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FACTORS ASSOCIATED ON HEAD, FACE AND NECK REGION INJURIES IN RECREATIONAL SURFERS IN ACAPULCO, MEXICO.

FACTORES ASOCIADOS A LAS LESIONES DE LA REGIÓN DE CABEZA, CARA Y CUELLO EN SURFISTAS RECREATIVOS DE ACAPULCO, MÉXICO.

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ABSTRACT

Introduction: Surfing carries potential and significant risk of head and face injuries in almost half of the surfers admitted to emergency departments. Objective: To estimate the frequency of head, face and neck injuries and identify associated factors in recreational surfers in Acapulco, Mexico. **Methods:** Cross-sectional study of 125 surfers during the period January - August 2023. With the Mantel-Haenszel process, the odds ratio (OR) along its confidence interval of 95% (95%CI) were estimated for explanatory factors associated with injuries with the CIETmap statistical package. **Results:** In the last year, the 37.6% (n=47) of surfers have experienced at least one injury to the head, face and neck region. The highest proportion of injuries were superficial scrapes (51.1%; n=24/47) caused by the impact with the surfboard (82.9%; n=39/47). Three factors were associated with independent effect in the final multivariate model: practice ≤ 10 years (aOR= 0.32; CI95%= 0.11-0.94), wave size ≥ 2 meters (aOR= 0.27; CI95%= 0.09 - 0.82) and not use of the board leash (aOR= 3.64; CI95= 1.70 - 8.94). **Conclusion:** The findings underline the importance of promoting safety measures such as the use of leashes on the board, even among more experienced surfers, to reduce the risk of injury in this sport.

Keywords: Wave Surfing; Athletic Injuries; Mexico. (Source: MESH-NLM)

RESUMEN

Introducción: La práctica del surf conlleva riesgo potencial y significativo de lesiones en la cabeza y la cara en casi la mitad de los surfistas ingresados a los servicios de urgencia. **Objetivo:** Estimar la frecuencia de las lesiones en la región de cabeza, cara, cuello e identificar los factores asociados en surfistas recreativos de Acapulco, México. **Métodos:** Estudio transversal en 125 surfistas durante el periodo de enero a agosto de 2023. Con el proceso de Mantel-Haenszel se estimó la razón de momios (RM) e intervalo de confianza del 95% (Ic95%) de factores explicativos asociados a las lesiones con el paquete estadístico de CIETmap. **Resultados:** En el último año, el 37.6% (n=47) de los surfistas han experimentado al menos una lesión en la región de cabeza, cara y cuello. La mayor proporción de las heridas fueron raspaduras superficiales (51.1%; n=24/47) producidas por el golpe con la tabla (82.9%; n=39/47). Tres factores estuvieron asociados con efecto independiente en el modelo multivariado final: práctica ≤ 10 años (RMa= 0.32; IC95%= 0.11-0.94), tamaño de la ola ≥ 2 metros (RMa= 0.27; IC95%= 0.09 – 0.82) y no usar el leash en la tabla (RMa= 3.64; IC95%= 1.70 – 8.94). **Conclusión:** Los hallazgos subrayan la importancia de promover medidas de seguridad como el uso de leash en la tabla, incluso entre surfistas con más experiencia, para disminuir el riesgo de lesiones en este deporte.

Palabras clave: Surf; Lesiones en Deportes; México. (Fuente: DeCS- BIREME)

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INTRODUCTION

Surfing is a sport with origins in Hawaii dating back more than 1,000 years, with reports of people using primitive surfboards[1,2]. It is a recreational sport enjoyed by people of a variety of socioeconomic backgrounds, ages, geographic locations and sex[3,4]. Some persons surf for recreation, but others consider it a fundamental part of the daily routine in coastal communities[5]. The main parts of the activity of surfing involve paddling, jumping, riding waves and performing acrobatics[4,6,7]. The practice of surfing carries a significant potential risk of head and facial injuries, with around half of all surfers admitted to the emergency services for this reason[8].

It is estimated that one in three surfers experience an injury serious enough to keep them out of the water for varying periods of time[5]. Injuries in recreational surfers average around 1.23 to 3.5 per 1000 hours of practice [9,10], and 6.6 per 1000 hours in professional surfers [11]. Other accidents also include attacks by marine wildlife [12].

The National Electronic Injury Surveillance System of the US Safety Commission database mentions that at the year 2002 to 2013, approximately 131,494 injuries were recorded on 2,072 surfers [13]. Common injuries sustained by surfers to the head and facial region include lacerations, tissue contusions, facial fractures, eye trauma and dental fractures [4,14-17]. Further studies report lesions in the lower back, foot, knee and ankle regions[18]. In Australia, the National Media and Incident Reporting and Forensic Information System adjudicated 155 surf and bodyboard fatalities during the period June 2004 to June 2020[19]. It is estimated that contusions and facial lacerations affect 29% to 42% of surfers in different geographical region[5,9,20]. These types of injuries require rest periods that allow surfers to recover[5]. Even a minimal risk of concussion has been documented in this type of accident, ranging of 3.2% to 6.5%. Knowledge of the spectrum and mechanisms of injuries suffered by surfers drives the design of accessories and boards that minimize the risk of accidents[8].

Concerning the factors associated with surfing, it is documented that competitive surfers are more at risk than recreational surfers [9,10], experience in surfing [8], training at least three times a week [8,22], wave size[11,23], surfing on rocky or reef bottom[13], and age[20]. In terms of sex, no evidence has been found, but males are described as having the highest number of injuries, partly due to the fact that they are more likely to surf [5,8-10,23]. It is even mentioned that surf teachers and competitive surfers are susceptible to orthopedic, skin and external injuries during their practice [24,25]. It is important to know the distribution of injuries in surfers, since they will always influence both the physical and emotional aspects of those who practice it [16]. In our region there are no studies that denote the frequency of the event, so an estimate of persons who practice it and who have a history of accidents is unknown. The objective of the research was to generate knowledge on the subject in order to estimate the frequency of injuries in the head, face and neck region and the associated factors in recreational surfers in Acapulco, Guerrero, Mexico.

METHODS

Study design

Cross-sectional study that estimated the frequency of head, face and neck injuries and identified associated factors in recreational surfing in Acapulco, Guerrero, Mexico during the period of January to August 2023. Acapulco, located on Mexico's Pacific coast, is known for its favorable surfing conditions, attracting both local and international surfers year-round. With a range of beaches that cater to varying skill levels, Acapulco is a prominent destination for recreational surfing within the region, which provides a relevant context and justification for selecting this location as the study area.

Population and sample

Based a non-probability snowball sampling, six surfers were identified and assisted in disseminating the measurement instrument, with a scope of 129 recreational surfers included. The inclusion criteria were people of legal age who practice recreational surfing in the different beaches of Acapulco. To reduce selection bias, four people belonging to a professional surfing committee with a history of participation in national and international competitions were excluded, as well as people with a physical limitation that kept them out of the practice. As for elimination criteria, only incomplete forms were eliminated.

Instrument and variables

The measurement instrument was a 44-item form

validated with experts in the areas of Epidemiology, Public Health, Anthropology, Maxillofacial Surgery and one expert in the subject of surfing [26]. Sociodemographic data was collected on surfing, surfboard parts and accessories (Table 1), considerations on the practice and mainly physical injury related aspects. The outcome variable was the history of any injury to the head, face and neck region in the last year according to the established nominal categories (yes/no). Some explanatory variables were estimated with information collected, such as body mass index (BMI), which was categorized based on the parameters established in national guidelines: grade 1: BMI 30-34.9; grade 2: BMI 35-39.9; and grade 3 BMI > 40 [27].

The rest of the variables were operationalised according to the researchers' criteria based on scientific evidence.

Table 1. Description of surfboard parts and accessories.

Surfboard parts and accessories	Description
Nose	Part of the board that has a relevant influence on paddling and manoeuvrability.
Rocker	It is the curvature of the surfboard for the tip to the tail.
Tail	Part of the board that has a relevant influence on speed and manoeuvrability.
Stringer	Part that helps to resist and absorb the typical impacts that occur during surfing.
Rails	These are the edges of the board that extend over the tail, through the sides, to the nose.
Keels	Device that gives stability, control and direction to the surfboard.
Leash	Safety element that always keeps the surfer on the surfboard
Grip	Accessory that attaches to the board made of foam or cork, and helps to improve stability and adherence on the water.
Board waxing	Surf wax keeps the surfer connected to the board in order to prevent slipping and improve wave performance.

Procedures

The measurement instrument was developed via a Microsoft Forms® form, and the link generated was shared with the first recruiters, who shared it with their acquaintances. The replies were compiled into a database in an Excel template and coded for analysis [28].

Statistical analysis

Statistical analysis of the data was processed with the CIETmap package [29]. A descriptive analysis was performed for simple frequencies of each of the study variables; subsequently, the Mantel-Haenszel process was used to estimate the odds ratio (OR) along its

confidence interval of 95% (CI95%) in the bivariate and multivariate analyses. The multivariate analysis began with the saturated model, where the explanatory variables that reached statistical significance were included and eliminated one by one with the backward method, until those with a level of significance in the final model were left ($P < 0.05$).

Ethical aspects

The research protocol was approved by the Research Ethics Committee of the State Health Services of Guerrero, Mexico with the folio number 10281022, and was considered risk-free accordance to the guidelines established in the Regulations of the General Health Law on Research. The study adhered to the ethical principles outlined in the Declaration of Helsinki. The form was applied online using Microsoft Forms® and was answered freely and voluntarily with an informed consent checkbox. The application complied with the General Data Protection Regulation, given that it did not request the linking of e-mail, which guaranteed the anonymity of the participants.

RESULTS

Among the total population, four surfers were excluded, so the analysis considered 125 observations. Age ranged of 19 to 41 with a mean of 26.9 years (SD= 4.6). Regarding anthropometric measurements, weight ranged of 38 to 95 with a mean of 65.5 kilograms (SD=10.1); and height ranged of 1.54 to 1.86 with a mean of 1.71 meters (SD= 0.06). When estimating BMI, values ranged of 15.6 to 34.9 with a mean of 22.2 (SD=2.7). The sociodemographic characteristics of the surfers are shown in Table 2.

Table 2. Sociodemographic characteristics in surfers of the Acapulco region.

Factor	Category	Frequency	%
Sex	Male	111	88.8
	Female	14	11.2
Age	≤ 25 years	47	37.6
	≥ 26 years	78	62.4
BMI	Normal weight	100	80.0
	Low weight	12	9.6
	Overweight	12	9.6
	Obesity	1	0.8
Education level	Undergraduate	87	69.6
	High school	32	25.8
	Middle school	6	4.6
Social security	Yes	25	20.1
	No	100	79.9

In relation to the information on surfing, only 12% (n=15) of the people mentioned physiotherapy activities as a complement to the practice of the sport. The majority learned surfing self-taught (n=77; 61.6%), with ≤ 10 years of experience (n=106; 84.8%), practice days per week ≥ 2 days (n=84; 67.2%) and ≤ 10 hours practice hours per week (n=108; 86.4%). Bonfil beach is the most visited with 68.1% (n=85), characterised by a sandy bottom type (n=108; 86.4%) and a wave length of two metres (n=63; 50.4%). On the board, the most used is the pointed nose (n=86; 68.8%), the continuous rocker (n=75; 60.1%), the rounded tail (n=54; 43.2%), the polyester resin board (n=96; 76.8%) with rounded rails (n=69; 55.2%). Concerning the fins of the board, most of them have three fins (n=62; 49.6%), with leash (n=87; 69.6%) and use of grip (n=77; 61.6%). Regarding some perceptions of situations prior to surfing, 44.8% (n=56) considered warm-up exercises, wind conditions

(n=54; 43.2%), swell conditions (n=58; 46.4%), keel position (n=69; 55.2%) and board waxing (n=75; 60.1%) to be of high importance. The 16% (n=20) use a face-shield, the 63.2% (n=79) usual route is position to take the wave face on (frontside), and the 66.4% (n=83) surf with the right foot placed in the rear position on the board (regular). Some 6.4% (n=8) produce teeth clenching and 1.6% (n=2) wear protective eyewear during their rides. Table 3 describes the information on the characteristics of surfing.

Table 3. Surfing characteristics of recreational surfers in the Acapulco region.

Factor	Category	Frequency	%
Experience years	≤ 10 years	106	84.8
	≥ 11 years	19	15.2
Practice days per week	1	41	32.8
	≥ 2	84	67.2
Practice hours per week	≤ 10	108	86.4
	≥ 11	17	13.6
Frequent beach	Bonfil beach	85	68.1
	Pie de la Cuesta beach	40	31.9
Type of seabed	Sandy	108	86.4
	Rocky	17	13.6
Wave size	1.5 meters	22	17.6
	2 meters	63	50.4
	2.5 meters	40	32.0
Type of nose	Pointed	86	68.8
	Rounded	36	31.2
Type of rocker	Continued	75	60.1
	Phased	34	27.2
	Hybrid	16	8.7
Type of tail	Rounded or squash	54	43.2
	Diamond tail	39	31.2
	Swallowtail	32	25.6
Type of stringer	Polyester resin	96	76.8
	Carbon fiber	18	14.4
	Fiberglass	11	8.8
Type of rails	Boxy rails	69	55.2
	Hard rails	56	44.8

Number of keels	1	37	29.6
	2	27	21.6
	3	61	48.8
Warm-up exercises	High importance	56	44.8
	Medium importance	47	37.6
	Low importance	22	17.6
Wind conditions	High importance	54	43.2
	Medium importance	45	36.0
	Low importance	26	20.8
Swell conditions	High importance	58	46.4
	Medium importance	43	34.4
	Low importance	24	19.2
Keel position	High importance	69	55.2
	Medium importance	15	12.1
	Low importance	41	32.7
Board waxing	High importance	75	60.1
	Medium importance	16	12.7
	Low importance	34	27.2
Usual route along surf	Frontside	79	63.2
	Backside	46	36.8
Position of the foot on the	Regular	83	66.4
board along surf	Goofy	42	33.6

The 93.6% (n=117) of surfers have experienced a lifetime bodily injury while surfing. In the last year, 37.6% (n=47) of surfers have experienced at least one injury to the head, face and neck region, with a frequency of 1 to 3 times (mean 1.13; SD=3.6). The highest proportion of injuries were superficial scrapes (51.1%; n=24/47), followed by contusion (31.8%; n=15/47) and lacerations (17.1%; n=8/47). With respect to the type of accident, striking the surfboard was the most frequent with 82.9% (n=39/47), and the rest of the impacts with the seabed. None of the injuries caused any situation limiting practice or dental loss. In the bivariate analysis there were five factors potentially associated with head, face and neck injuries in recreational surfers: years in practice, wave size, use of the board leash, consideration of keel position and waxing of the surfboard prior to surfing (Table 4).

Only three variables were associated with injuries with independent effect in the final multivariate model: years in practice, wave size and not use of the of the board leash (Table 5).

Table 4. Bivariate analysis of factors associated with head, face and neck injuries in recreational surfers in the Acapulco region.

Factor	Category	Injunry n=47	No injury n=78	uOR	CI95%
Sex	Female [ref]	5	9	0.91	0.29 - 2.92
	Male	42	69		
Age	≤ 25 years [ref]	13	34	0.49	0.23 - 1.08
	≥ 26 years	34	44		
BMI	Uneven weight [ref]	6	19	0.45	0.17 - 1.22
	Normal weight	41	59		
Education level	High / middle school [ref]	12	26	0.69	0.31 - 1.54
	Undergraduate	35	52		
Social security	No [ref]	36	64	0.72	0.29 - 1.74
	Yes	11	14		
Surfing learning mode	Self-taught [ref]	25	52	0.57	0.27 - 1.19
	Influence by others	22	26		
Experience years	≤ 10 years [ref]	36	70	0.37	0.14 - 0.97*
	≥ 11 years	11	8		
Practice days per week	1 [ref]	13	28	0.68	0.31 - 1.50
	≥ 2	34	50		
Practice hours per week	≤ 10 hours [ref]	41	67	1.12	0.38 - 3.28
	≥ 11 hours	6	11		
Frequent beach	Bonfil beach [ref]	31	54	0.86	0.40 - 1.87
	Pie de la Cuesta beach	16	24		
Type of seabed	Rocky [ref]	9	8	2.07	0.75 - 5.75
	Sandy	38	70		
Wave size	≥ 2 meters [ref]	34	69	0.34	0.14 - 0.86*
	< 2 meters	13	9		
Type of nose	Pointed [ref]	36	50	1.83	0.81 - 4.15
	Rounded	11	28		
Type of rocker	Hybrid / Phased [ref]	14	36	0.49	0.23 - 1.06
	Continued	33	42		
Type of tail	Squash [ref]	21	33	1.10	0.53 - 2.29
	Swallowtail / diamond tail	26	45		
Type of stringer	Polyester resin [ref]	32	64	0.47	0.20 - 1.08
	Carbon fiber / Fiberglass	15	14		
Type of rail	Boxy rails [ref]	25	44	0.88	0.42 - 1.82
	Hard rails	22	34		

Number of keels	One [ref]	17	20	1.64	0.75 - 3.59
	Two / Three	30	58		
Leash	Not use [ref]	21	17	2.90	1.33 - 6.30*
	Use	26	61		
Grip	Not use [ref]	23	25	2.03	0.97 - 4.27
	Use	24	53		
Warm-up exercises	Medium / low importance [ref]	24	45	0.77	0.37 - 1.59
	High importance	23	33		
Wind conditions	Medium / low importance [ref]	30	41	1.59	0.76 - 3.35
	High importance	17	37		
Swell conditions	Medium / low importance [ref]	24	43	0.85	0.41 - 1.76
	High importance	23	35		
Keel position	Medium / low importance [ref]	28	28	2.63	1.26 - 5.51*
	High importance	19	50		
Board waxing	Medium / low importance [ref]	25	25	2.41	1.15 - 5.05*
	High importance	22	53		
Usual route along surf	Frontside [ref]	32	47	1.41	0.66 - 3.02
	Backside	15	31		
Position of the foot on the board along surf	Regular [ref]	34	49	1.54	0.70 – 4.40
	Goofy	13	29		
Teeth clenching along route	No [ref]	42	75	0.34	0.08 - 1.40
	Yes	5	3		
Use of face shield along route	Not use [ref]	37	68	0.54	0.21 - 1.42
	Use	10	10		

Ref= Reference category.
uOR= Unadjusted odds ratio.
Ci95%= Confidence interval of 95%.

Table 5. Final model of the multivariate analysis of the factors associated with head, face and neck injuries in recreational surfers in the Acapulco region.

Factor	Category	uOR	aOR	Ci95%	X^2 het	P
Experience years	≤ 10 years	0.37	0.32	0.11 – 0.94	4.11	0.995
Wave size	≥ 2 meters	0.34	0.27	0.09 – 0.82	5.30	0.993
Leash	Not use	2.90	3.64	1.70 – 8.94	10.35	0.985

uOR= Unadjusted odds ratio.
aOR= Adjusted odds ratio.
Ci95%= Confidence interval of 95%.
X2 het= Chi-square of heterogeneity to identify effect distractor.
P= Significance level for heterogeneity test.
* The explanatory factors were adjusted for the sex variable based on the biological plausibility criterion.

DISCUSSION

The 37.6% of recreational surfers in Acapulco, Mexico have experienced at least one injury to the head, face and neck region in the last year. The majority of the injuries were superficial scrapes as a result of blows with the board, none of which made it impossible to continue surfing. Three factors were associated: practice ≤ 10 years, wave size ≥ 2 meters, and not use of the board leash.

The frequency of injuries reported was moderate, similar to that obtained in Portuguese surfers[9].;in contrast to Brazilian and Australian surfers, who report a higher occurrence[17,18]. It is important to mention that the reported distribution was lapsical, so that when we delve deeper into lifetime injuries in any body region, the rate increased. Monteiro et al.[25] mention that injuries in recreational surfers range on average of 31% to 35% and 42% to 49% in competitive surfers; and over a lifetime for both groups ranges of 81% to 100%.In another study, the incidence of injury is estimated to be 27% in New Zealand surfers[22].

About years of experience, the less time spent surfing, the lower the risk of injury; this is in disagreement with Minghelli et al.[9] and Cordeiro et al.[17] who suggest that inexperience in surfing carries a higher risk. These results are subject to other variables that impact experience, such as the days and hours per week dedicated to surfing; in this study, 67.2% of people surf more than at least two times per week, but 86.4% dedicate 10 hours or less to surfing. Therefore, if this assumption is true, the fewer years of practice, the shorter the exposure time for injury. Lawes et al.[19] document that Australian surfers surf 45.7 times a year, for 1.88 hours per visit, which equates to 86.1 hours of exposure, which even influences the mortality rate of the sport.

In relation to wave size, Nathanson et al. mention that health professionals who treat surfing injuries attribute high wave heights as a cause[11]. In our case, we point out the opposite, since the larger the wave size, the lower the probability of injury, similar to that expressed by Thom et al.[23] in Australian surfers, who conclude that a wave size of less than 1.25 meters increases the probability of an accident by 40%. These situations will depend largely on the coastal geography of the coast, the size of the waves in the area and the type of seabed. In this case, we assume that the larger the wave size, the lower the probability of an impact with the seabed or some other structure, which gives the surfers more time to react with some maneuver.

With regard to board accessories, we documented that not using the leash was a risk factor for injury. The leash is an accessory that helps maintain contact with the board after a fall or capsize, since it serves as a buoyancy aid and ensures the safety of the wearer and third persons. MacArthur et al.[15] in a systematic review emphasize that the proposed use of protective equipment, as well as other elements on the boards, reduces injuries in surfers; therefore, under this criterion, we assume that not using the proper equipment precedes the effect.

As for the type of injury, most were superficial scratches caused by the blow with the same board, similar to the report of other studies[5,8,15]. In other studies, the injuries are serious and require emergency care and prolonged periods of rest[8,10,13,20]. Remmant et al. in their study of 550 serious injuries, mention that 44% of the injuries have a duration of less than three months and 56% have a longer duration[22].

This research appears to be one of the first to explore the subject of surfing in the country, specifically in Acapulco, Guerrero, hence the importance of access to health services, since the current problem with reference to physical injuries in surfers is that the public services of government agencies are not contemplated in some type of immediate emergency for their attention. This is because their statistics are based on the mortality and/or morbidity of the population and this limits their classification as a priority in public health and in international organisations such as the World Health Organization[30]. However, this study makes visible the group of people who practice the surfing activity and the risk of injuries that can be suffered when it becomes a daily and recreational sport on the beach. In the public sphere, especially when affordable medical care services are not immediately available to surfers.

Due to the nature of the cross-sectional design, there are limitations in the causal relationships, since the explanatory factors are modifiable, and it is not possible to assume whether these were before or after the self-reported injury, so there could be inverse causality. Obtaining retrospective data limits us to know exactly the recreation of the facts, so follow-up studies are needed to better explore the subject to denote

temporality. Additionally, the BMI was calculated based on self-reported weight and height, which may introduce inaccuracies due to potential reporting bias. Also, we note that the anatomical area affected by the injuries was not obtained specifically, but was described regionally, so in future research we suggest incorporating an anatomical map in the respondents in order to indicate the areas most prone to impacts derived for surfing.

The snowball sample selected for the study is not representative of recreational surfers in the region, as the initial recruiters were able to designate persons with the same traits and characteristics, and this makes it impossible to extrapolate the results. Non-differential selection bias is evident, caused by overlapping connections among the initial recruiters and the interconnectedness of links with the other participants. Nevertheless, the chain process benefited in reaching out to this type of population and for future research to get an estimate of the number of surfers on the different coasts of the state.

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CONCLUSION

Injuries to the head, face, and neck region in recreational surfers in Acapulco are moderate. The findings underscore the importance of promoting safety measures such as the use of leashes on the board, even among more experienced surfers, to decrease the risk of injury in this sport. Future research with representative sampling methods could validate and extend these results by providing a more complete understanding of the factors influencing surfer safety.

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