

Fit Assessment Analysis on User Centric Shin Pad Design Based on Current Shin Pad Design

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Abstract

Using existing shin pad designs as a baseline, this study analyses fitness assessments with an emphasis on user-centric shin pad design. The purpose of the study is to assess the effectiveness of current shin pads in terms of overall performance, protection, and user comfort. The study looks at material qualities, biomechanical factors, and user input in detail to find possible areas where shin pad design might be improved. The ultimate objective is to provide knowledge that may direct the creation of shin pads that are more effective and user-friendly, catering to the unique requirements and preferences of users and athletes in a range of sports scenarios.

1. Introduction

In the ever-changing field of sports equipment development, user experience optimisation and safety continue to be top priorities. The style and fit of shin pads are one such important component in the field of athlete protection. The necessity for protective gear that not only satisfies legal requirements but also flows naturally with the demands of the user has increased as sportsmen push the limits of performance. This scientific document presents the results of a thorough Fit Assessment Analysis that compares the design of a user-centric shin pad to current models. Through a critical examination of shin pad technology as it is now, we want to close the gap between traditional design paradigms and the changing needs of players in different sports.

The main benefit of using shin pads is to supply protection from injury. Shin pads provide a barrier between the shin bone and any impact, reducing the risk of injury from accidental kicks, tackles, or collisions with other players. Second, it gives players the confidence to play more aggressively and make tackles without the fear of injuring themselves or others. Third, it supplies better performance as shin pads can also help players to focus on their performance without worrying about getting hurt, enabling them to play better and more effectively. [1]

Advances in manufacturing techniques and materials have made it possible to manufacture shin pads with greater delicacy in recent years. This research aims to further the current discussion by offering a thorough analysis of the essential components that characterise the ideal fit in shin pads. By conducting a methodical examination of user input, biomechanical factors, and developing patterns, our goal is to identify potential areas for enhancement and suggest inventive approaches that balance comfort and functionality. My study technique combines qualitative information from athlete and sports professional interviews with quantitative data from surveys and ergonomic assessments. We hope to provide a future protective gear roadmap that easily integrates with the changing demands of the athletic community by contrasting these findings with the state-of-the-art shin pad design. [2]

Lastly, to follow regulations as in many sports, it is mandatory to wear shin pads and it is now an obligation part of playing the sport. In conclusion, wearing shin pads can help players to stay safe, confident, and compliant,

while also improving their performance on the field. In the end, this study aims to provide insightful information that may direct the creation of user-centered solutions in addition to evaluating the efficacy of current shin pad designs. Sports equipment must advance in step with players' constant quest of perfection, guaranteeing that performance and safety are given first priority throughout the design process.

2. Literature Review

A shin guard is provided, as well as a technique for creating it. The shin guard includes a foam base made of polyurethane and a hard-polyurethane outer shell. By pushing a heated die with the desired recess profile into the foam backing, a recess is created. The tibia or shin bone is covered by an oblong recess. The depression is then filled with a thick, changed polyurethane casting. In a lightweight shin guard, polyurethane foam and thick, modified polyurethane combine to give great shock absorption [3]. There are three types of shin guards that are available currently on the market. Each version of the shin guard has different purpose and advantages. If the specific types are being used in specific way, it can grant the user the upper hand in the pitch or field. The types of shin guard are slip-ins shin guard, ankle shin guard and shin socks.

The main properties of shin pad are shown below:

Shin guard	Length (cm)	Thickness (mm)	Weight (g)
Compressed air guards			
Mean (SD)	19.3 (1.1)	12.0 (1.3)	152 (18)
Lotto Air Silicone ^a	20.7	13.4	151
Nike Air Field ^b	18.9	10.4	178
Uhlsport Air	18.0	12.5	141
Cushion ^c			
Umbro Tomahawk	19.6	11.7	138
Supreme ^d			
Fiberglass guards			
Mean (SD)	22.8 (1.3)	7.4 (0.8)	100 (18)
Adidas Orthofit ^e	24.2	7.9	112
Adidas Orthofit Lite ^e	23.0	6.5	115
Cobra Striker ^f	20.7	7.3	116
Diadora Chevron ^g	22.9	6.6	83
Diadora Primofit ^g	24.2	7.2	72
Nike OSI 5+2 ^h	22.0	8.7	102
Kevlar guards			
Mean (SD)	21.5 (1.0)	7.2 (0.6)	104 (28)
Adidas Safe Top	20.9	6.8	109
Senior ⁱ			
Adidas Safe Pro	21.9	6.8	142
Deluxe ^j			
Brine 2+2 Pro ^k	20.5	8.1	87
Lotto Uatleta Kevlar ^l	22.6	7.1	80
Plastic guards			
Mean (SD)	19.9 (3.1)	9.0 (2.8)	125 (62)
4C Sports Striker	20.4	11.6	170
Guard ^m			
Adidas Safe First	19.9	4.9	49
Senior ⁿ			
Adidas Safe Team ^o	17.7	10.0	110
Lanzera NeoTech	14.7	7.4	96
Elite Jr. ^p			
Nike Field ^q	17.4	12.4	120
Nike Structure ^r	19.5	5.8	37
Sondico Switchback ^s	24.9	8.3	201
Uhlsport Trabant ^t	21.7	7.9	124
Umbro Gladiator ^u	23.2	12.7	216

^a Priva Sport, Montreal, Quebec, Canada.
^b Nike, Beaverton, Oregon.
^c Uhlsport, Lauterach, Austria.
^d Umbro America, Greenville, South Carolina.
^e Adidas, Herzogenaurach, Germany.
^f Cobra Shinguards, Taylorsville, Utah.
^g Diadora America, Kent, Washington.
^h Brine, Milford, Massachusetts.
ⁱ 4C Sports, Manhattan Beach, California.
^j Kappa USA Inc., Sterling, Virginia.
^k SSL International plc, Cheshire, England.

Fig. 1 Common Properties of a Shin Pad

2.1 Type of Shin Pads

Slip-in shin guards are made of lightweight, strong materials like foam padding or impact-resistant materials like EVA. Their low-profile design allows them to absorb impacts as effectively as possible. The simplicity and ease of use of slip-in shin guards is one of their main benefits. They fit in perfectly with the player's clothing when athletes slide them into their football socks. The lack of bulky straps adds to a sleek and nimble appearance while supplying the required protection during active play. The guards often have breathable fabric or ventilation components, which guarantee comfort and moisture control during prolonged use. Slip-in shin guards emphasise simplicity without sacrificing positional stability in their design. Because the guards are firmly positioned inside the sock, there is less chance that they will move during the intense movements of a game. Athletes value the low-profile design's freedom of motion, which allows agility without compromising protection. Professional football players often select slip-in shin guards, highlighting their desire for a discreet and fashionable solution that meets their performance requirements. [4]



Fig. 2 Slip-ins Shin Guard

Ankle shin guards are a particular kind of protective equipment that is intended to supply complete coverage for the ankle and shinbone when taking part in sports, especially football. These guards usually incorporate extra padding or protective components around the ankle area to lower the likelihood of injuries there. A durable plastic shell or foam padding is often used in the design to protect the shin, and an added layer of protection is added by the extension to cover the ankle. More protection is provided by ankle shin guards than by slip-in shin guards. On both sides of the ankle, added cushioning is typically included. Stirrups that go under the foot and a strap or elastic band to wrap around the calf for a snug fit are other features of ankle shin guards. The usual and suggested choice for youth athletes is ankle shin guards. They provide the best combination of defence against kicks and affects with sufficient mobility. The defenders should get the ankle shin guards as it supplies more protection since they experience the most "damage" from contact. For this reason, ankle shin guards are recommended for this position. [5]



Fig. 3 Ankle Shin Guard

Shin socks, sometimes referred to as shin guard sleeves or shin guard socks, are a type of multipurpose athletic wear that are intended to improve comfort and functionality when taking part in sports, especially football. These socks stand out due to their integrated pocket or sleeve on the front, which offers a safe and dedicated area for shin guard insertion. Because of their design, the shin guards will stay securely in place even when players make quick movements on the field. Shin socks feature the built-in cushioning of traditional shin guards but have the appearance of socks. They are therefore practical and comfortable. They are an excellent alternative for young players and simplify proper positioning. You only need to put them on, and you are ready to go. The National Operating Committee on Standards for Athletic Equipment (NOCSAE)-approved shin socks must be worn by all players on the high school football team, according to the coaches. Shin socks are made of a variety of materials, including elastic materials like spandex or elastane and strong synthetic fibres like nylon or polyester, to supply a comfortable and flexible fit. Typically composed of elastic materials, the integrated sleeve fits snugly without sacrificing comfort by moulding to the contours of the shin guard. This makes it unnecessary to apply extra tape or strapping, which makes getting ready for a practice or game easier. [6]



Fig. 4 Shin socks

2.2 Fit Related Issue of Shin Pads and Sports Equipment

There are several problems with the current shin pad sizing and as shin pads nowadays are the design might be too long or too short, depending on the size of user. For example, Asian people will have problem with the current shin pad design that based on Europe sizing scale as it might either covering the shin area too much or going beyond what is needed. Next, is the issue with the shin pads that are currently used for sports is that they tend to shift or slip, requiring the user to make frequent adjustments. If no adjustments are made, the user will become uncomfortable and find it more difficult to engage in sports. Then, during vigorous exercise is that the shin pads are irritating, limiting movements, or are uncomfortable. This is because of the loose fit between the shin pads and shin itself. After that, shin pads do not sufficiently deflect blows or shield users from harm as we see injury happening between athlete are still happening often. This might be caused by the failure of the shin pad to absorb the impact from tackles and aggression. The factors that might has caused this is the fit of the shin pad that did not cover the whole shin surface and the material used by the shin pad. [7] There also problems such as shin pads' fit do not match those listed on the manufacturer's size chart is often happening as the standard sizing is based on European people body size. People with smaller body sizing like Asean tend to face the problem as the shin pad is too big for them while African people will have problem that the shin pad is too small for them. There are differences in leg shape or size between every participant, even though the participant is between same age range and lives in same continent, which is Asean, the shin pads still do not fit properly on one leg and each participant has different shin size. Which is led to a conclusion that every person has different body size and it not just based on the continent the lives.

3. Methodology

The Sense™ 3D scanner was used for the anthropometric study. As a handheld white light scanner, it can produce accurate point clouds up to one hundred micrometers at a half a millimeter resolution. It is completely portable and utilizes surface geometry and texture algorithms to align itself in space and therefore does not require any targets to be placed on the scanned area.

When measuring someone's shin with a 3D scanner, precise measurements of the lower leg's size and features must be taken through a methodical approach. Choosing a 3D scanner with the required accuracy and resolution is the first step. In order to get the best visibility possible while scanning, the scanning environment must be set up properly, with enough illumination and room. In order to guarantee precise readings in accordance with recommendations, calibration is necessary after connecting the 3D scanner and installing any necessary drivers or software. The software on the scanner is used to start the scanning process when the leg is correctly positioned. Depending on the type of scanner, this might include either physically moving the scanner or employing a fixed arrangement. [8]

To guarantee full data collection, check the scanning programme often. If more scans are required, the scanner's location may be adjusted. Post-processing, which includes duties like aligning scans, removing flaws, and improving the 3D model, could be necessary. When satisfied, the 3D model is exported in an appropriate file format for use in a variety of applications, such making custom protective gear or carrying out research. The 3D model may be used to extract specific shin metrics using inbuilt tools or other applications. Measured values must be recorded and stored for later use. This will help with product customization and allow for the tracking of shin measurements over time. By following these recommendations, you may use a 3D scanner to measure your shins accurately and efficiently. For optimal results, always follow the manufacturer's recommendations.

During the scanning process, participants were asked to place their leg straight and sit at a fixed point on the chair without moving their shin. The posture position and scanning techniques were in accordance with the requirements of ISO 20685:2010(E) 3-D scanning methodologies for internationally compatible anthropometric databases (International Organization for Standardization, 2010b). Participants were asked to wear shin pad later on the surface of their shin for comparison. The scanner can record single scan at a rate of fifteen frames per second for about thirty seconds and automatically aligned the frames while scanning

3.1 Gather the respondent

To guarantee a representative and varied sample, creating a responder group for a survey or research project involves a methodical process. It's critical to specify your target audience's age range, place of employment, and physical attributes. The process of creating instruments, designing surveys, and choosing respondents is guided by the study objectives. Select a suitable technique for gathering data, such as online surveys, phone interviews, in-person meetings, or Google form questionnaires. To establish a sample frame, compile a list of possible respondents from online panels, public records, customer databases, and other pertinent sources. The choice between probability and non-probability sampling techniques, as well as research aims, determine which sample strategy to use: stratified or random.

Create a compelling recruiting message that makes it obvious what the study's objectives are, how important it is to participate, and if there are any incentives. To reach a large audience, make use of email lists, newsletters, social media, internet platforms, targeted advertising, and professional networks. Incentives such as gift cards, vouchers, or opportunities to win can increase engagement. Make that ethical standards are met, including disclosing the goal of the study to participants, keeping their information private, and getting their informed permission.

Prior to the survey's official launch, a limited sample size is used for pilot testing to assist find any problems. Keep an eye out for biases or gaps in the sample during the recruiting process and make necessary modifications to improve representativeness. Focus on acquiring and evaluating data after you have replies to make sure they are in line with the objectives of the research. By adhering to this methodical process, researchers may effectively gather a varied and perceptive sample for their study.

4. Result and Discussion

This chapter will focus on the data gathered from the 3D scanning session, which was conducted following the research goals. Every question from every part of the survey will be answered. The data was evaluated using either a percentage distribution or a statistical distribution. The analysis varies depending on the applicability and relevance of the questions. The data will be thoroughly studied, and the general results will be reviewed at the end of this chapter. The survey form was generated using the Google Form application, and a few survey forms were delivered to UTHM students using online platforms such as WhatsApp, and Facebook. The data gained will be discussed deeper into this chapter.

A 3D scanning session has been held to figure the problem related to shin pad fit assessment. The respondent bare shin and shin with shin pad has been scan. The table below shows the detailed information on the scanning session which have the attributes of the respondent chosen:

Table 1 3D scanning participant information

RESPONDENT NO.	HEIGHT (CM)	WEIGHT (KG)	SHIN LENGTH (CM)	SHIN CIRCUMFERENCE (CM)	SHIN PAD A COMFORT LEVEL (1-5)	SHIN PAD B COMFORT LEVEL (1-5)	SHIN PAD D COMFORT LEVEL (1-5)
1	173	79	30	20.0	4	2	4
2	179	83	31	20.5	2	1	3

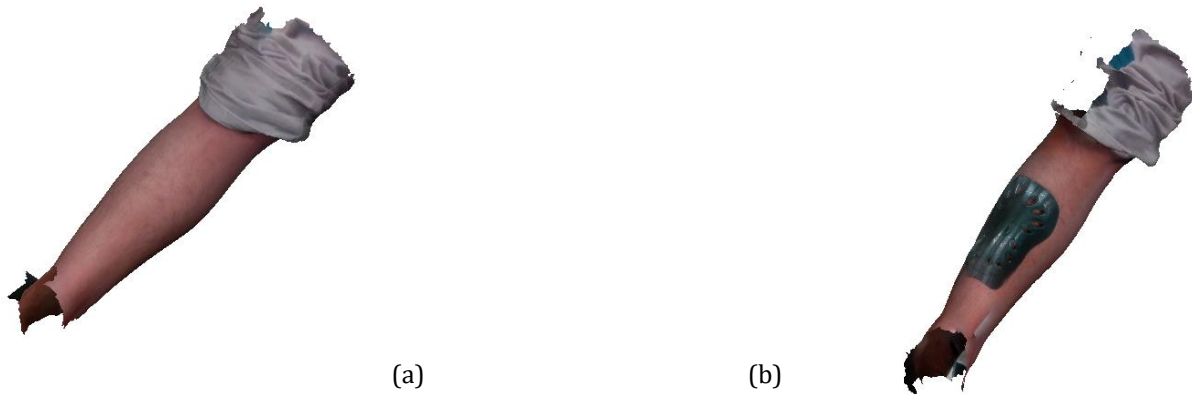


Fig 5: (a) Participant right shin (b) Participant right shin with shin sock

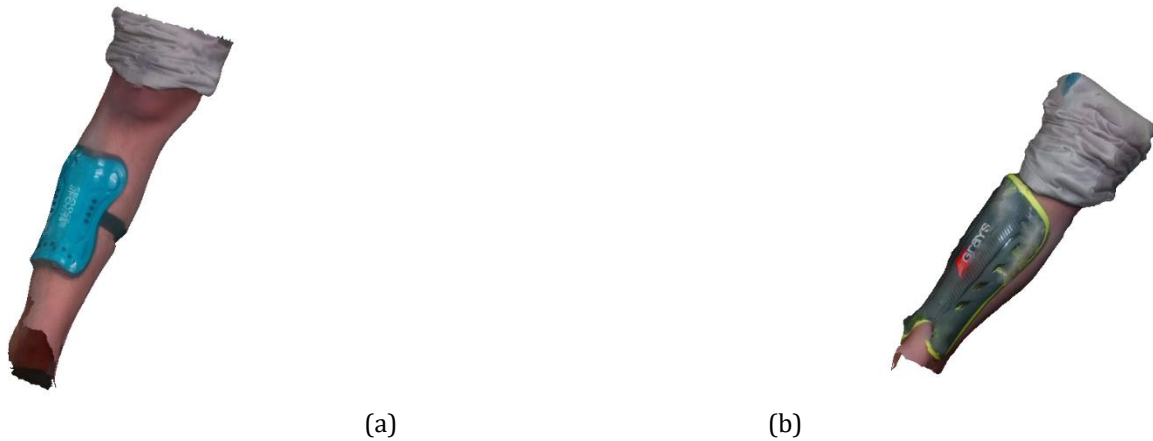


Fig 6: (a) Participant right shin with strapped shin pad (b) Participant right shin with hockey shin pad

4.1 Demographic of Survey Respondents and Usage of Shin Guard

The most respondent is Male with 27 respondents. Whilst the second highest percentage of respondents is Female with 3 respondents. With the age classification of respondents is between 20-28 years old with majority of them is 20-22 years old with 12 respondents. Minority for age classification of respondents is between 27-28 years old with 1 respondent. The major designation of respondents is Malay with 24 respondents. Then followed by Chinese with 5 respondents, Indian with 4 respondents and Others with 1 respondent. The average frequency of the respondents playing sports is 1-5 hours per week based on the survey and supported with 22 respondents. Followed by 6-10 hours with 3 respondent and less than 1 hour with 2 respondents. For the sports sectors highest percentage for respondents' sport sector is football with

21 respondents while hockey with 8 respondents and Muay Thai with 1 respondent. Most of the respondent usage of shin guard is less than 39% with 24 respondents. Next, is 90%-70% with 3 respondents, 69%-40% with 2 respondents and lastly every time playing sports with only 1 respondent. Based on the question is the current shin pad is comfortable with the sizing available, there are 24 respondents that did not agree with the statement and only 6 respondents are agree with the statement. The factor of the comfortless while wearing shin pad is most likely to be the weight of the shin pad that has been supported by 23 respondents. Followed by warmness with 4 respondents and humidity with 3 respondents.

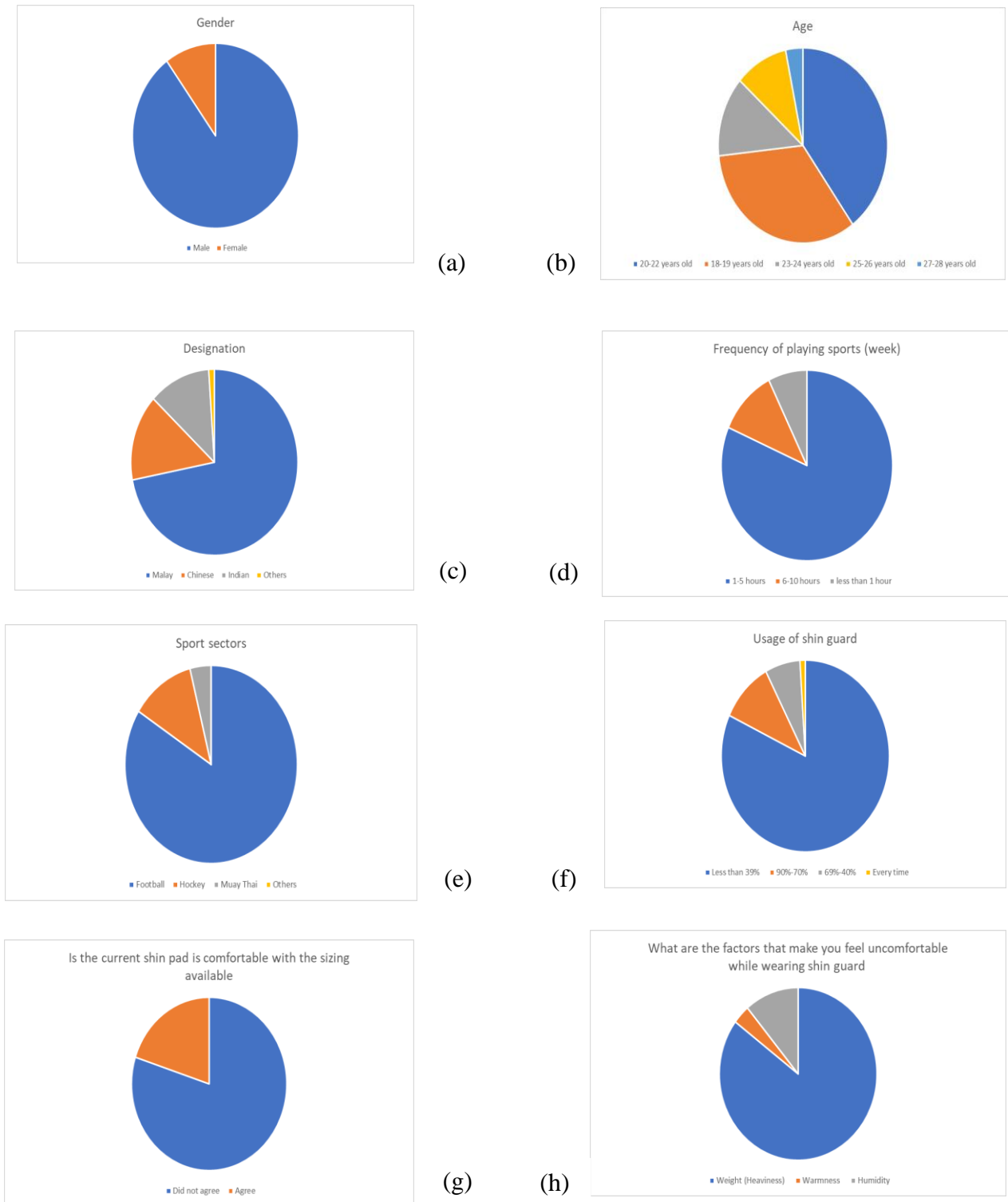


Fig 7: (a) Respondent Gender (b) Respondent Age (c) Respondent Designation (d) Respondent Frequency of playing sports (week) (e) Respondent Sport Sector (f) Respondent Usage of Shin Pad (g) Respondent opinion on current shin pad comfort (h) Factors that make shin pad uncomfortable to the respondent

5. Conclusion

This research concludes by comparing the FIT (Functional, Innovative, and Technological) components of shin pad design to current models and providing a full analysis of them. I've pinpointed areas for development by examining existing designs and taking user preferences into account. I've placed a strong emphasis on utility, creativity, and technology integration. The study emphasises the need for adaptable designs that meet a range of user requirements and offers innovations such as impact-resistant materials and smart fabrics. In summary, the article promotes a comprehensive methodology that integrates user feedback with technical details to create shin pads that are more focused on the needs of the user. With this strategy, we hope to bring in a new age of shin pads that surpass athletes' expectations and embrace constant innovation and adaptability to the ever-changing sports world.

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