

Driving Posture Preferences Among Southeast Asian Drivers: Insights from Malaysia, Thailand, and Indonesia

N. K. Khamis^{*1,2}, M. R. Abu Mansor^{1,2}, M. A. H. Mazlan¹, N. A. Amiruddin¹, A. Ardiyanto³, F. Trapsilawati³ and E. Sombatsawat⁴

¹ Department of Mechanical & Manufacturing Engineering, Faculty of Engineering & Built Environment, Universiti Kebangsaan Malaysia, 43650 Bandar Baru Bangi, Selangor, Malaysia

² Center of Automotive Research, Faculty of Engineering & Built Environment, Universiti Kebangsaan Malaysia, 43650 Bandar Baru Bangi, Selangor, Malaysia

³ Department of Mechanical and Industrial Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia

⁴ Faculty of Public Health, Thammasat University, Rangsit Campus, Pathumthani, Thailand

*Corresponding author: kamaliana@ukm.edu.my

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ABSTRACT – This study aims to determine the preferred seating positions and driving postures of passenger vehicle drivers in Southeast Asia, particularly in Malaysia, Thailand, and Indonesia. The outcomes are intended to improve the effectiveness of dummy placement in vehicle security evaluations, including the ASEAN NCAP procedure. A standardized questionnaire was created, validated by expert review, and disseminated online. The survey addressed six primary adjustable elements for drivers: seatback angle, seat sliding distance, steering wheel height, headrest height, seat height, and seat belt height. It assessed postural standards after adaptation, encompassing knee and leg orientation, upper body and head alignment, and hand positioning on the steering wheel. A total of 1,374 valid responses were obtained: 21% from Malaysia, 40% from Thailand, and 39% from Indonesia. Results demonstrate a regional norm where the majority of drivers prefer a seatback angle of 90 degrees (48%), mid-position with elbow angle between 90 and 130 degrees (55%), mid-position of steering wheel height (47%), standard headrest height (49%), and a standard seat belt adjustment (58%). Most individuals adopt a slightly knee-bent and feet flat on the pedal (53%), upper body and head position with upright with head centered (76%), and their hands placed at the 9 and 3 o'clock steering positions (60%). Although several choices conform to ergonomic guidelines, others, such as the inability to alter seatbelt and headrest height, indicate a discrepancy between current practices and safety regulations. These findings are useful in enhancing the anthropometric applicability of crash test dummy configurations and guiding car interior design for Southeast Asian users. The results may be utilized to optimize crash test dummy positioning techniques, improve seat design ergonomics, and bolster vehicle safety assessments particular to ASEAN. It is advisable to bridge behavioral gaps through ergonomic education and adaptive design to improve real-world driver safety.

KEYWORDS: Posture, driver, vehicle, car, interior, angle

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1. INTRODUCTION

The rate of road traffic accidents in Southeast Asia remains higher than worldwide averages, with several countries in ASEAN reporting death rates over 17.0 per 100,000 individuals annually (Baharuddin et al., 2019; ASEAN NCAP 2019). Despite legislative and infrastructural measures enhancing traffic regulation, the rates of occupant injuries and fatalities persistently remain elevated, particularly among rear-seat passengers and drivers of passenger cars. As vehicle ownership in the region increases, providing optimal occupant safety through ergonomically designed seating layouts has become increasingly vital. The relationship between human posture and vehicle safety systems such as seat belts, airbags, and child restraint devices requires a comprehensive understanding of how individuals in this area generally place themselves when traveling.

Current ergonomic and vehicle safety research has primarily depended on Western anthropometric datasets and posture assumptions, frequently sourced from North American or European driving demographics. Although foundational research has explored the relationship between posture and injury risk, including the impact of seatback angle on spinal loading and headrest positioning on whiplash prevention, limited studies have investigated cultural or regional differences in actual seated behavior. Research conducted by Peng et al. (2018) and Sabri et al. (2021) has emphasized variations in posture influenced by demographic and anthropometric characteristics. Nevertheless, their findings are confined to controlled laboratories or experimental environments and do not encompass ASEAN participants. While ASEAN NCAP offers systematic crash test methodologies, the dummy designs may inadequately reflect the normal seating postures of Southeast Asian drivers, thus compromising the authenticity of occupant safety evaluations (ASEAN NCAP, 2019).

A review of current practices reveals a critical knowledge gap: normative data on occupant seating posture and position specific to Southeast Asian drivers is lacking. The absence of such data inhibits both the localization of crash test dummy protocols and the refinement of safety systems tailored to this demographic. As occupant biomechanics and safety device effectiveness are closely tied to posture, capturing region-specific postural norms is imperative. This study is thus motivated by the need to empirically document real-world seating behaviour among drivers in Malaysia, Thailand, and Indonesia, providing foundational input to support anthropometric alignment in occupant safety testing and the future design of ergonomically responsive vehicle interiors.

A comprehensive examination of the existing literature reveals a pronounced scarcity of research addressing occupant posture within the ASEAN context across all passenger categories. Despite the region's substantial vehicle fleet and diverse demographic composition, systematic studies documenting the seating preferences and postural characteristics of adult drivers and passengers remain virtually absent from academic literature. This research gap extends beyond the driver's seat to encompass adult passengers, whose seating behaviors may differ significantly from those of drivers due to variations in comfort priorities, seat adjustment accessibility, and engagement with in-vehicle activities. The limited availability of region-specific data represents a critical oversight, particularly given that adult passenger posture can substantially influence injury outcomes during vehicular incidents, with rear-seat passengers often experiencing different injury patterns compared to front-seat occupants.

Although global standards such as SAE International (SAE J287) and the International Organization for Standardization (e.g., ISO 7250 anthropometric standard) provide general ergonomic design requirements, there remains no fully harmonized regional ergonomic posture regulation in Southeast Asia. However, vehicle safety guidelines under ASEAN NCAP emphasize appropriate seating position and restraint use in occupant protection assessments, indirectly stressing posture relevance in crash testing and seatbelt evaluation. Several ASEAN countries have adopted seatbelt use regulations and minimum vehicle design standards, but none explicitly prescribe normative driving postures. This regulatory gap underscores the importance of generating region-specific ergonomic evidence to inform both policy development and automotive design adaptation.

The knowledge gap is particularly evident in studies concerning vulnerable passenger demographics in ASEAN nations, notably children and newborns. Research on child passenger posture and positioning in Southeast Asian vehicles is largely absent, despite increasing evidence that cultural practices, vehicle design differences, and economic factors substantially affect child restraint utilization and seating configurations in this area (Albanese et al., 2020; Ma et al., 2024). Likewise, research examining infant passenger placement and the efficacy of baby car seat installations in actual Southeast Asian driving situations is notably lacking in the literature. The disparity is especially alarming due to the distinct challenges encountered in ASEAN nations, such as inconsistent enforcement of child safety legislation, a variety of vehicle types from compact cars to multi-passenger vans, and cultural preferences for family seating arrangements that may diverge from Western standards. The lack of extensive occupant posture data across all age demographics restricts the formulation of region-specific safety standards and obstructs the progress of vehicle safety systems designed for the unique requirements and habits of Southeast Asian families.

2. METHODOLOGY

2.1 Research Methodology Design

This research utilized a quantitative cross-sectional survey methodology to examine driving posture and seating preferences among occupants of passenger vehicles in Southeast Asia. The survey method was chosen for its effectiveness in gathering attitudes, opinions, and practices across several countries in a consistent and comparable format.

2.2 Participants and Sampling Methodology

Participants were recruited from Malaysia, Thailand, and Indonesia, representing three significant ASEAN member states with varied car usage trends and road safety conditions. A total of 1,373 respondents participated in the survey, comprising licensed drivers from Malaysia (21%), Thailand (40%), and Indonesia (39%). Convenience sampling was conducted via online distribution methods (email, social media, institutional networks) from January 2025 until July 2025. The criteria for inclusion were at least 18 years of age and holding a valid driver's license.

2.3 Survey Tool

The survey tool was a structured questionnaire, modified and created based on recognized sources in ergonomics and road safety. All questions were adapted and adopted from the Automotive Seating Discomfort Questionnaire (ASDQ) (Smith et al., 2006) and Bubb et al. (2021), as well as hand position preferences according to SAE International – Driver Hand Control Reach (SAE J287), Walton and Thomas (2005), Jonsson (2011), and De Waard et al. (2010). The questionnaire employed a combination of multiple-choice items to facilitate both descriptive and comparative analysis. The pilot test was conducted with 30 participants to evaluate the clarity, flow, and interpretability of the questionnaire. Based on pilot feedback, several items were refined for linguistic clarity, simplified terminology, and improved logical sequencing to minimize ambiguity. The Cronbach's alpha value obtained ($\alpha = 0.853$) indicated strong internal consistency. Items that contributed to lower reliability were either reworded or merged to improve comprehension. These refinements ensured that the final questionnaire maintained both content validity and internal reliability before full deployment. The driver portion consisted of two subsections:

- Demographic Data – gender, age, height, weight, highest education, occupation, household monthly salary, marital status, total children in family, driving license ownership, driving experience, and type of vehicle used.
- Driver's Posture and Position Style – norm of driver's posture and position related to seatback angle, norm of driver's posture and position related to seat sliding distance, norm of driver's posture and position related to steering wheel height, norm of driver's posture and position related to head rest height, norm of driver's posture and position related to seat belt, norm of driver's knee and leg position, norm of driver's upper body and head position, and norm of driver's arm and hand position as well as overall norm posture after driver's seat adjustment

2.4 Procedure for Data Collection

The completed poll was disseminated online via platforms including Google Forms. Participants granted informed consent before involvement. Responses were gathered anonymously. Data were securely saved and utilized exclusively for academic purposes.

2.5 Data Analysis

The survey data were analyzed utilizing Microsoft Excel. The analysis plan was congruent with the study aims. Table 1 shows the type of analysis and outcomes for each aim.

TABLE 1: Type of analysis and outcome for each aim

No.	Aim	Type of Analysis	Outcome
1.	To identify the preferred seating position and posture of drivers in Southeast Asia's passenger vehicles via a survey	Utilize descriptive data (frequency/ percentage) to ascertain the predominant seating and posture choices	Pie chart based on questions.
2.	To identify the relationship between demographic and preferred posture and position	Correlation analysis	Consolidation of outcomes to present representative trends.

2.6 Ethical Considerations

The research complied with ethical requirements. Participation was optional, with the right to disengage at any point. No incentives were offered to mitigate bias. Ethical approval was secured from Universiti Kebangsaan Malaysia with code number JEP-2025-598.

3. RESULTS AND DISCUSSION

3.1 Demographic Values

A total of 1,374 respondents participated in this survey, as tabulated in Table 2. The distribution of participants, 21% from Malaysia, 40% from Thailand, and 39% from Indonesia, generally mirrors the regional vehicle ownership patterns, where Thailand and Indonesia rank among the highest in passenger vehicle registration in ASEAN, followed by Malaysia. Therefore, the proportionate sampling adopted in this study reflects the actual market distribution, enhancing the representativeness and external validity of the findings.

The gender distribution appeared to be nearly equal (51.4% female, 48.6% male), limiting gender sampling bias (Weber et al., 2021), with most of them being more concentrated in young adults aged between 20 and 39 years old (74%). Thus, this survey's findings mostly reflect working-age adults as compared to teenagers or older adults. Moreover, the mean height and weight of the respondents were 163.8 ± 7.3 cm and 63.9 ± 14.5 kg, respectively (Kumar et al., 2023), reflecting the average heights and weights of Southeast Asians, which tend to be useful for ergonomic recommendations for vehicle seats, specifically on how they position themselves in terms of comfort and/or injury risk prevention in car crashes (Sabri et al., 2022).

TABLE 2: Type of analysis and outcome for each aim

Demographic Variables	Frequency (n)
Gender	Male Female
	668 706
Age	< 20 20-29 30-39 40-49 50-59 ≥ 60
	39 606 421 226 77 5
Height (cm)	Minimum Average Maximum SD
	142 163.84 187 7.31
Weight (kg)	Min Average Max SD
	34 63.94 170 14.52

TABLE 2: (Continued)

Demographic Variables		Frequency (n)
Highest Education	No Formal Education	1
	Primary/ Secondary School	249
	Vocational Certificate	6
	Diploma	124
	Bachelor's Degree	804
	Master's Degree	118
	PhD	60
	Others	12
Occupation	No occupation	429
	Government Officer	430
	Private employee	401
	Self-business	81
	Others	26
Household Monthly Salary (RM)	< 1000	342
	1000 - 3000	313
	3001 - 5000	228
	5001 - 7000	245
	7001 - 10000	112
	> 10001	134
Marital Status	Single	788
	Married	563
	Divorced/Widowed/Separated	15
	Others	1
Number of Children per Household	0	924
	1	157
	2	158
	3	75
	4	28
	5	16
	> 5	10
Years of Driving Experience	0	116
	<1	124
	1-5	427
	6-10	278
	10-15	242
	15-20	169
	>20	122
Type of Vehicle Used	Sedan	573
	Hatchback	140
	Truck	17
	SUV	124
	MPV	214
	Van	8
	Others	87

As observed, most respondents completed tertiary education (76.6%), which is supposedly correlated with higher safety measures' awareness. Nevertheless, this does not necessarily translate into better restraint use, as other factors such as socioeconomic status and cultural beliefs can also play a role (AlAwad et al., 2025). In addition, they are primarily employed in either government (31.3%) or private (29.2%) sectors, and more than half earn below RM 5000. This is an important factor to consider when evaluating child restraint system (CRS) usage, as the cost of purchasing and installing CRS can be a barrier for low-income families (AlAwad et al., 2025). Additionally, 67.3% of the respondents' households reported no children, whereas among those with children, one or two children were observed to be more common. This could be due to various reasons, such as respondents being single, childless couples, or having adult children (Wang et al., 2020). In terms of driving experience, the largest proportion of respondents have 1-5 years of driving experience (33.4%), followed by 6-10 years

(21.4%), and 10-15 years (18.7%). This indicates that most of the respondents are primarily composed of less experienced drivers who are relatively young in age, where there could be a possible connection between age distribution with the early and mid-career drivers (Aidoo et al., 2019). The majority of respondents reported driving sedans (45.8%) and multipurpose vehicles (MPVs) (17%), which aligns with the Southeast Asia market that advertises more compact cars and family-oriented vehicles to consumers (Guruminda & Widodo, 2023).

3.2 Driver Posture and Position Style in Vehicle

The analysis of drivers' posture norms among respondents presented consistent findings across the adjustment of their seat and steering positions. Figure 1 shows the norm of driver's posture related to seatback angle. As observed in Figure 1, most drivers position their seat upright or slightly reclined with the seatback angle of 90 degrees (55%), followed by a seatback angle positioned at 110 degrees (42%), whereas only approximately 3% of drivers adjust their seats to be in a very reclined position of 130 degrees. This can be seen as an indication of proper spinal alignment awareness and a wider and clearer visibility range during driving (Reed et al., 2019).

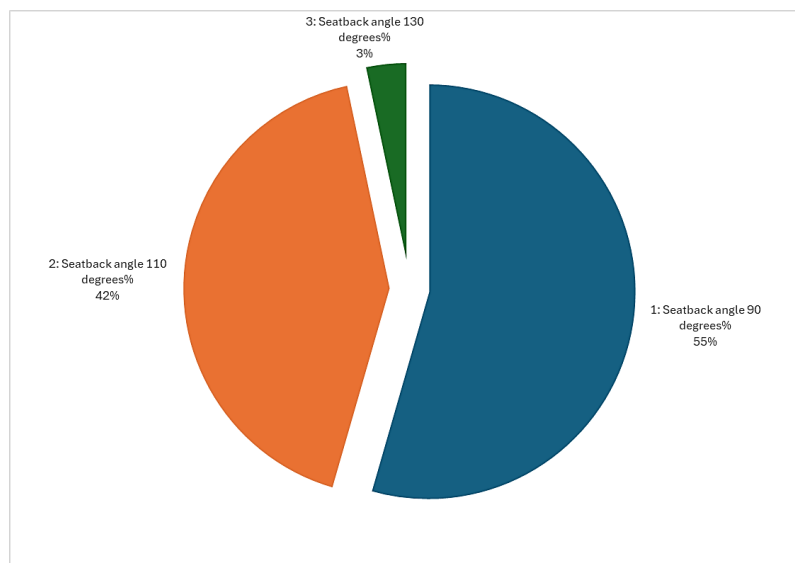


FIGURE 1: Distribution of driver seatback angle preferences

Figure 2 shows the norm of posture for seat sliding distance from the steering wheel. Interestingly, a similar trend is observed for seat sliding distance from the steering wheel (Figure 2), where most drivers preferred their steering wheel to be in a mid-position, allowing them to have an elbow angle of 90-130 degrees (55%), whereas some prefer in close-position (29%) or even a further distance (approximately 5%). This might suggest an understanding of maintaining adequate control and maneuverability among drivers (Reed et al., 2019).

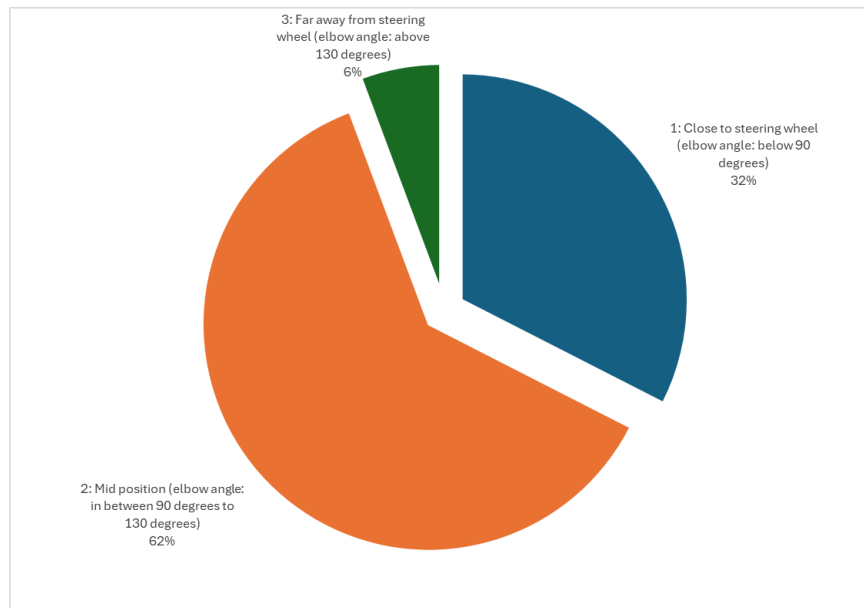


FIGURE 2: Driver seat sliding distance preference

Figure 3 shows the norm of posture for steering wheel height. The finding that 47% of drivers prefer a mid-position steering wheel height reflects a tendency toward maintaining a neutral upper-limb posture that optimizes steering control, minimizes shoulder elevation, and enhances visibility of the dashboard. This is consistent with ergonomic recommendations emphasizing alignment of the steering wheel with the chest level to reduce musculoskeletal strain and improve reaction time during critical maneuvers. Notably, 27% of respondents indicated that steering wheel height adjustment was not possible, which can be attributed to the prevalence of fixed steering wheel columns in entry-level and compact vehicles commonly sold in the ASEAN market (Guruminda & Widodo, 2023). This suggests that the lack of adjustability is likely vehicle-design driven rather than preference-driven. Such limitations can compromise individualized ergonomic alignment, particularly for shorter or taller drivers, and may contribute to suboptimal driving postures and increased fatigue during prolonged driving (Nie et al., 2020). These findings highlight a mismatch between driver ergonomic needs and vehicle design features in the region. Addressing this gap through improved vehicle interior design standards and consumer education could enhance both comfort and safety outcomes.

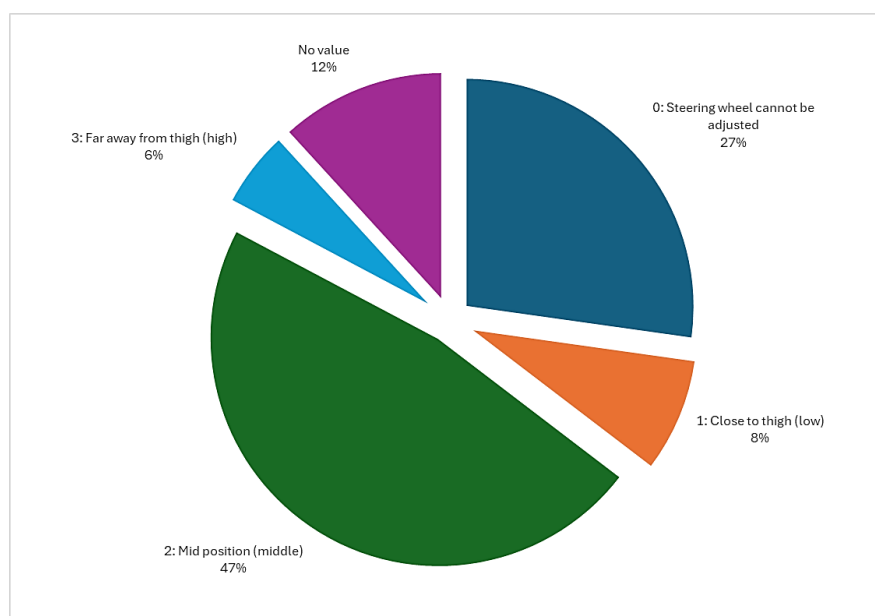


FIGURE 3: Distribution of steering wheel height position among drivers

Figure 4 shows the results for preferred setting for headrest height. The finding that nearly half of the respondents (49%) left their headrests at the standard factory setting and only a small proportion adjusted them minimally (37%) or maximally (2%) underscores a prevalent behavioural reliance on default vehicle settings. This reflects a low awareness of the importance of correct headrest positioning in mitigating whiplash and cervical injuries during rear-end collisions. Previous studies have demonstrated that improper headrest positioning, especially if set too low, can significantly increase the risk of neck injury (Reed et al., 2019; Hill & Boyle, 2006). Properly adjusted headrests should be at least level with the occupant's head and close to the occiput to minimize relative motion during impact (Beck et al., 2014; Sato et al., 2021).

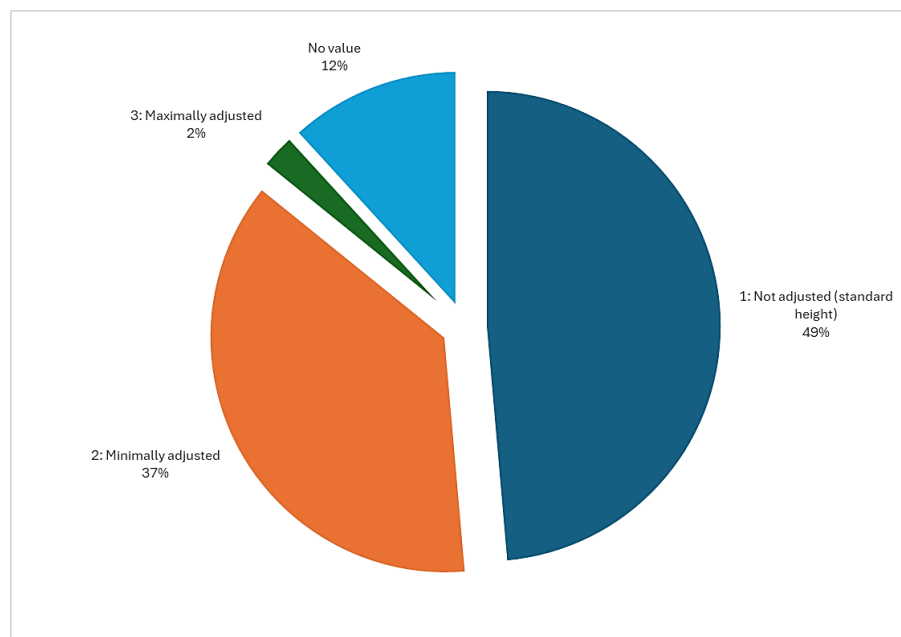


FIGURE 4: Adjustment of headrest height among drivers

Figure 5 depicts the setting for the seat belt position. Similar to the trend in Figure 4, a similar trend was noted for seat belt adjustment, where most drivers rely on the standard non-adjusted setting (58%), in which only a few of them prefer to adjust them either minimally (18%) or maximally (4%). This trend is consistent with the factory-setting reliance phenomenon, common in markets where adjustable safety features are available but underutilized due to limited safety education, perceived sufficiency of factory settings, or difficulty accessing adjustment levers (Begg & Langley, 2000; Missikpode et al., 2021). In the ASEAN context, this may also be attributed to the high proportion of entry-level vehicles with either limited or poorly designed adjustability features (Guruminda & Widodo, 2023). Failure to optimize seat belt positioning can compromise shoulder and lap belt fit, increasing the risk of thoracic or abdominal injuries during a crash (Albanese et al., 2020; Beck et al., 2014). These results emphasize the critical gap between safety feature availability and user behaviour, suggesting a need for ergonomic awareness campaigns and vehicle design interventions that nudge users toward correct adjustment practices.

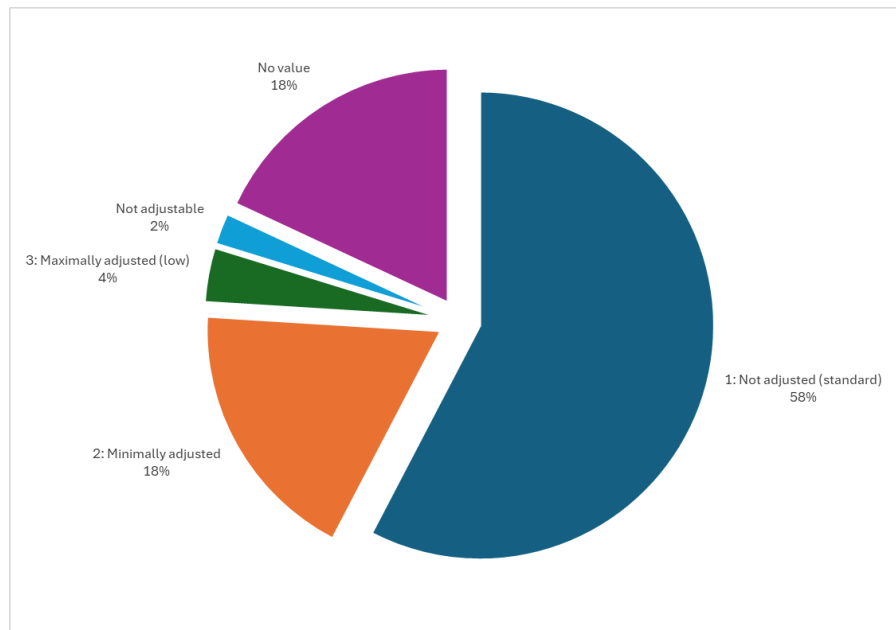


FIGURE 5: Adjustment of seat belt position among drivers

Figure 6 demonstrates results for driver's knee and leg position. The preference of 53% of drivers for slightly bent knees with feet flat on the pedals reflects an ergonomically optimal lower limb posture that minimizes musculoskeletal strain and ensures effective pedal control. Maintaining a neutral knee angle allows for better circulation, reduced lower limb fatigue, and faster reaction times in braking or acceleration (Nie et al., 2020; Sato et al., 2021). Conversely, 23% of respondents preferred an outward-angled knee position, and the 12% who extended their left leg may represent comfort-driven compensatory postures, often observed in longer driving durations or in vehicles with limited cabin adjustability. Such postures, while subjectively comfortable, can increase asymmetric loading on the lower back and hip joints, potentially contributing to discomfort and fatigue over time (Fiorillo et al., 2022; Ma et al., 2024).

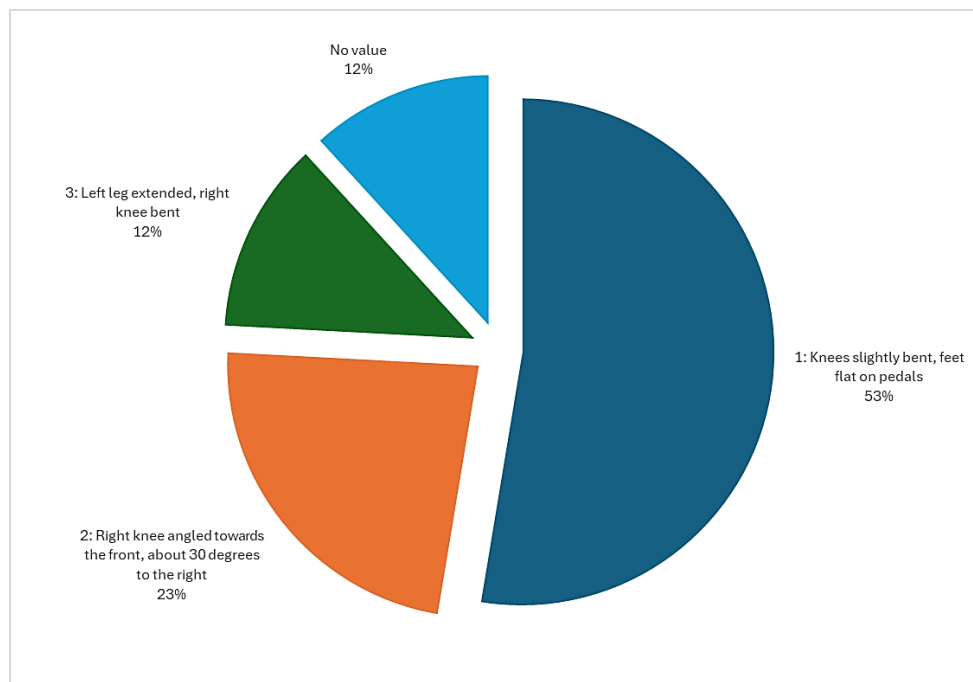


FIGURE 6: Driver knee and leg position during driving

A similar trend is observed in Figure 7. The predominance of upright upper body posture (76%) with head centered, as shown in Figure 7, aligns with recommended driver posture guidelines for optimal visibility, reaction time, and reduced cervical strain. Maintaining an upright head position facilitates correct alignment of the cervical spine and enhances vigilance, which is crucial for safe driving (Nie et al., 2020; Sato et al., 2021). The smaller percentages of drivers tilting their head forward (5%) or laterally (7%) may indicate habitual slouching or insufficient seat ergonomics, which have been linked to increased neck and shoulder load as well as reduced situational awareness (Albanese et al., 2020; Wang et al., 2020).

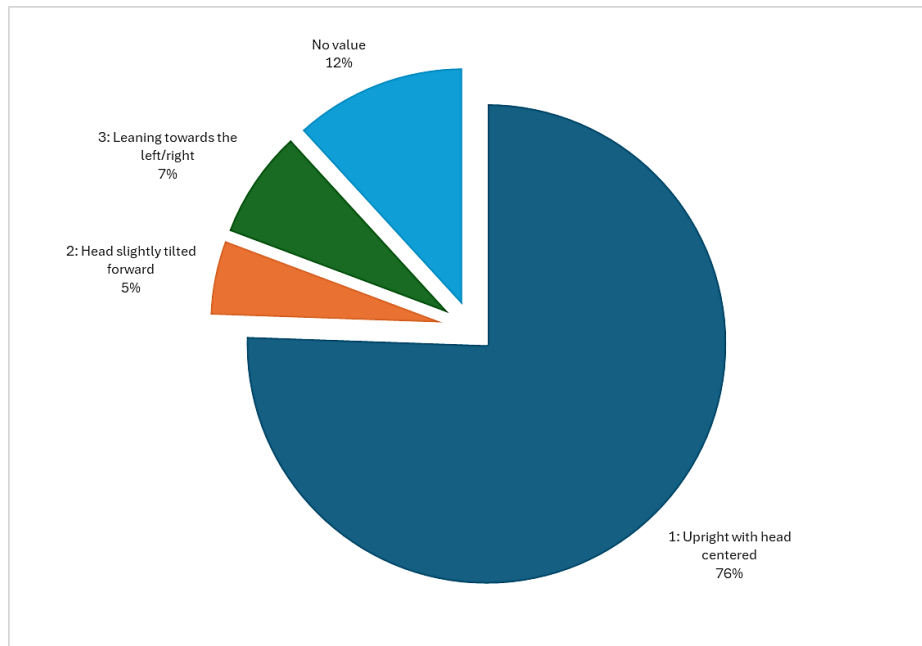


FIGURE 7: Driver upper body and head position during driving

These findings emphasize the importance of proper ergonomic seat design and driver posture awareness. In particular, they reveal that while most drivers naturally adopt recommended postures, a significant minority may still benefit from educational interventions or vehicle interior redesigns to mitigate fatigue and enhance safety.

As depicted in Figure 8, results for preferred driver's arm and hand position show that most drivers indicated a strong preference for placing their hands at the 9-and-3 o'clock position on their steering wheel (60%), followed by placing both hands at the lower part of the steering wheel (10%), and 10-and-2 o'clock 9 (9%), whereas single-hand positions were less preferred among the drivers. This is because the 9-and-3 o'clock position allows optimal steering control and airbag deployment safety (Beck et al., 2014). Maintaining both hands symmetrically at shoulder height provides the greatest leverage, allows faster maneuvering in critical situations, and minimizes the risk of upper limb injury during frontal collisions (Nie et al., 2020; Wang & Bulle, 2017; Sato et al., 2021).

By contrast, the lower preference for alternative hand positions – such as both hands at the lower part of the steering wheel (9%) or single-hand positions (2% and 5%) – may indicate comfort-driven habits rather than control optimization. These positions can reduce the driver's ability to execute rapid steering corrections and may increase reaction time and shoulder strain during prolonged driving (Fiorillo et al., 2022; Ma et al., 2024). Furthermore, asymmetrical hand placement is associated with reduced postural stability and a higher likelihood of fatigue accumulation, particularly during extended drives. The high prevalence of the recommended hand position in this study suggests a positive trend in posture awareness among drivers in the ASEAN region. However, the persistence of suboptimal habits in a notable minority highlights the importance of targeted ergonomic education and driver training programs to reduce injury risks and enhance control precision.

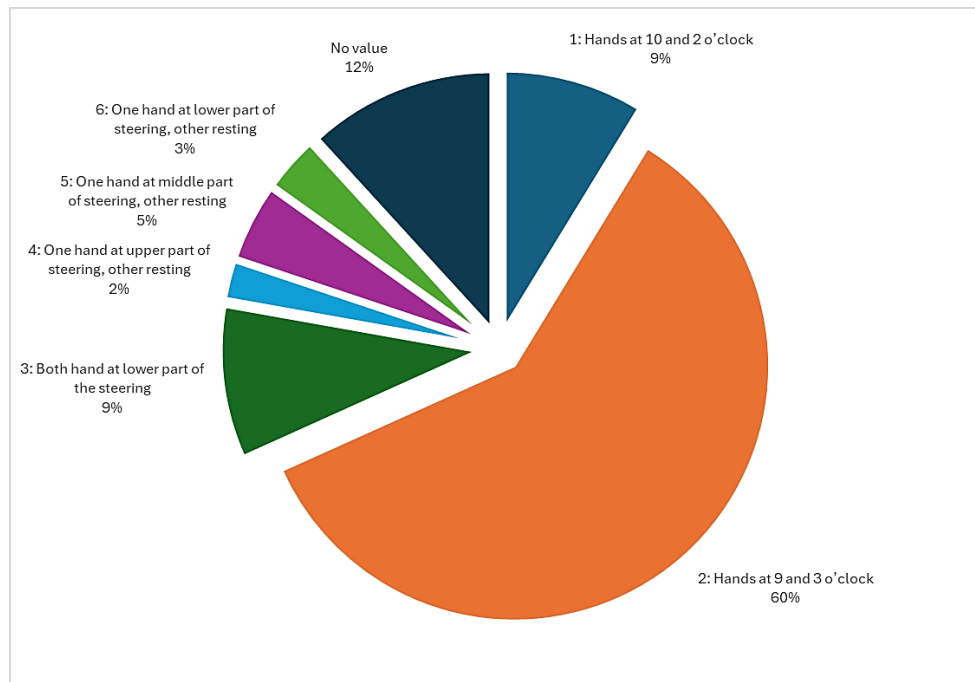


FIGURE 8: Driver arm and hand position on the steering wheel while driving

Figure 9 shows the overall norm posture after seat adjustment. The predominance of Posture 1 (59%) as the preferred overall norm posture reflects a strong inclination among drivers to adopt ergonomically recommended seating configurations, which typically combine an upright seatback, mid-sliding distance, and 9 and 3 o'clock hand placement. This posture is widely recognized for its ability to optimize driving performance, maintain musculoskeletal alignment, and reduce fatigue during prolonged driving (Nie et al., 2020; Sato et al., 2021). Drivers who adopt this posture benefit from enhanced steering control, optimal pedal reach, and proper visibility, aligning with established ergonomic guidelines. Meanwhile, Figure 10 shows the pictures for postures 1, 2, 3, and 4.

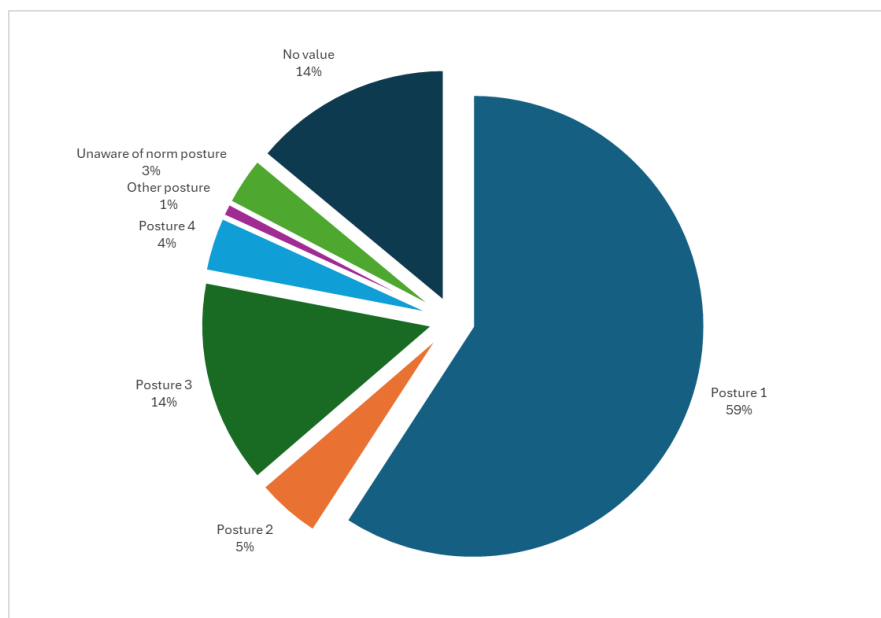


FIGURE 9: Distribution of overall norm posture after driver's seat adjustment



FIGURE 10: Posture sampling while driving

Posture 1 in Figure 10 is generally considered the most ergonomically sound and safest driving posture and is the posture that is most adopted among drivers (59%), as confirmed in Figure 10. The 90° seatback angle promotes proper spinal alignment, reducing the risk of back pain and fatigue (Sato et al., 2021). The mid-sliding seat position allows for comfortable reach to the pedals and steering wheel, while maintaining a safe distance from the airbag (Wang & Bulle, 2017). The 9-and-3 o'clock hand position provides optimal steering control and minimizes upper limb loading, supporting rapid response and reducing fatigue (Wang & Bulle, 2017; Sato et al., 2021; Yoo et al., 2013). The alignment of upper and lower limbs with ergonomically recommended postures further enhances comfort and reduces strain (Sato et al., 2021). The fact that 59% of respondents adopt this posture indicates good alignment with safe driving practices in the region (Nie et al., 2020).

Posture 2 is preferred by a small group of drivers (5%), often by shorter drivers aiming for improved visibility or those navigating high-traffic situations. While maintaining the 9-and-3 o'clock hand position, the forward-leaning posture can increase neck and trunk flexion, which is associated with elevated muscle activity and faster onset of discomfort during long-duration driving (Nie et al., 2020; Wang & Bulle, 2017). This constrained posture can limit joint range of motion, leading to increased fatigue and reduced biomechanical efficiency. Drivers adopting this position should ensure a safe distance from the steering wheel and airbag system.

Posture 3 tends to prioritize comfort but may compromise safety and control, which is aligned with 14% of the drivers. The 110° seatback angle reduces spinal support and can lead to slouching, which can cause back pain and fatigue (Sato et al., 2021). Placing hands at the lower part of the steering wheel also decreases leverage and steering precision, potentially delaying corrective maneuvers during emergencies (Fiorillo et al., 2022). Although this posture may be subjectively comfortable for short, low-speed drives, it is not recommended for long-distance or high-speed driving due to its negative impact on alertness and biomechanical control (Ma et al., 2024).

Posture 4 is the least common among drivers and is ergonomically suboptimal. This posture involves leaning back and extending the arms, which increases shoulder loading, reduces control precision, and may place the driver too far from the airbag deployment zone. Extended arm positions have been shown to reduce maneuverability, increase neck and shoulder strain, and negatively affect driver reaction time during emergency steering tasks (Wang & Bulle, 2017; Fiorillo et al., 2022; Ma et al., 2024). Such posture reflects either habitual comfort-seeking behavior or inadequate seat adjustment, indicating an opportunity for targeted ergonomic education. Additionally, 1% of the drivers preferred other unique postures that do not fall under these four postures, whereas the remaining 46 drivers reported being unaware of the presence of normative postures and seat adjustments.

3.3 Correlation Analysis of Demographics and Drivers' Posture Style

Figure 11 and Table 3 illustrate the correlation between demographic factors and driver posture norms, where age can be observed to exhibit the strongest positive correlation ($r=0.705$), followed by marital status ($r=0.544$), household income ($r=0.431$), and weight ($r=0.332$). On the other hand, almost all other postural variables exhibited weak correlations with demographics, indicating a minor demographic influence on the driver's preferred posture while driving. Thus, the provided analysis effectively argues that driving posture is primarily influenced by ergonomic factors, vehicle design, and cultural habits, rather than demographic characteristics (Sato et al., 2021).

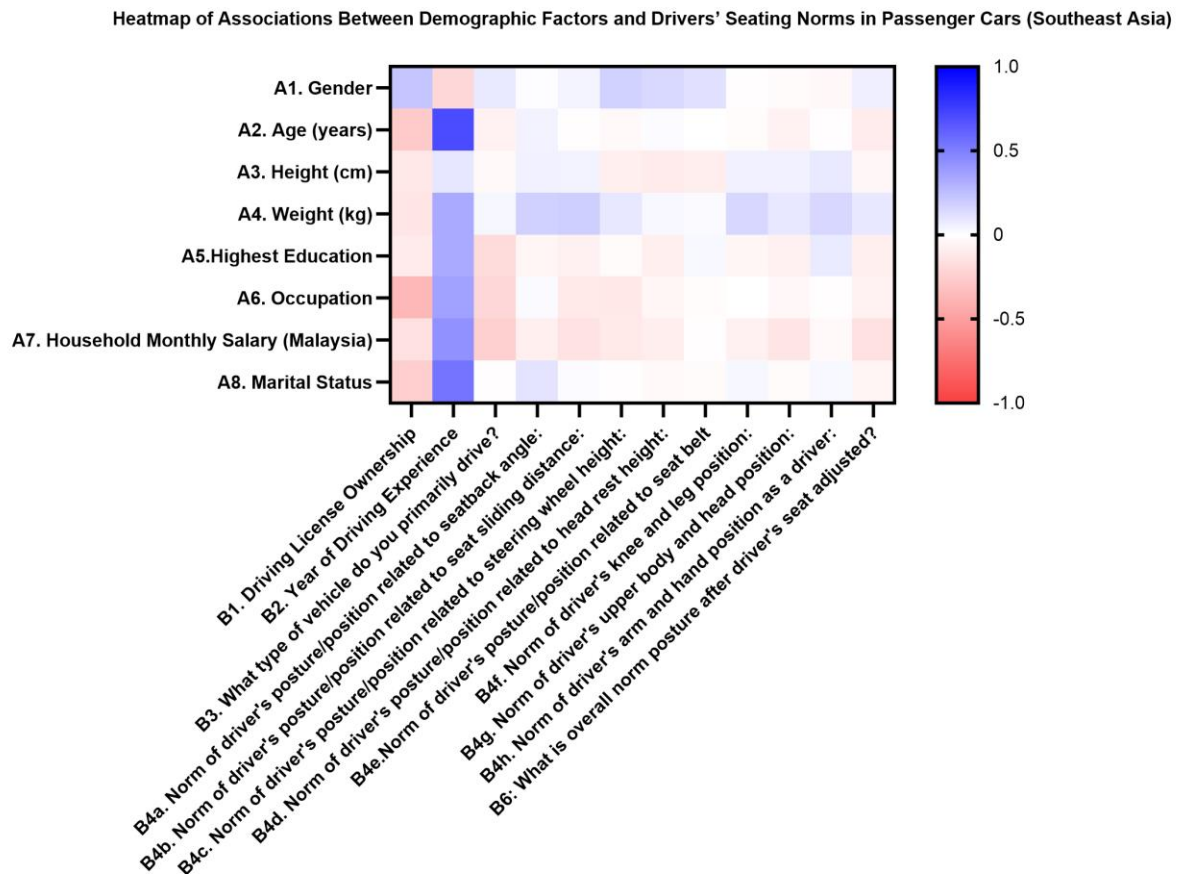


FIGURE 11: Heatmap correlation between demographic factors and driver's posture style

TABLE 3: Correlation analysis between demographic factors and driver's posture style

	B1. Driving License Ownership	B2. Year of Driving Experience	B3. What type of vehicle do you primarily drive?	B4a. Norm of driver's posture / position related to seatback angle:	B4b. Norm of driver's posture / position related to seat sliding distance:	B4c. Norm of driver's posture / position related to steering wheel height:	B4d. Norm of driver's posture/ position related to head rest height:	B4e. Norm of driver's posture/ position related to seat belt	B4f. Norm of driver's knee and leg position:	B4g. Norm of driver's upper body and head position:	B4h. Norm of driver's arm and hand position as a driver:	B6: What is overall norm posture after driver's seat adjusted?
A1. Gender	0.224	-0.205	0.081	0.007	0.039	0.175	0.148	0.115	-0.010	-0.021	-0.041	0.061
A2. Age (years)	-0.276	0.705	-0.069	0.046	-0.005	-0.030	0.009	-0.001	-0.016	-0.071	-0.006	-0.103
A3. Height (cm)	-0.126	0.091	-0.028	0.053	0.045	-0.083	-0.108	-0.093	0.052	0.054	0.083	-0.044
A4. Weight (kg)	-0.136	0.332	0.028	0.180	0.186	0.090	0.024	0.015	0.154	0.089	0.154	0.088
A5. Highest Education	-0.110	0.330	-0.187	-0.047	-0.076	-0.026	-0.088	0.025	-0.052	-0.076	0.077	-0.082
A6. Occupation	-0.373	0.365	-0.204	0.013	-0.120	-0.124	-0.049	-0.020	-0.004	-0.037	-0.006	-0.073
A7. Household Monthly Salary	-0.157	0.431	-0.249	-0.088	-0.148	-0.114	-0.092	-0.005	-0.073	-0.138	-0.033	-0.160
A8. Marital Status	-0.252	0.544	-0.010	0.103	0.009	-0.015	-0.031	-0.024	0.029	-0.026	0.026	-0.056

The strong positive correlation observed between demographics (such as age, marital status, and household income) and driving experience is expected. Driving years should increase cumulatively over the years; hence the reason why older respondents tend to have higher driving histories (Saryazdi et al., 2019). Moreover, marital status has a positive impact on driving experience as they are required to start driving earlier and drive longer due to family responsibilities (Ang et al., 2020; D'Ambrosio et al., 2007), such as family trips and commuting to children and spouses. Higher-income respondents are more likely to own cars and use them more frequently, as compared to lower-income households (Feyzollahi et al., 2024; Lee & Cheah, 2015), thus, it can be said that socioeconomic factors influence driving years.

In contrast, negligible correlations were observed in almost all remaining associations between demographic factors and driving posture norms, in which a lack of direct influence is observed. A slight positive correlation is only observed between gender and driving license relationship, whereas the correlation with other posture norms appeared to be almost zero. Most drivers adopt similar posture norms (such as upright seatback at 90 degrees and placing their hands at 9-and-3 o'clock), due to the reason that posture preference is more influenced by safety purposes and vehicle ergonomics rather than gender differences (Jonsson, 2011). Moreover, age exhibited a weak correlation with driving posture norms. This suggests that drivers, regardless of their age or gender, tend to adopt postures dictated more by vehicle design or comfort to maintain alertness and avoid fatigue (Shin et al., 2021). Weak negative correlations were also presented between demographic factors (such as education status, occupation, and household incomes) and driving posture norms. These results can be interpreted in a way that seating posture is not influenced by social class or job type. Lastly, a weak correlation was observed between overall driving posture norms and demographic factors, indicating almost identical preference for seating adjustment across all demographic factors. Hence, suggesting that drivers prioritize ergonomics like safety and comfort in selecting the final posture during driving (Jonsson, 2011).

These findings suggest that safety protocols and dummy positioning in crash testing should prioritize commonly observed postural traits (such as upright seatback angles and mid-range adjustments) over demographic tailoring. The emphasis on standardised ergonomic principles is further supported by the observation that vehicle design and environmental context exert a stronger influence on posture than demographic factors (Shin et al., 2021). While several posture choices align with best practices, the neglect of adjustable safety features signals the need for improved driver education, especially regarding the biomechanical importance of seat belt height and headrest alignment. Moreover, the data support calls for ASEAN-specific crash dummy calibration, as current test postures may not accurately reflect real driver behaviour in this region.

4. CONCLUSION

This study offers the first multi-country overview of normative driver seating postures in Southeast Asia based on empirical data from 1,374 participants. The findings underscore a regionally consistent pattern of mid-position seat adjustments, moderate recline angles, and stable hand and knee placement, yet also reveal behavioural gaps in the use of headrest and seat belt adjustment features. These insights hold direct implications for crash dummy configuration, ergonomic vehicle design, and safety awareness strategies in the ASEAN context. The integration of region-specific posture data into vehicle safety standards can enhance the ecological validity of testing protocols and contribute to more effective occupant protection for Southeast Asian drivers.

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