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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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ORIGINAL PAPER

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 conducted via an online survey 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:** Head, face, and neck injuries in Acapulco surfers are moderate, mostly superficial, and mainly caused by surfboard impacts; key risks include ≤10 years of experience, smaller waves, and not using a leash. 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 mediante encuestas virtuales. 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:** Las lesiones en la cabeza, cara y cuello en los surfistas de Acapulco son moderadas, en su mayoría superficiales y principalmente causadas por impactos con la tabla de surf; los principales factores de riesgo incluyen ≤10 años de experiencia, olas pequeñas y no usar leash. 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

This cross-sectional study estimated the frequency of head, face, and neck injuries and identified associated factors in recreational surfers in Acapulco, Guerrero, Mexico, from 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 survey instrument was designed using Microsoft Forms® and shared initially with the recruited participants, who then distributed it to other surfers in their networks. Responses were consolidated in a Microsoft Excel® database 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 Considerations

The study protocol received approval of the Research Ethics Committee of the State Health Services of Guerrero, Mexico (approval number 10281022), and was classified as risk-free under the General Health Law Regulations on Research. The study adhered to the ethical principles outlined in the Declaration of Helsinki. Participants completed the online survey voluntarily, indicating informed consent via a checkbox. The data collection was compliant with the General Data Protection Regulation, ensuring participant anonymity by not collecting email addresses.

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.

ORIGINAL PAPER

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

Approximately 37.6% of recreational surfers in Acapulco, Mexico, reported experiencing at least one head, face, or neck injury within the past year. Most injuries were superficial scrapes, primarily resulting from impacts with the surfboard, and did not prevent continued surfing. Three risk factors were identified: ≤10 years of practice, wave heights ≥2 meters, and the absence of a board leash. The frequency of reported injuries was moderate and comparable to rates found in Portuguese surfers[9], contrasting with the higher injury occurrence reported in Brazilian and Australian surfers[17,18]. It is important to note that the injury distribution was episodic; however, when examining lifetime injuries across all body regions, the injury rate increased significantly. Monteiro et al.[25] reported that injury prevalence in recreational surfers ranges of 31% to 35%, rising to 42% to 49% in competitive surfers, with lifetime injury rates across both groups spanning from 81% to 100%. In a separate study, the incidence of injuries among New Zealand surfers was estimated at 27%[22].

Regarding experience, a shorter surfing history was associated with a reduced risk of injury, which contradicts findings by Minghelli et al.[9] and Cordeiro et al.[17], who suggest that inexperience is linked to a higher injury risk. This discrepancy may be influenced by other factors impacting experience, such as the frequency and duration of weekly surfing sessions; in this study, 67.2% of participants surfed at least twice weekly, yet 86.4% reported spending 10 hours or less surfing each week. Therefore, if this assumption holds, fewer years of practice may correlate with shorter cumulative exposure to injury. Lawes et al.[19] documented that Australian surfers engage in surfing an average of 45.7 times annually, for 1.88 hours per session, totaling 86.1 hours of exposure, which could even influence sport-related mortality rates.

Concerning wave size, Nathanson et al.[11] indicated that healthcare professionals attribute larger wave heights to an increased risk of surfing injuries. In contrast, our findings suggest an inverse relationship, where larger waves correlate with a reduced injury likelihood, aligning with Thom et al.[23], who found that waves under 1.25 meters increase the accident probability by 40% among Australian surfers. This variability may largely depend on the coastal geography, wave sizes specific to the region, and the type of seabed. We postulate that larger waves might decrease the chance of impact with the seabed or other structures, affording surfers more time to maneuver and reduce injury risk. With respect to surfboard accessories, our study identified the lack of a leash as a significant injury risk factor. The leash assists in retaining board contact after falls or capsizes, serving as a buoyancy aid and enhancing safety for the surfer and others. MacArthur et al.[15], in a systematic review, emphasized that protective equipment, including leashes, reduces injury rates among surfers. Therefore, we infer that inadequate use of protective equipment could precede injuries.

Regarding injury types, most were superficial abrasions from board impacts, similar to reports in other studies[5,8,15]. In contrast, severe injuries requiring emergency care and extended recovery periods have been reported in other research[8,10,13,20]. Remmant et al.[22] documented that of 550 serious injuries, 44% had a recovery period of under three months, while 56% required longer.

This study appears to be among the first to examine surfing-related injuries in Mexico, particularly in Acapulco, Guerrero, underscoring the importance of healthcare access. Currently, government-provided emergency medical services for surfers are limited, as public health services prioritize conditions associated with population-level morbidity and mortality. Consequently, surfing injuries are not recognized as a public health priority, even by organizations such as the World Health Organization[30]. Nonetheless, this study highlights the injury risks faced by surfers and the need for affordable healthcare services, especially in the public sector.

Due to the cross-sectional design, establishing causal relationships is limited, as the modifiable factors could precede or follow the reported injury, introducing potential inverse causality. The retrospective nature of data collection further limits precise reconstruction of events, highlighting the need for longitudinal studies to better explore temporality. Additionally, body mass index (BMI) was calculated based on self-reported weight and height, which may introduce reporting bias. Specific anatomical details of injury locations were not collected, being instead described regionally; future studies should incorporate an anatomical map for respondents to indicate high-risk areas. The snowball sample selected for the study is not representative of recreational surfers in the region, as it lacked a formal

sample size calculation, and the initial recruiters were able to designate individuals with similar traits and characteristics. This limited the diversity within the sample and made 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.

CONCLUSION

Injuries to the head, face, and neck region in recreational surfers in Acapulco are moderate, with most being superficial and primarily caused by surfboard impacts; key risk factors include less surfing experience (≤10 years), smaller waves (<2 meters), and not using a leash. 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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ORIGINAL PAPER

Author contributions: CAJM participated in the conceptualization, data curation, formal analysis, research, methodology, visualization, and writing of the original draft; JMGR in project administration, validation and writing of the original draft; ARVA performed data curation and formal analysis; MARA support with software and supervision; MVBL the validation and writing of the original draft; MHN= did the conceptualization and validation; and SAR in project and resource administration. All authors approved the final version of the document.

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