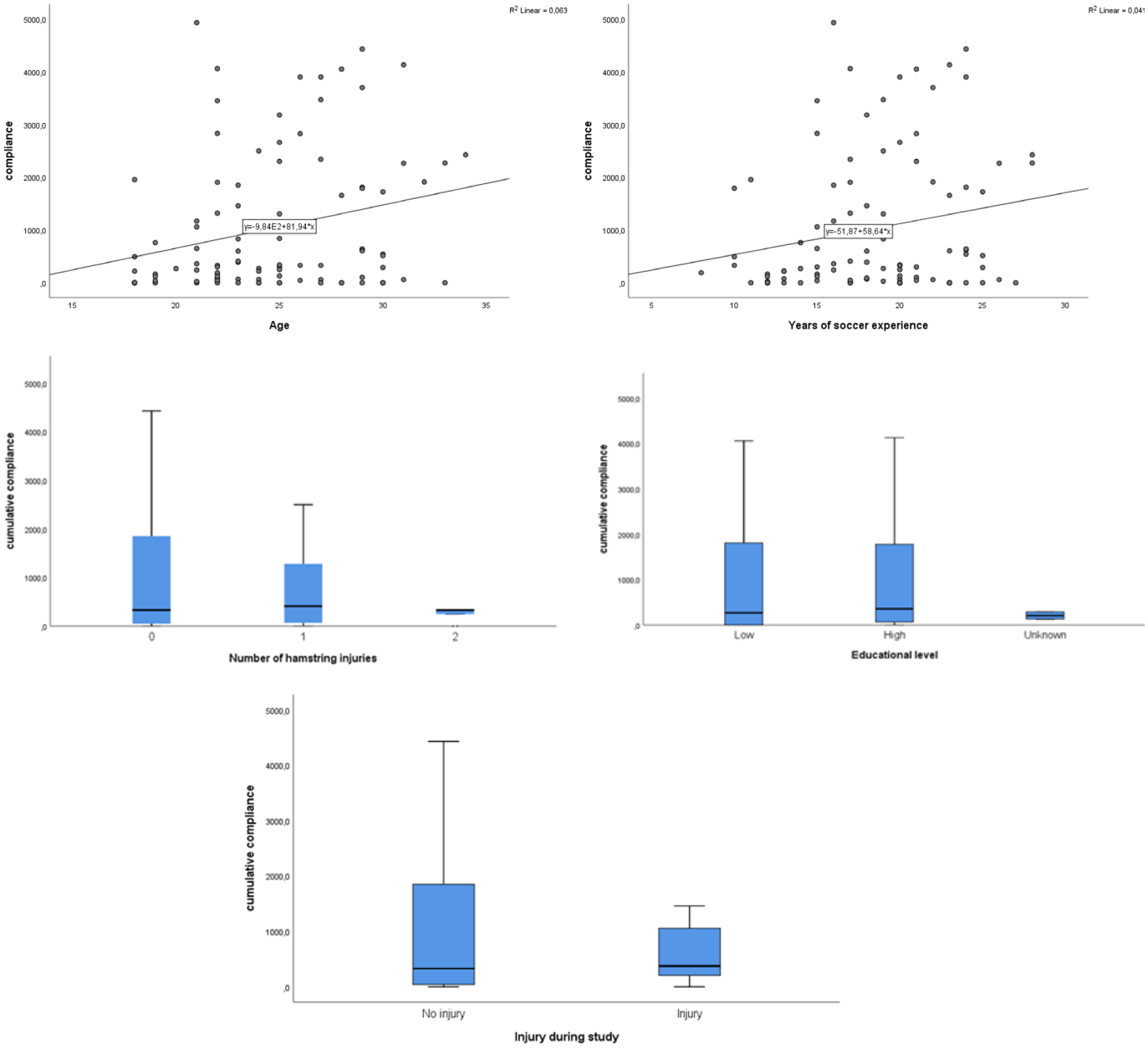

Figure 1 Relationship between player characteristics and adherence.

Player's characteristics and adherence

Significant but low correlations were found between adherence and age (r=0.25, 95% CI 0.054 to 0.429) and adherence and years of football experience (r=0.20, 95% CI 0.004 to 0.387). Adherence did not significantly differ between players with or without previous hamstring injuries ($F_{1,96}$=0.874, p=0.420) and between players with or without future hamstring injuries ($F_{1,97}$=0.228, p=0.634) or between high or low educational level ($F_{1,97}$=0.602, p=0.512) (figure 1).

Player's perceptions about BEP and adherence

Adherence was higher in players who perceived BEP as more useful ($F_{1,97}$=2.747, p=0.033), less intense ($F_{1,97}$=3.202, p=0.027), more functional (ie, exercise that corresponds with a key activity in football) ($F_{1,97}$=4.181, p=0.018) and less time-consuming ($F_{1,97}$=4.317, p=0.003) than the group that reported the contrary. No evidence was found for a relationship between adherence and difficulty of the programme ($F_{1,97}$=0.637, p=0.593), and between adherence and intention of performing the BEP in the coming season ($F_{1,97}$=1.465, p=0.219) (figure 2).

DISCUSSION

This study found that increased age and years of football experience were poorly related to higher adherence. Players who considered BEP useful, less intense, functional or less time-consuming adhered better than players who reported otherwise.

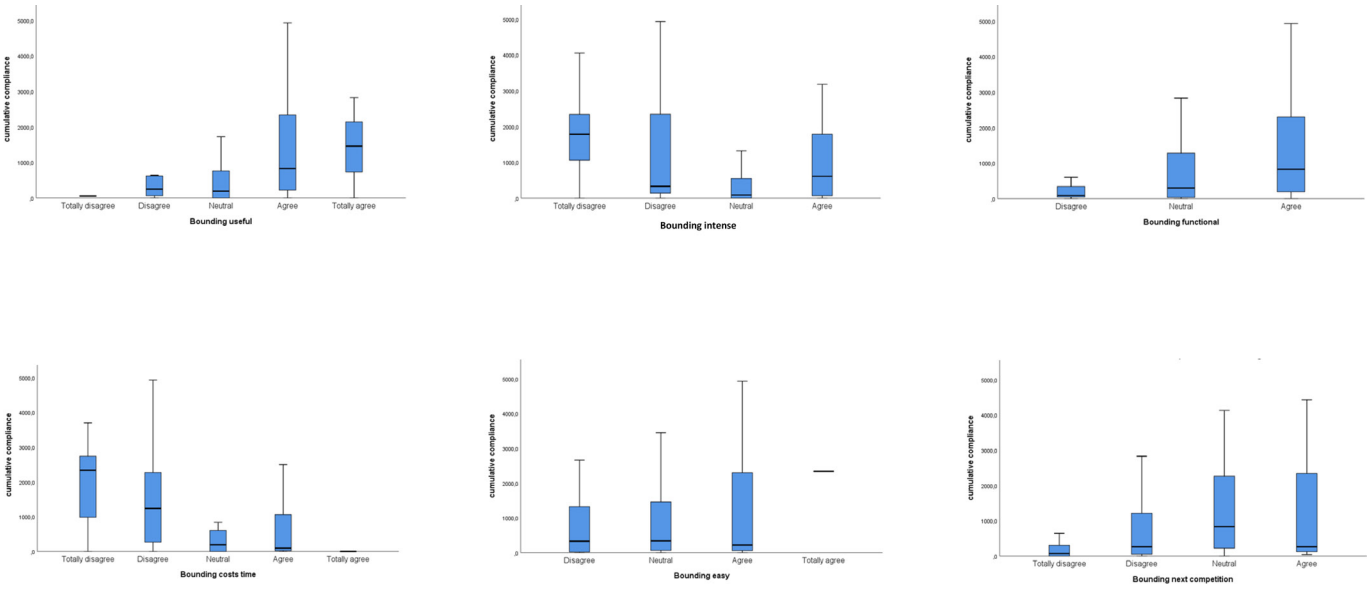

Figure 2 Differences between player's perceptions of the bounding exercise programme concerning adherence.

Player's characteristics

This study found that older and more experienced players tended to adhere better to IPEPs than the younger and less experienced players. These older players seemed to have developed a certain routine and were more motivated to invest in staying fit than younger players.[14] Older, experienced players seem to have learnt how to apply preventive measures and become more accountable for their health protection.[12]

No significant relationship was found between previous or new hamstring injuries and adherence to the hamstring IPEP. This was unexpected since players tend to change their risk-taking behaviour when an event has occurred.[18] These results are based on the number of injuries and not on the injury severity, as it was not recorded in our study (recall bias). According to the HBM, perceived seriousness and, therefore, the injury severity of the previous injury may be more relevant.[15] Additionally, players that sustained an injury during the football season might have thought that the programme failed and changed their behaviour accordingly.[15]

Player's perceptions

Usefulness was related to adherence as players who perceived the BEP as useful in hamstring injury prevention adhered better to the programme. This confirms that personal motivation for IPEPs depends on perceived benefits and influences the intention to continue using an IPEP.[15] Perceptions and knowledge about the effectiveness of the IPEP are key to successful implementation.[4 16] Perceptions about intensity, functionality and time expenditure are also related to adherence and could be considered when designing and implementing an IPEP in football. These results confirm that efficacious injury prevention measures must be easy to execute and take little time.[4 21]

Strengths and limitations

Although data were collected in a large cluster RCT, the power was low for correlations due to the relatively low incidence of hamstring injury. Furthermore, adherence was probably underestimated because players with missing weekly reports were considered non-adherent. This decision was made because players were instructed to report 0 m when absent or injured. Nevertheless, this has likely created some measurement error, which may have affected the correlation coefficient.[22] Additionally, only players that filled in both questionnaires were included, and therefore selection bias cannot be ruled out, which may have resulted in an overestimation of the results. It was also considered that group dynamics might affect adherence, but the cluster RCT presented large differences within the clusters. Therefore, the influence of group dynamics may be limited in this cohort, and we did not adjust for this. Nevertheless, results need to be interpreted with caution because of the limitations mentioned above.

At last, this study only covered a part of the HBM because the questionnaires were designed to evaluate the BEP. Perceived severity, benefits and barriers have been (partly) covered. Besides the constructs of HBM, many other factors can be of importance in this complex matter. Additionally, other health behaviour models look into other aspects of health behaviour and might also be of interest in the implementation of IPEPs.[23 24]

Recommendations for implementation of preventive measures and future research

Our study highlights that to design and implement an IPEP successfully, the players themselves and all stakeholders (coaches, medical staff) should be included in the implementation process. Our study also confirms

that older and more experienced players can be considered early adopters since they seem more motivated to adopt IPEPs. Future research could focus on methods that encourage players to change their sports behaviour. Theories from social psychology, such as 'social proof' and a focus on group dynamics, might be useful for implementing IPEPs.[25]

This study partly covered the HBM. Important information about players' perceptions towards their own injury risk, their perceptions about self-efficacy in preventing injury and their perceptions about what exercises or strategies would be helpful and are important to investigate in future research.

This study shows that IPEPs consisting of functional, not too intense and not too time-consuming exercises are related to better adherence. Even though the BEP aimed to comply with these perceptions, adherence decreased during the RCT. This raises the question of whether we need to stick to IPEPs incorporated in group warm-ups, whether we need new thoughts and focus on implementing football-specific preventive exercises, individual targeted preventive measures or whether we need to shift perceptions from injury prevention towards performance enhancement.

CONCLUSIONS

Age, years of experience and player's perceptions of programme usefulness, functionality, intensity and time investment correlate with adherence. Previous and new hamstring injuries, educational level, the programme's difficulty and intention to continue were not related to adherence.

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REFERENCES

1 Silvers-Granelli HJ, Bizzini M, Arundale A, *et al*. Higher compliance to a neuromuscular injury prevention program improves overall injury rate in male football players. *Knee Surg Sports Traumatol Arthrosc* 2018;26:1975–83.
2 McKay CD, Verhagen E. 'Compliance' versus 'adherence' in sport injury prevention: why definition matters. *Br J Sports Med* 2016;50:382–3.
3 Bahr R, Thorborg K, Ekstrand J. Evidence-based hamstring injury prevention is not adopted by the majority of champions League or Norwegian premier League football teams: the Nordic hamstring survey. *Br J Sports Med* 2015;49:1466–71.
4 van der Horst N, van de Hoef S, van Otterloo P, *et al*. Effective but not adhered to: how can we improve adherence to evidence-based hamstring injury prevention in amateur football? *Clin J Sport Med* 2018.
5 Van de Hoef S, Huisstede BMA, Brink MS, *et al*. The preventive effect of the bounding exercise programme on hamstring injuries in amateur soccer players: the design of a randomized controlled trial. *BMC Musculoskelet Disord* 2017;18:355.
6 Slimani M, Chamari K, Miarka B, *et al*. Effects of plyometric training on physical fitness in team sport athletes: a systematic review. *J Hum Kinet* 2016;53:231–47.
7 van de Hoef PA, Brauers JJ, van Smeden M, *et al*. The effects of lower-extremity plyometric training on soccer-specific outcomes in adult male soccer players: a systematic review and meta-analysis. *Int J Sports Physiol Perform* 2020;15:3–17.
8 van de Hoef PA, Brink MS, Huisstede BMA, *et al*. Does a bounding exercise program prevent hamstring injuries in adult male soccer players? – A cluster – RCT. *Scand J Med Sci Sports* 2018.
9 Finch C. A new framework for research leading to sports injury prevention. *J Sci Med Sport* 2006;9:3–9.
10 van Mechelen W, Hlobil H, Kemper HCG. *Incidence, severity, aetiology and prevention of sports injuries: a review of concepts*. Sports Medicine: An International Journal of Applied Medicine and Science in Sport and Exercise, 1992.
11 Brakema EA, van der Kleij RM, Poot CC, *et al*. A systematic approach to context-mapping to prepare for health interventions: development and validation of the SETTING-tool in four countries. *BMJ Glob Health* 2021;6:e003221.

12 Ling DI, Boyle C, Schneider B. Coach education improves adherence to anterior cruciate ligament injury prevention programs. *Randomized Controlled Trial* 2021.
13 Brown JC, Gardner-Lubbe S, Lambert MI, *et al*. Coach-directed education is associated with injury-prevention behaviour in players: an ecological cross-sectional study. *Br J Sports Med* 2018;52:989–93.
14 Bolling C, Delfino Barboza S, van Mechelen W, *et al*. Letting the cat out of the bag: athletes, coaches and physiotherapists share their perspectives on injury prevention in elite sports. *Br J Sports Med* 2020;54:871–7.
15 Rosenstock IM. Historical origins of the health belief model. In: *Health Education & Behavior*. , 1974: 2, 328–35.
16 McKay CD, Steffen K, Romiti M, *et al*. The effect of coach and player injury knowledge, attitudes and beliefs on adherence to the FIFA 11+ programme in female youth soccer. *Br J Sports Med* 2014;48:1281–6.
17 Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the health belief model. *Health Educ Q* 1988;15:175–83.
18 Gabriel EH, Hoch MC, Cramer RJ. Health belief model scale and theory of planned behavior scale to assess attitudes and perceptions of injury prevention program participation: an exploratory factor analysis. *J Sci Med Sport* 2019;22:544-549.
19 O'Brien J, Finch CF. Injury prevention exercise programs for professional soccer: understanding the perceptions of the End-Users. *Clin J Sport Med* 2017;27:1-9.
20 IBM Corp. IBM SPSS statistics version 25.0, 2017
21 Dalen-Lorentsen T, Ranvik A, Bjørneboe J, *et al*. Facilitators and barriers for implementation of a load management intervention in football. *BMJ Open Sport Exerc Med* 2021;7:e001046.
22 van Smeden M, Lash TL, Groenwold RHH. Reflection on modern methods: five myths about measurement error in epidemiological research. *Int J Epidemiol* 2019.
23 Hartley EM, Hoch MC, Cramer RJ. Health belief model and theory of planned behavior: a theoretical approach for enhancing lower extremity injury prevention program participation. *Int J Athl Ther Train* 2018;23:16–20.
24 McKay CD, Merrett CK, Emery CA. Predictors of FIFA 11+ implementation intention in female adolescent soccer: an application of the health action process approach (HAPA) model. *Int J Environ Res Public Health* 2016;13. doi:10.3390/ijerph13070657. [Epub ahead of print: 07 07 2016].
25 Cialdini RB. *Influence: the psychology of persuasion*. New York, USA: HarperCollins Publishers, 2007.