# Mainz Foot-school: a course concept for prevention and treatment of foot disorders

**Martin Betz**
Johannes Gutenberg Universitat Mainz https://orcid.org/0000-0002-9493-7755

**Jürgen Konradi**
Institute of Physical Therapy, Prevention and Rehabilitation, University Medical Center Mainz

**Ulrich Betz** ( Ulrich.Betz@unimedizin-mainz.de )
Institute of Physical Therapy, Prevention and Rehabilitation, University Medical Center Mainz
https://orcid.org/0000-0002-2157-4287

**Philipp Drees**
Department of Orthopaedics and Trauma Surgery, University Medical Center, Mainz

**Research article**

**Keywords:** Foot-school, Educational Program, Foot dysfunction, Mainzer Fußschule, Spiraldynamik

**Posted Date:** September 16th, 2020

**DOI:** https://doi.org/10.21203/rs.3.rs-57332/v2

# Abstract

**Background:** Physiotherapy offers an active approach to prevent and treat foot dysfunction, but it is currently rarely used. A Spiraldynamik®-inspired 6–8-h educational program, called “Mainzer Fußschule” (Mainz Foot-school, MFS), was established to offer a framework for effective implementation. Elements of the courses are: knowledge transfer about anatomy and function, perception training, mobilization, as well as strengthening and coordination. In order to evaluate opinions of former participants about the course format and their subjective effects of course participation, we collected patient-reported outcomes (PROs).

**Methods:** In mid-2018, we conducted a retrospective, monocentric, questionnaire-based cohort study. The online-questionnaire comprised 23-items. All MFS attendees in 2015–2017 who were contactable via e-mail (522; 90.3%) were approached. Finally, 350 completed questionnaires (67%) were returned.

**Results:** The overall framework of the course was evaluated very positively by most participants, with 94.8% expressing a positive opinion about the course format, 97.2 % about the theory vs. practice ratio, and 97.2% about the information content. PROs regarding the offering were equally positive, with 84.3 % stating that their feet are now used and treated differently, and 63,9 % that they still perform exercises learned in the MFS. Furthermore, the majority (67.9 %) believes that the procedure had a positive effect on their existing foot problem. Feedback on the various other examined aspects was similarly positive.

**Conclusions:** The courses were rated positively by the majority of former participants, both in terms of format and subjective effects. Thus the MFS is a promising therapy option that should be included in an extended treatment concept with individual orthopedic examination and therapy options. Our results should be verified in a multicenter, randomized controlled study.

**Trial registration:** The Trial was approved by the ethical review committee of the Rhineland-Palatinate state chamber of physicians (18.04.2018). International Clinical Trials Registry Platform (ICTRP), DRKS00013890. Registered 11 May 2018, http://apps.who.int/trialsearch/Trial2.aspx?TrialID=DRKS00013890.


# Background

The feet constitute the part of the human musculoskeletal system that, after the spine, is affected by pain most often, with a prevalence of 17.4–30.4% (1, 2). Inadequate muscular support is a key factor in the development of postural foot disorders (3, 4). In order to use muscles as a natural resource for treatment, an active therapeutic approach is necessary. Currently, this therapeutic option is used much less often to treat functional disorders of the feet than those of the spine (5). As a framework for an effective implementation of such an active approach, we developed an educational program, called the "Mainzer Fußschule" (Mainz Foot-school, MFS) (6). It consisted of either classic (4 × 2 h) or compact courses (1 × 6 h). The content of the MFS is based on Spiraldynamik®: it contains the concept of "spiral movement," which is seen as a universal phenomenon, both functional and structural. This concept assumes that the

longitudinal arch of the foot is an evolutionary torsion (spiral) of the forefoot against the hindfoot, generated by verticalization of the talus while maintaining the metatarsal bones parallel to the ground. The torsional element of the midfoot has been verified by in vivo measurements (7-9). This movement and therapy concept is developed by cooperation between therapists and educators (10) and focuses on so called “physio-pedagogy” with an emphasis on empowerment. The MFS course objective is to empower the participants to recognize and optimize the use of their feet in all activities of daily life. The educational approach for addressing complaints related to the movement system has long been used for back-schools and is applied here for the treatment of dysfunctional foot problems (11, 12). In order to maximize the effect, three major techniques of empowerment: knowledge transfer, goal setting, and action planning (13-15) are combined (16). To that end, the program entails the following (17) (Additional file 1: Course concept; Additional file 2: Handout):

- Mutual introduction round about individual foot problems, expectations about the course, and goal-setting
- Transfer of knowledge about anatomy, natural function, and dysfunction of the feet and the consequences of these for the foot and overall mobility
- Transfer of general knowledge about suitable shoes and insoles, barefoot walking, and proper foot care
- Proprioceptive training (action planning)
- Mobilization of joints (action planning)
- Strengthening and coordination of foot muscles (action planning)

Since the concept of the MFS has only been developed in recent years, there are still no reports about its effect in the scientific literature. To obtain a first evaluation, we surveyed 522 former participants in this course to gain insight into the effectiveness of the course.

# Methods

The "Evaluation der Mainzer Fußschule" was approved at the meeting of the ethical review committee of the Rhineland-Palatinate state chamber of physicians on April 18, 2018 (reference number is 2018-13222). Informed consent was given as part of the completion of the questionnaire.

Data were collected mid-2018 using a 23-item online questionnaire (Additional file 3) that was constructed with LimeSurvey (18), an online tool provided by the Center for Data Processing of Mainz University (ZDV). All attendees of the MFS from the years 2015—2017 who could be contacted via e-mail (522; 90.3%) were included. Overall, 350 questionnaires (67%) were returned (Figure 1)(Additional file 4). We have decided to also include data from not completely filled-out questionnaires in order to take full account of the available information.

Figure 1: Overview of the trial process

Questions addressed to the participants were divided into three blocks.

To facilitate subsequent comparisons between different subgroups, the first block was used to collect demographic data. It included 7 items that enabled forming a differentiated picture of the attending participants. The questions covered standard demographic variables, such as age and sex, as well as pathology-related variables, such as insoles, specialist visits, shoe selection, and surgery before participation. The reason for participation and the state of feet at the time of course participation were also included. The second block, comprising 6 items, was included to collect data concerning the course format. In addition to questions about the overall extent of the course, information gain, balance between theory and practice, and stress caused by the course, there were also two free-text fields that provided participants with the opportunity to commend or criticize the course. The third block, comprising 10 items, was the most comprehensive and was used to collect subjective ratings regarding the course effects on participants. To achieve a differentiated picture, we queried subjective information gain, improvement of perception, regular performance of exercises learned in the course, influence of the course on the feet's use and treatment in everyday life, and whether participation was considered subjectively worthwhile. To allow a pre- and post-participation comparison, some items of the first block were readopted (shoe selection, insoles, surgery, and complaints).

Answers given by participants were sent anonymously to the ZDV (Mainz University Data Center (Zentrum für Datenverarbeitung)).

For the confirmatory analysis of the question whether there is a difference between the preventive and curative group, we allocated participants to 2 groups: those who had classified their foot problems before participation as < 3 on a scale of 0—10 were labeled as primarily concerned with prevention, while those who classified the problem as > 2 were primarily concerned with curing an existing foot problem. To investigate whether there was a difference between preventive and curative groups of participants in the rating of the effects, we statistically analyzed the answers to the question, "Attending the foot-school was worthwhile for me." For statistical analysis, the responses, "I agree" and "I tend to agree," to this question were rated as "participation was advantageous," while responses of "tend to disagree" and "strongly disagree" were rated as "participation not worthwhile." These results were compared using Fisher's exact test.

Additionally, using a chi-square test and a z-test, an exploratory data analysis was conducted on the influence of age, gender and type of course attended on the assessment of whether participation was rated worthwhile. A Wilcoxon's signed-rank test was used to check whether the pain changed significantly before and after participation in the course.

# Results

Below we present the results following the structure of the three blocks used in the questionnaire: 1) demographic data; 2) course format; 3) course effects. The study population comprised participants from

three different course years (for the complete dataset, see Additional file 4). Most completed questionnaires (60.6%) were returned by the participants of 2017 course.

In addition to the year of participation, participants also differed by the type of course they attended. Within the group of those whose questionnaires we received, 87.9% of participants attended a compact course (1 × 6 h). The average age was 54.53 years. Only 12.6% of valid answers came from men. Refer to Table 1 for an overview of the demographic characteristics of the study population.

Table 1: Overview of participants' demographic characteristics

| | Females (N) | Males (N) | Classical-course (N) | Compact-course (N) | Age (years) |
|---|---|---|---|---|---|
| **Overall** | 221 (87.4 %) | 32 (12.6 %) | 42 (12.0 %) | 308 (88.0 %) | M: 54.53 [SD: 9.395] |
| **2015** | 15 (88.2 %) | 2 (11.8 %) | 2 (9.5 %) | 19 (90.5 %) | M: 53.88 [SD: 7.262] |
| **2016** | 87 (90.6 %) | 9 (9.4 %) | 26 (22.2 %) | 91 (77.8 %) | M: 55.69 [SD: 9.499] |
| **2017** | 119 (85.0 %) | 21 (15.0 %) | 14 (6.6 %) | 198 (93.4 %) | M: 53.81 [SD: 9.527] |

M, mean; SD, standard deviation

While only 56.5% of the participants previously consulted a specialist because of an existing foot problem, 86.2% already had insoles. Hence, about a third (29.7%) of those insoles were prescribed by a non-specialist doctor or were selected by the participant. Fifteen percent of all respondents had already undergone foot surgery before attending the course.

The answers to the question about the severity of foot problem before course participation were ranged across all available options (Figure 2), but most participants indicated scores in the middle of the range (median 5).

Figure 2: Subjective severity of the foot problems at the time of participation in the course

The top three reasons for participation cited were 1) "I suffered from painful feet, bruises, or had a limited walking distance and wanted to address this"(49%); 2) "My foot was deformed (for example, hallux valgus), and I was hoping to be able to do something about it" (40%); and 3) "I did not suffer from pain,

but I had a foot malalignment, such as flat feet, and wanted to prevent the development of complaints" (20.4%) (Table 2).

Table 2: Reasons for participation

| Reason for participation | Absolute fre-quency | Relative fre-quency |
|---|---|---|
| I had no complaints or known malalignment, but I wanted to do something for my health. | 12 | 4.7 % |
| I did not suffer pain, but I had a foot malalignment, such as flat feet, and wanted to prevent the development of complaints | 52 | 20.4 % |
| I suffered from painful feet, bruises, or had a limited walking distance and wanted to address this. | 125 | 49 % |
| My foot was deformed (for example, hallux valgus), and I was hoping to be able to do something about it. | 102 | 40 % |
| Surgery was being considered, and I was hoping to be able to handle the problem through active practice instead. | 6 | 2.4 % |

Overall, 94.9% of all respondents had a positive opinion regarding the extent of the course, and 97.2% believed that they had received much helpful information in the course. Even among the respondents who had participated in the course 3 years earlier, the answers were very positive (94.1%).

Similar to the opinions regarding the extent and information content, the opinions regarding the balance of theoretical and practical shares were also predominantly positive (97.2%). When asked whether the course caused any stress, only a very small portion of participants expressed a negative opinion (3.6%).

In the free text field, the most frequently mentioned suggestion was that additional course dates should be offered afterwards in order to revise what had been learned and to gain control over the execution of the exercises (7.7%). The most frequently posed criticism was that there was not enough time to discuss individual foot problems (2.4%).

Positive effects of the course included a greater level of knowledge (94.4% positive feedback). Additionally, 93.6% of respondents believed that their perception of their feet had improved.

While answering question on whether they continued practicing the exercises taught at the MFS, the participants of earlier courses responded that they practiced less than those who had attended the program more recently (Figure 3).

Figure 3: Responses to the statement: "I regularly perform exercises that I learned in the foot-school", divided by year

Regarding the question whether the course had an impact on managing their feet in everyday life, 84.3% of respondents said that it did, at least, in part.

In terms of the potential difference between preventive and curative group of participants, we examined the answers in response to the statement, “Attending the foot-school was worthwhile for me.” In the curative group, 88.9%, and in the preventive group, 92.7% of participants stated that they considered participation was advantageous (Figure 4). Fisher’s exact test showed that with a predefined alpha error of 5%, the rating was not significantly different between groups ($p = 0.587$).

Figure 4: Opinions on whether participation in the foot-school was worthwhile, divided by curative and preventive intention

Additionally to the difference between the preventive and curative group, the influence of the type of course attended and age and sex of the participants on their assessment of whether the course was worthwhile or not were tested as part of an exploratory data analysis. The influence of the course type could not be further examined because the model as a whole was not significant (chi-square (1) = 0.115, $p = 0.735$, $n = 249$). To assess the influence of age, participants who were below the average age were compared with those who were above it. Again, the model was not significant (chi-square (1) = 0.023, $p = 0.880$, $n = 249$). When testing the influence of sex, the model was significant (chi-square (1) = 7.586, $p = 0.006$, $n = 249$). However, a z-test revealed that sex did not have an effect on the assessment of whether the course was labelled advantageous or not (Wald (1) < 0.001, $p = 0.998$).

The last four items readopted questions from the first block and were meant to enable a before vs after comparison. The first comparison was about wearing of insoles before and after participation. Almost the same number of people wore insoles in all of their shoes, permanently. However, the proportion of respondents who indicated that they only wore insoles occasionally and in certain shoes had increased by 6.3 percentage points (from pre 39.5% to post 45.8%)(Figure 5). Of the respondents, 24.1% stated that they paid more attention to the feet and shoe compatibility when buying new shoes, while 2.8% of subjects underwent surgery, after participating in the course (15% had undergone surgery before the course).

Figure 5: Comparison of insole-wearing behavior between before and after the course

Furthermore, at 67.9%, the majority of participants stated that the course had a positive effect on their existing foot complaints. This was also reflected in the subjectively perceived burdens that had significantly ($Z = -8.92$, $p < 0.001$ Wilcoxon’s signed-rank test) decreased from a median of 5 (before participation) to 3 (at the time of the survey), on a scale of 0—10. The proportion of participants, who noticed a positive effect, decreased slightly with increasing time distance from the course (Figure 6).

Figure 6: Impact of the course on existing foot problems, by year

# Discussion

In this exploratory data analysis, neither the type of course nor the age or sex of participants had a significant impact on their assessment of whether the MFS course was worthwhile. This, combined with the consistently high level of participant satisfaction, supports the assumption that the approach of empowerment by conveying theoretical knowledge and exercises that can be performed autonomously, is beneficial for the majority of participants regardless of the magnitude of their pre-existing problem, the type of course attended, or participants' age or sex.

The composition of the surveyed group was very inhomogeneous in terms of sex, age, and the type of course attended. This phenomenon has been addressed previously in the literature (11, 12, 19). According to results of the Robert Koch Institute (RKI)'s[1] "Adult health status study in Germany," women use these types of services almost twice as often as men (19).

The fact that the compact course was more favored (88%) than the classical course was surprising. Only the classical course was recognized as a preventive service, according to the German Social Security code (§ 20 Abs. 4 Nr. 1 SGB V), and its cost is covered by health insurance companies. Additionally, some respondents stated that the classical course made more sense from a pedagogical point of view. The popularity of the compact course may be caused by the fact that mainly working people participated in the course (median age: 55 years) and many participants had to travel far to attend the course.

In the above-mentioned study by the RKI, which addressed group composition in prevention courses, most participants were in the 65–79-year age group (19). In contrast, the average age of the MFS participants was lower, at around 55 years. One possible explanation is that many prevention groups are concerned with cardiovascular diseases, which often emerge at a later age than common foot problems. For example, hallux valgus usually first occurs between the ages of 30 and 60 years (20).

Only half of the participants (56.5%) consulted a specialist because of their foot problem. Hence, it would be interesting to know whether the remaining 38.8% of respondents who had at least slight problems or a foot malalignment had used the MFS as primary care or had previously seen a general practitioner. Unfortunately, the questionnaire did not address this issue; in future studies, the questionnaire should be amended to include questions addressing this item.

The insoles, used by one-third of the participants, were not specialist prescribed. Excessive care or improper selection of insoles can result in deconditioning of the active, muscular foot support, and in the worst case, can actually cause foot problems. To improve this situation, the MFS now aims to expand cooperation with general practitioners, so that potentially interested people can be assisted earlier. Additionally, the transfer of knowledge about insoles will be optimized.

All three of the most frequently stated reasons for course participation implied that participants had at least a slight problem with their feet. Hence, we conclude that participation, solely for preventive reasons, is rather rare.

The course format was rated very positively; only a small number was unsatisfied with the extent of the course (5.2%). This may be related to the choice offered. It is possible for everyone to choose the model that best suits personalized needs. Despite the much higher popularity of the compact course, it would make sense to continue offering the classic course in future, as it is pedagogically more valuable. In addition, the phases of self-exercise between the lessons, which are not available in the compact-course, are an integral part of the classic course. Future research may address this potential difference between the course types using a prospective, function-related quality of life assessment.

Opinions regarding the informative content of the courses were predominantly positive. It is particularly noteworthy that even those who had participated in 2015 rated this aspect of the course positively. This speaks to the almost surprisingly good sustainability of the imparted knowledge, particularly in relation to the effort required.

The assumption that those who had a more severe foot problem prior to the course may also feel more stress during the course was not confirmed by the results.

The respondents' desire for further course dates (7.7%) should be considered critically, as most of the participants consciously opted for a compact course and thus for a single appointment. Therefore, it is uncertain how many would participate in future events. Nevertheless, a refresher course should be offered. Another means of better preserving the MFS effects could be the introduction of an online or app-based intervention.

The most frequently posed criticism (2.4%) that there was not enough time to discuss individual problems, is understandable. Owing to the time constraint, a more personalized treatment could not be offered. Moreover, an extension of the course is contrary to its concept. Consequently, an extended concept of foot treatment with individual orthopedic examination and individual treatment options, besides the MFS course, would require incorporation.

The first question of the effects-block of the questionnaire related to whether, at the time of the survey, respondents still felt that they had knowledge about the function of the foot and were familiar with the exercises that support the statics and function of the foot. The result was almost unexpectedly positive, even though assessment of one's knowledge decreases with growing time distance. Nevertheless, the overwhelmingly positive answers to this question suggest that the type of theoretical content, type of exercises, etc., are well suited to achieving patients’ satisfaction in perception of their empowerment within a short time frame of 6—8 h. However, the evaluation could not clarify whether the course had actually motivated participants to correct their foot position actively or changing their foot's function in everyday life. To this end, prospective objective studies are required.

Improvement in awareness and perception of the feet through the MFS course was also positively rated. Refined perception did not decline as much with increasing time-distance. This might suggest that the abstract ability of improved perception, once enhanced, fades less over time than specific knowledge, as addressed above.

As knowledge fades over time, the frequency of performance of the exercises learnt in the course decreased with increasing time-distance. Nevertheless, about one-third of those who had attended a course in 2015 still performed exercises regularly. Based on the large number of people who performed exercises, even after a long time, it can be deduced that the course is motivating and the Spiraldynamik® exercises, which focus on empowerment, provide enough benefit to result in lasting application by the participants. As described above, the physiological function of the foot is complex, but the time available in the course seems to be sufficient to convey an understanding of the function and in learning the exercises. However, we did not test whether the participants were actually able to perform the exercises correctly at the time of the evaluation.

The question posed by the second block aimed to ascertain whether participation had influenced the way the feet are used and treated. The collected answers show that the MFS also extends to factors that come into play in everyday life, such as daily use and care.

When contemplating the question how the course has impacted foot complaints, the phenomenon that the effects reduced slightly over time. Although the assessments of participants from the 2015 course were still surprisingly positive, they more often had the opinion that the course had a negative impact or no effect, compared to responses of participants from other years. With regard to this question, the comparison between preventive and curative intention group showed that the former was assessed more positively. This was surprising, because satisfaction, as examined by the statement, “Attending the foot-school was worthwhile for me,” was already very high and without significant differences between curative and preventive group. In addition to the pure alleviation of complaints, which is queried here, this could indicate that other factors also play a role in the evaluation. Some of those factors may include newly gained knowledge about the anatomy and function of the foot, greater understanding of one's problem or new insights into different treatment options.

When comparing the use of insoles before and after the course, a higher proportion of people were found using insoles after participating in the course than before joining. This finding is somewhat surprising, since the concept of the MFS, while not attempting to replace insoles, focused on making some insole use obsolete by training the active support of the foot architecture.

Nevertheless, the selection of footwear was clearly improved by the course. Thus, almost a quarter of those surveyed stated that they now paid more attention to the feet-shoe compatibility factor. This is particularly substantial because according to their own statement 63.1% had already done that before participation.

With the exception of a few rare cases, such as those where surgery was unavoidable (2,8 %), the reported complaints developed positively after course participation as compared to before (median before: 5, after: 3). From this it may be concluded that functional foot problems can be treated satisfactorily conservatively in the overwhelming number of cases and that MFS can be a useful element. However, pain is a multifactorial process, and without a randomized controlled study, the reduction in pain cannot be attributed solely to the MFS.

The limitations of the study were its retrospective, monocentric, internally evaluated attributes based on PROs. Furthermore, recall and response bias, both of which are typical for retrospective surveys, may have potentially affected the results. The questionnaire, which was designed specifically for our study and was not validated, may have influenced the external validity of the results. Validation should be considered for future research. An extended evaluation, using a prospective, randomized, and controlled design with objective and function-related parameters should be used to explore the effects of the course further in future.

[1] German institute with the aim to research and prevent infectious diseases, which also has the task of monitoring health nationwide

# Conclusions

In terms of PROs, this course was satisfactory, as participants across all groups and years graded the course positively, with respect to the areas of course format and subjective effects. These encouraging results suggest that the type of knowledge imparted, the relationship between theory and practice, and the chosen exercises were well suited to the length of the courses and the problem addressed.

As painful foot dysfunctions are a relevant problem, given their high prevalence, and since the MFS could subjectively achieve sustainable improvement with relatively little effort, the active approach should be continued as part of an educational program. As requested by many participants, the MFS should be extended by an optional refresher course. This would allow participants to master the execution of exercises and document the progress they have made. The criticism posed by some respondents that insufficient time is spent on individual counseling cannot be improved within the format of a group course. For this reason, the extended concept of foot treatment with individual orthopedic examination and treatment options, besides the existing MFS course, will need to be addressed. To generate data that are more reliable and take another step toward implementation as a therapeutic concept for dysfunctional foot problems, further studies are required to allow a more accurate differentiation between the effects of the course.

In summary, the concept of an educational program targeting dysfunctional foot problems, based on Spiraldynamik®, is a promising approach that should be pursued further through research.

# Declarations

### Ethics approval and consent to participate

The "Evaluation der Mainzer Fußschule" was discussed at the meeting of the ethical review committee of the Rhineland-Palatinate state chamber of physicians on 18.04.2018 and received an approving vote. The

reference number is 2018-13222. Informed consent was given as part of the completion of the questionnaire.

## Consent for publication

The participants have received a participant information sheet which informed them that by submitting the questionnaire they agree to participate in the study and that due to the anonymization of the data, a later withdrawal from participation would not be possible.

## Availability of data and materials

All data generated or analyzed during this study is included in this published article and its supplementary information files.

## Competing interests

Two of the co-authors are employed at the Institute of Physical Therapy, Prevention, and Rehabilitation of the University Medical Center Mainz, which stages the courses of the Mainz Foot-school. Ulrich Betz is the Director of the Institute and Jürgen Konradi is a research associate.

Herewith, we the authors declare that we do not profit financially from the Mainz footschool personally. Based on our knowledge we developed the course evaluated in this manuscript. It is provided the University Hospital Center of the Johannes Gutenberg-University as a program with cost coverage by the health insurance system upon demand. Also beyond there are no further COIs to declare.

## Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

## Authors' contributions

MB analyzed and interpreted most of the data from the survey and wrote most of the manuscript as part of his dissertation. JK played an important role in the design of the questionnaire, the evaluation of the data, and the revision of the manuscript. UB played a major role in developing the study design, and he was one of the main contact persons for technical questions during the process. PD was involved in the development of the design of the study and made a major contribution to the medical accuracy of the study. All authors read, added to, and approved the final manuscript.

## Acknowledgements

The employees of the Data Center of Mainz University accompanied the statistical analysis and helped with implementation of the online survey and adequate data protection.

The IMBEI (Institute for Medical Biostatistics, Epidemiology and Informatics) supported us with the development of the questionnaire and the statistical analysis.

# Abbreviations

ZDV: Mainz University Data Center (Zentrum für Datenverarbeitung)

RKI: Robert Koch Institute

M: Arithmetic mean

SD: Standard Deviation

MFS: Mainz Footschool

IMBEI: Institute for Medical Biostatistics, Epidemiology and Informatics

NRS: Numeric rating scale

ICTRP: International Clinical Trials Registry Platform

# References

1. Molgaard C, Lundbye-Christensen S Fau - Simonsen O, Simonsen O. High prevalence of foot problems in the Danish population: a survey of causes and associations. (1532-2963 (Electronic)).
2. Hill CL, Gill TK, Menz HB, Taylor AW. Prevalence and correlates of foot pain in a population-based study: the North West Adelaide health study. Journal of foot and ankle research. 2008;1(1):2.
3. Soysa A, Hiller C, Refshauge K, Burns J. Importance and challenges of measuring intrinsic foot muscle strength. Journal of foot and ankle research. 2012;5(1):29.
4. Ridge ST, Myrer JW, Olsen MT, Jurgensmeier K, Johnson AW. Reliability of doming and toe flexion testing to quantify foot muscle strength. Journal of foot and ankle research. 2017;10(1):55.
5. Bucksch S, Hoffmann N, Osterkamp N, Yilmaz S. Heil- und Hilfsmittelreport 2018. BARMER. 2018.
6. Rehabilitation IfPTPu. Mainzer Fußschule 2019 [updated 28.06.2019; cited 2019 07.07.]. Available from: http://www.unimedizin-mainz.de/physikalische-therapie/kurse/fussschule.html.
7. Arndt A, Wolf P Fau - Liu A, Liu A Fau - Nester C, Nester C Fau - Stacoff A, Stacoff A Fau - Jones R, Jones R Fau - Lundgren P, et al. Intrinsic foot kinematics measured in vivo during the stance phase of slow running. (0021-9290 (Print)).
8. Lundgren P, Nester C Fau - Liu A, Liu A Fau - Arndt A, Arndt A Fau - Jones R, Jones R Fau - Stacoff A, Stacoff A Fau - Wolf P, et al. Invasive in vivo measurement of rear-, mid- and forefoot motion during walking. (0966-6362 (Print)).

9. Wolf P, Stacoff A Fau - Liu A, Liu A Fau - Nester C, Nester C Fau - Arndt A, Arndt A Fau - Lundberg A, Lundberg A Fau - Stuessi E, et al. Functional units of the human foot. (0966-6362 (Print)).
10. SCHWEIZ SMCA. Jahresstatistiken Quality Report 2018 2018 [Available from: https://www.spiraldynamik.com/forschung.htm.
11. Parreira P, Heymans MW, van Tulder MW, Esmail R, Koes BW, Poquet N, et al. Back Schools for chronic non-specific low back pain. Cochrane Database Syst Rev. 2017;8:Cd011674.
12. Poquet N, Lin CWC, Heymans MW, van Tulder MW, Esmail R, Koes BW, et al. Back schools for acute and subacute non-specific low-back pain. Cochrane Database of Systematic Reviews. 2016(4).
13. Funnell MM. Patient empowerment. (0887-9303 (Print)).
14. Bravo P, Edwards A, Barr PJ, Scholl I, Elwyn G, McAllister M. Conceptualising patient empowerment: a mixed methods study. (1472-6963 (Electronic)).
15. Aujoulat I, d'Hoore W Fau - Deccache A, Deccache A. Patient empowerment in theory and practice: polysemy or cacophony? (0738-3991 (Print)).
16. Werbrouck A, Swinnen E, Kerckhofs E, Buyl R, Beckwee D, De Wit L. How to empower patients? A systematic review and meta-analysis. (1613-9860 (Electronic)).
17. Larsen C, Hende P. Füße in guten Händen: Spiraldynamik - programmierte Therapie für konkrete Resultate. Stuttgart: Thieme; 2014.
18. GmbH L. LimeSurvey Homepage Hamburg [Available from: https://www.limesurvey.org/de.
19. Jordan S, Lippe Evd. Participation in health behaviour change programmes. Robert Koch-Institut, Epidemiologie und Gesundheitsberichterstattung; 2013.
20. Waizy H, Panahi B, Dohle J, Stukenborg-Colsman C. [The Current S2e Guideline for Hallux valgus - Evidence-based Guideline Development Using Meta-analysis]. Zeitschrift fur Orthopadie und Unfallchirurgie. 2018.

# Figures

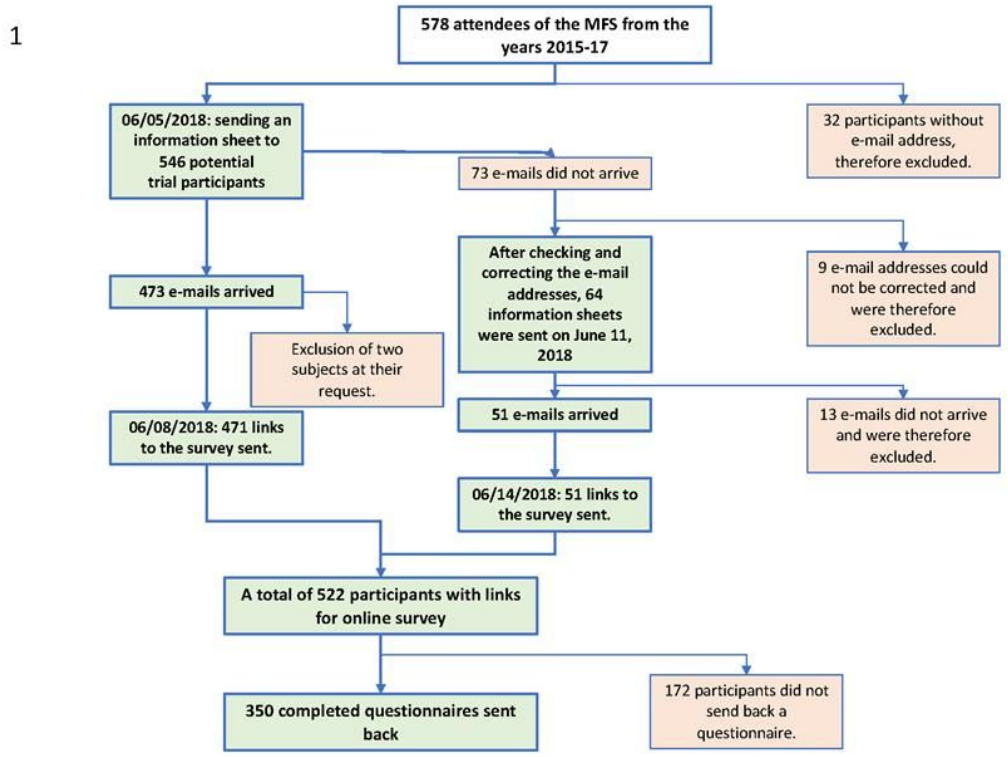


**Figure 1**

Overview of the trial process

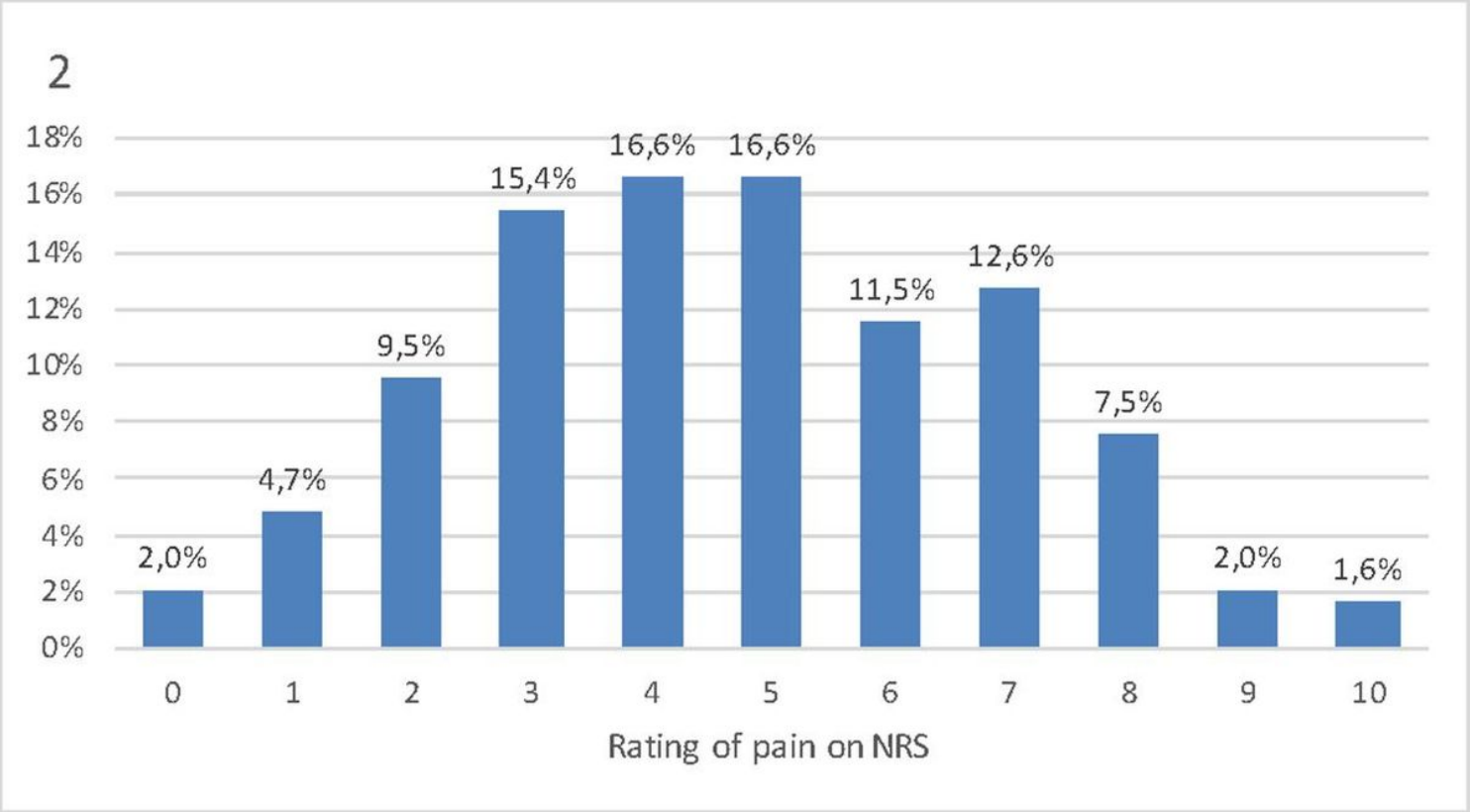


**Figure 2**

Subjective severity of the foot problems at the time of participation in the course

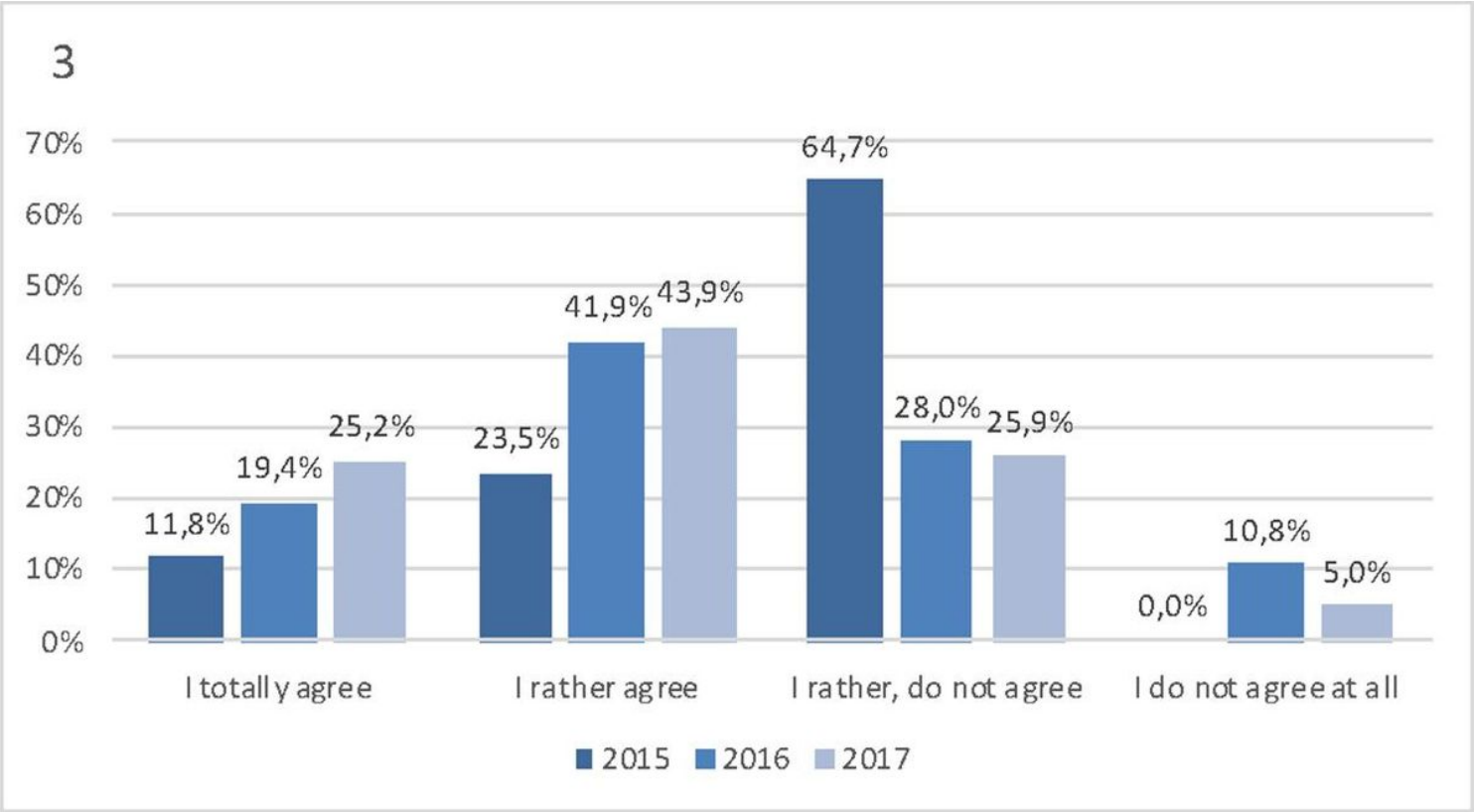


**Figure 3**

Responses to the statement: “I regularly perform exercises that I learned in the foot-school”, divided by year

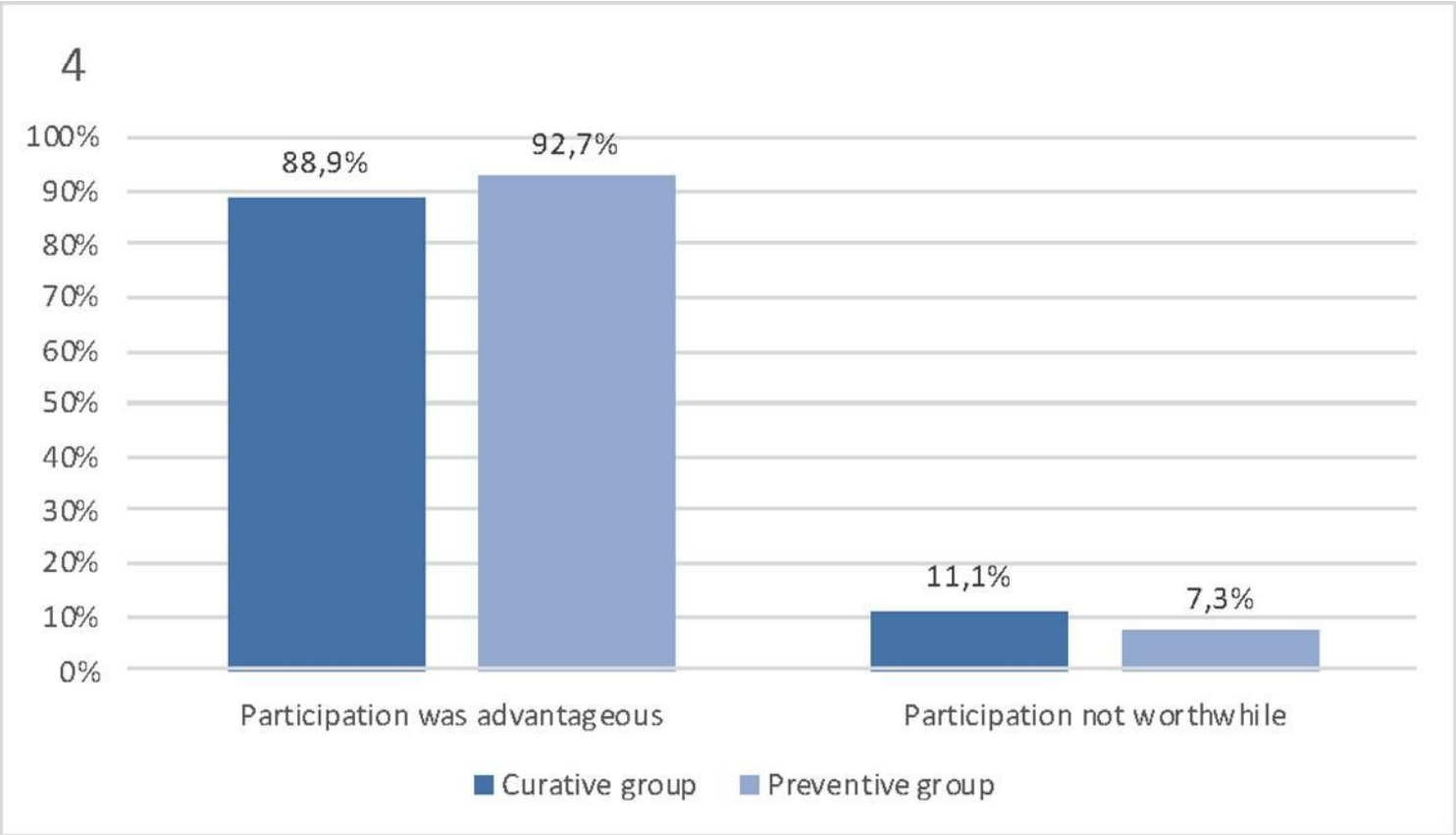


**Figure 4**

Opinions on whether participation in the foot-school was worthwhile, divided by curative and preventive intention

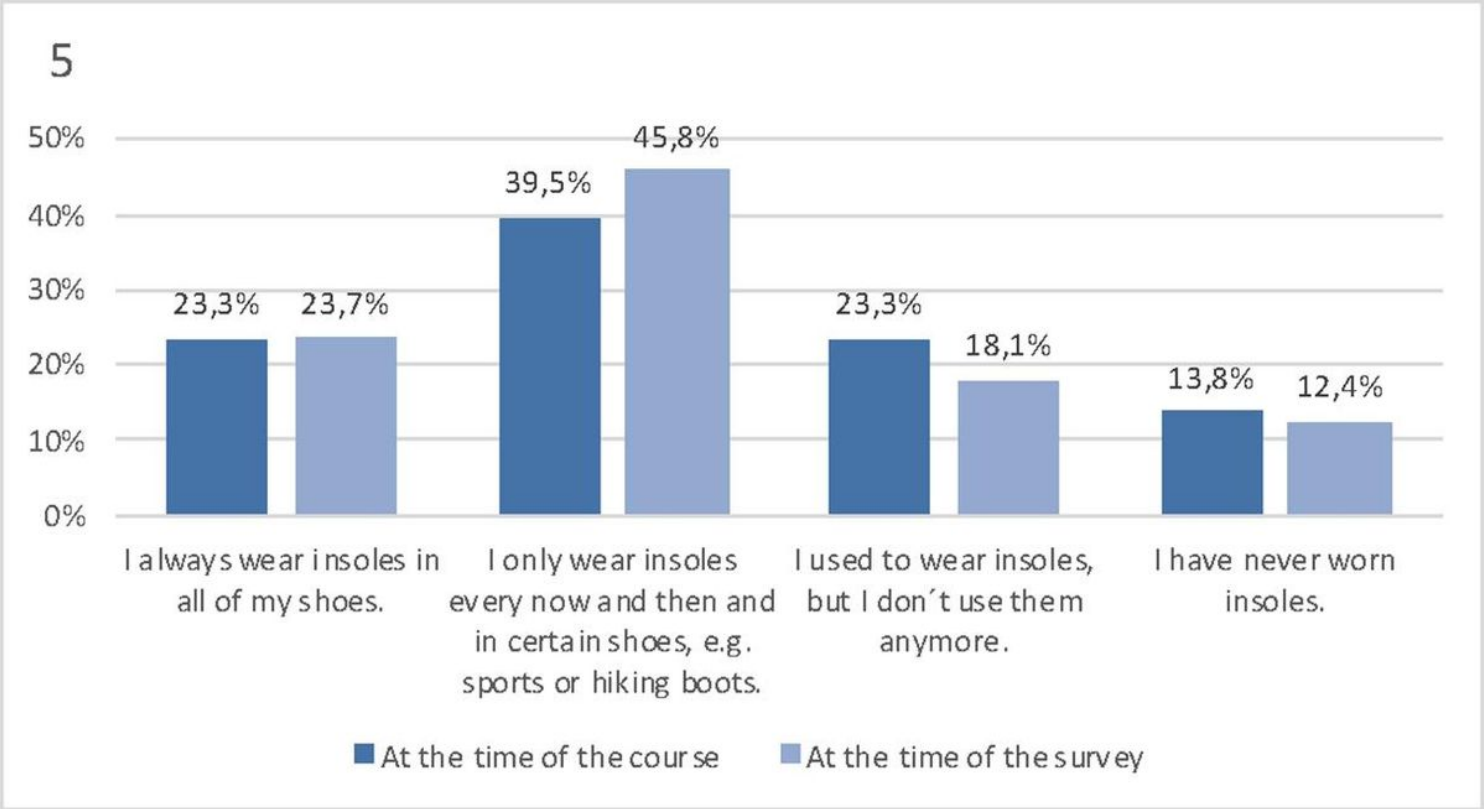

**Figure 5**

Comparison of insole-wearing behavior between before and after the course

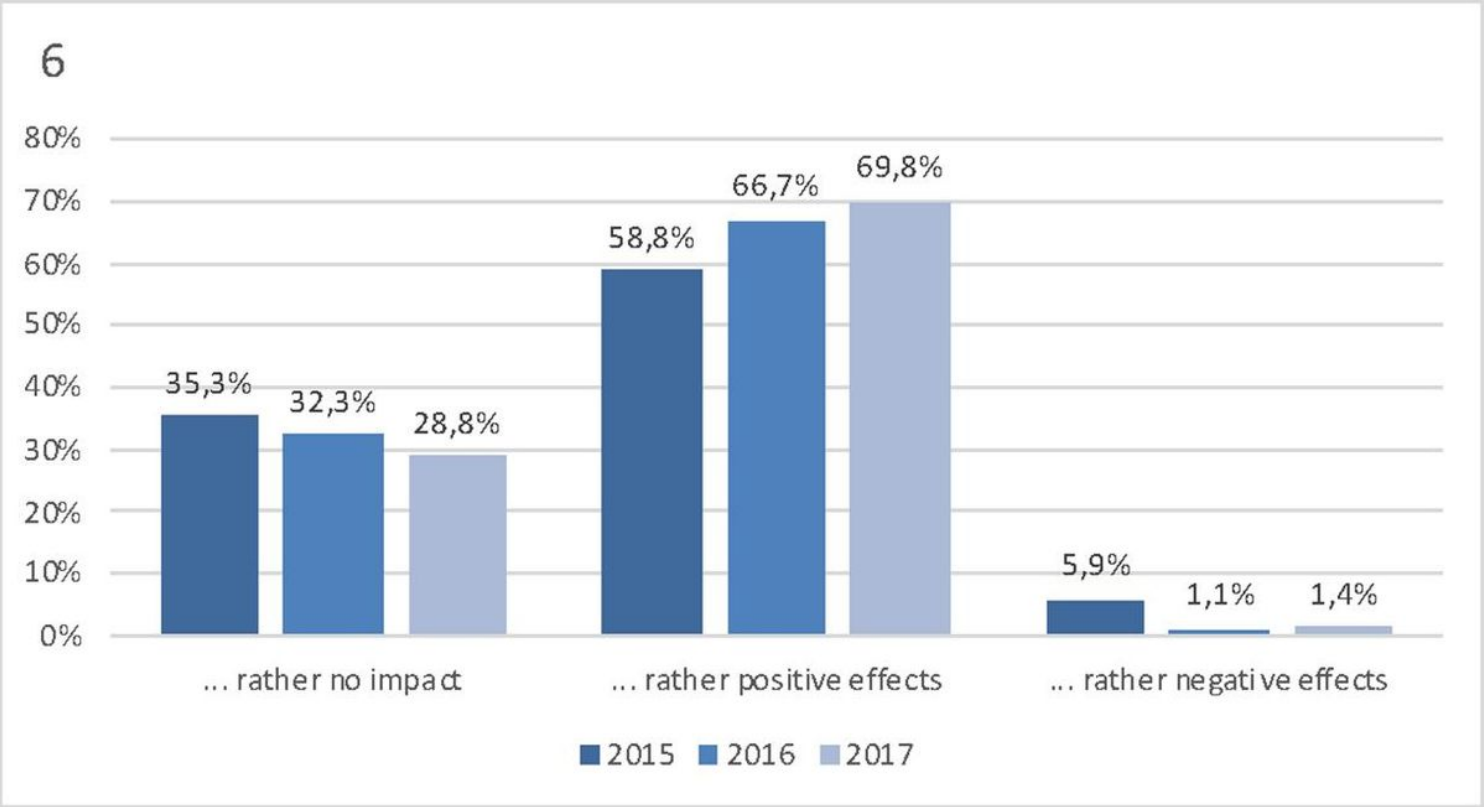


**Figure 6**

Impact of the course on existing foot problems, by year

# Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile1.pdf
- Additionalfile2.pdf
- Additionalfile3.pdf
- Additionalfile4.xlsx
- Additionalfile5.pdf
- Additionalfile6.docx