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RESEARCH PAPER

Prevalence and Ergonomic Awareness of Musculoskeletal Disorders among Malaysian Dental Students

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ABSTRACT
Musculoskeletal disorders (MSDs) pose a significant occupational health challenge in dentistry, potentially affecting the health of future dental professionals. This study aimed to assess the prevalence of MSDs among dental students of Universiti Sains Malaysia (USM) and to explore the relationships between MSD occurrence, demographic factors (academic year, gender, and physical activity levels), and ergonomic awareness. Fifty-five dental students participated in the study, responding to validated electronic questionnaires. The results showed a high prevalence of MSDs, especially over 12 months (41.8%) vs. 7 days (14.5%). Most affected areas were the lower back (74.5%), neck (70.9%), shoulders (60.0%), and upper back (54.5%). Female students showed higher prevalence in some regions (p= 0.032), with Year 5 students reporting the highest prevalence (p= 0.046). Ergonomic awareness was high, with 52.7% rating it as good and 47.3% as excellent. These findings highlight the need to integrate thorough ergonomic education and preventive measures into dental curricula, aiming to promote musculoskeletal health and reduce occupational risks for dental students, thereby supporting long-term occupational well-being in their future careers.

KEYWORDS: *Musculoskeletal disorders; Dental ergonomics; Dental students; Occupational health; Awareness; Prevalence.*

1. Introduction

Dental professionals commonly encounter various occupational hazards, including physical strain, biological infections, chemical exposure, psychosocial stress, and ergonomic challenges. Ergonomic risks are particularly notable for their significant contribution to musculoskeletal disorders (MSDs), which affect important components of the musculoskeletal system, including muscles, tendons, ligaments, nerves, intervertebral discs, and blood vessels [1, 2]. A substantial body of research highlights musculoskeletal disorders (MSDs) as a significant occupational health concern in dentistry, primarily linked to prolonged static postures, repetitive movements, unnatural body positions, poorly designed dental equipment, inadequate lighting conditions, occupational stress, and genetic predispositions [1-3]. The increasing prominence of MSD-related terminology in dental literature further highlights the significance and growing awareness of these conditions within dental practices [3].

The consequences of MSDs in dentistry extend beyond mere physical discomfort; they profoundly influence professional productivity, the quality of patient care, and personal well-being. MSDs are linked to increased absenteeism, diminished productivity, and lowered job satisfaction, significantly impacting professional longevity and quality of life [4, 5]. Symptoms experienced by dental professionals vary from mild, intermittent discomfort to severe, debilitating conditions that can prematurely terminate careers [2, 4].

Financial constraints frequently force dental hygienists and practitioners to persist in their roles, even when facing chronic pain, which in turn heightens occupational stress and burnout [1, 4]. Worryingly, MSD symptoms often emerge early in dental careers and become more severe as clinical experience and exposure to ergonomic stressors increase [1, 6].

Ergonomics, as a practical and multidisciplinary field, involves customising workspaces, tools, and processes to enhance safety, comfort, productivity, and overall health outcomes. The principles of ergonomics aim to reduce both physical and mental fatigue, decrease the incidence of occupational illnesses, and enhance overall professional performance and patient care standards [7].

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Within dentistry, ergonomic interventions include maintaining correct posture, utilising strategically designed dental chairs, placing instruments appropriately, ensuring optimal lighting, and incorporating regular breaks to mitigate the risk of repetitive strain injuries [8-10]. The proper implementation of ergonomic principles has been consistently shown to significantly reduce the prevalence of musculoskeletal disorders (MSDs), enhance clinicians' operational efficiency, and promote long-term professional sustainability [7-9]. Several demographic factors have been identified as significant determinants of MSD prevalence among dental professionals, including gender, academic year, and level of physical activity. Female dental professionals exhibit a higher susceptibility to MSDs, largely due to physiological and anatomical differences, as well as an increased proportion of females in the dental workforce [8, 11]. Furthermore, research consistently indicates that individuals who engage in higher levels of physical activity demonstrate lower rates of musculoskeletal discomfort, suggesting a protective effect of physical activity against the onset of MSDs [8, 12]. Moreover, variations in the prevalence of MSD have also been observed with academic progression, suggesting that clinical workload and cumulative ergonomic exposure significantly affect the risks of developing MSD [6, 11].

The inherent features of dental practice, which include extended durations of static positions, repetitive manual activities, and precise movements, increase the likelihood of musculoskeletal disorders (MSDs). Research indicates that dental professionals frequently report musculoskeletal issues, particularly pain and discomfort in the neck, shoulders, and both lower and upper back regions [8, 13]. Due to the repetitive nature and precision required in dental procedures, ongoing musculoskeletal strain poses a significant occupational risk, highlighting the essential need for proactive ergonomic measures in dental environments. To systematically evaluate the prevalence and severity of musculoskeletal disorders (MSDs) among dental professionals, researchers commonly use validated assessment instruments, such as the Nordic Musculoskeletal Questionnaire (NMQ). The NMQ is acknowledged for its reliability, validity, and cost-effectiveness in evaluating musculoskeletal complaints across various occupational populations, including dental practitioners and students [14, 15]. It provides valuable epidemiological data that is essential for developing targeted ergonomic interventions and preventive strategies.

Despite considerable global attention and numerous studies centred on practising dentists, relatively few have specifically investigated the prevalence of musculoskeletal disorders (MSD) and ergonomic awareness among dental students, particularly in Malaysia. Dental students constitute a vital group, as MSD symptoms often surface during their training, potentially affecting their long-term health and career viability. The primary objective of this study was to determine the prevalence of musculoskeletal disorders among dental students at Universiti Sains Malaysia (USM).

While many studies have examined the prevalence of MSDs among dental professionals, fewer have explicitly focused on dental students, particularly within the Malaysian context. Most existing research in this field was descriptive and lacked theoretical context, which creates a gap in understanding the practical application of ergonomic awareness in behavioural practices. Furthermore, despite widespread inclusion of ergonomic content in dental curricula, the persistence of high MSD prevalence among students remains underexplored. This study uniquely highlights the apparent disconnect between high ergonomic awareness and continued reporting of MSD symptoms, pointing to an important gap in implementation rather than knowledge. By examining this dynamic within a local institutional context, this research provides valuable insights into potential enhancements at the curriculum and policy levels necessary to reduce long-term occupational health risks among future dental practitioners.

2. Methodology

2.1. Study design and sampling

This study employed a descriptive cross-sectional design to assess the prevalence and associated risk factors of musculoskeletal disorders (MSDs) among dental students at Universiti Sains Malaysia (USM). The cross-sectional approach was chosen for its effectiveness in collecting data at a specific point in time, allowing researchers to capture a snapshot of MSD prevalence and levels of ergonomic awareness among the target population. This design was particularly suitable as it enabled the examination of potential correlations between demographic variables, such as gender, academic year, and physical activity levels, and the occurrence of MSDs.

A purposive sampling method was employed to select participants, specifically targeting students in the third, fourth, and fifth years of the Bachelor of Dentistry program. Generally, odontology ensured that respondents possessed adequate clinical experience, as students generally commence practical clinical sessions during their second year of study. Consequently, participants were required to have a minimum of 12 months of clinical exposure to be eligible for inclusion in this research. Students who had participated in the preliminary pilot study or who had experienced any accidents or surgical interventions within the preceding 12 months were excluded to mitigate potential confounding variables that could affect the study's outcome.

2.2. Data collection

Data collection was conducted from January to March 2023 at the Universiti Sains Malaysia campus, located in Kubang Kerian, Kota Bharu, Kelantan. Before embarking on the primary data collection phase, a pilot study was carried out to assess the validity and reliability of the structured questionnaire. This process aimed to ensure the clarity, relevance, and appropriateness of the items included. The findings revealed a Cronbach's Alpha reliability coefficient of 0.865, indicating excellent internal consistency, which implies that no additional modifications were required.

Following approval from the Universiti Sains Malaysia Ethics Committee (JEPeM Code: USM/JEPeM/KK/23010016) for ethical clearance, data collection was initiated using an online platform. Student representatives from the Year 3, Year 4, and Year 5 cohorts were engaged to facilitate the dissemination of Google Forms through WhatsApp. Each participant received an information sheet explicitly delineating the study's objectives, procedures, confidentiality measures, and the voluntary nature of their participation. Before accessing the questionnaire, participants were required to provide electronic consent.

The questionnaire was divided into three main sections, comprising a total of 51 questions. Section A collected demographic information, including gender, academic year, daily clinical hours, number of patients per day, and level of physical activity. Additionally, respondents were asked about their involvement in gardening activities and any past injuries or surgeries they had experienced within the last year. Section B focused on evaluating respondents' awareness of ergonomics using a 12-item scale that required binary responses (yes/no). Ergonomic awareness was classified into three levels: poor (0-4 positive responses), good (5-8 positive responses), and excellent (9-12 positive responses). This provided a clear distinction of participants' understanding and application of ergonomic principles. The questions were adapted from a previous study [8, 12]. Section C utilised a standardised Nordic Musculoskeletal Questionnaire (NMQ) to evaluate the prevalence of MSDs across specific body regions, capturing both chronic (within the past 12 months) and acute symptoms (within the past 7 days). Participants were required to report whether the pain they experienced had hindered their daily activities, thus providing insight into the severity and functional impact of MSDs among dental students.

Although the required sample size was 93, calculated with a 95% confidence level and 80% power, only 55 students responded, resulting in a 59% response rate. The lower participation could be due to academic workload, limited access during data collection, and restrictions on voluntary involvement. Although the achieved sample size still permits basic inferential analysis, the reduced participation rate might restrict the generalizability of the findings and the robustness of the observed associations.

2.3. Data analysis

Data obtained from completed questionnaires were systematically analysed using IBM's Statistical Package for the Social Sciences (SPSS) software, version 27.0. Descriptive statistics were initially computed to summarise demographic characteristics, levels of ergonomic awareness, and data on the prevalence of musculoskeletal disorders (MSDs), employing frequency and percentage distributions to facilitate straightforward interpretation and presentation of results. For inferential statistical analyses, Pearson Chi-square tests (χ^2) were used to examine the associations between demographic variables (gender, academic year, and physical activity level) and the occurrence of MSDs in specific body regions. These analyses aimed to identify significant demographic predictors associated with higher incidences of musculoskeletal symptoms.

Furthermore, Pearson Chi-square tests were used to examine the associations between demographic factors, specifically gender and academic year, and levels of ergonomic awareness categorised as either good or excellent. A significance

threshold of $p < 0.05$ was established to determine meaningful relationships among the variables under investigation. The rigorous analytical methods applied yielded robust insights into the prevalence of musculoskeletal disorders (MSD) among dental students, while also pinpointing key demographic factors that influence ergonomic awareness.

3. Results and Discussion

3.1. Demographic and working conditions

The majority of respondents were female (74.5%), and they were relatively evenly distributed across academic years (Table 1), with the most significant proportion in Year 3 (40.0%), followed by Year 4 (38.2%), and then Year 5 (21.8%).

Tab.1. Demographic characteristics of respondents

Variables		n	(%)
Gender	Female	41	(74.5)
	Male	14	(25.5)
Academic year	Year 3	22	(40.0)
	Year 4	21	(38.2)
	Year 5	12	(21.8)
Level of physical activity	High	12	(21.8)
	Moderate	29	(52.7)
	Low	14	(25.5)
Have you been involved in gardening during the last year?	Yes	15	(27.3)
	No	40	(72.7)
Gardening frequency	Daily	1	
	Weekly	1	
	Monthly	4	
	Once in a few months	9	
Working Conditions			
Variables		**n**	**(%)**
Clinical hours/day	< 5	3	(5.5)
	5-10	45	(81.8)
	>10	7	(12.7)
Number of patients/days	1-2	53	(96.4)
	3-4	1	(1.8)
	>4	1	(1.8)

Physical activity levels varied among students, with most engaging in moderate activities (52.7%), while 25.5% reported low activity levels and 21.8% reported high activity levels. The gender distribution reflected the overall demographics in dental schools, where female students typically constitute a greater proportion, in line with previous studies suggesting similar demographic profiles [16, 17].

3.2. Prevalence of musculoskeletal disorders (MSDs)

The prevalence of MSDs among dental students was notably high, with 41.8% reporting symptoms within the past year and 14.5% within the last seven days (Table 2). This annual prevalence aligns with existing literature that highlights the chronic nature of MSDs resulting from prolonged exposure to ergonomic stressors in dentistry [18, 19]. The most frequently reported regions were the lower back (74.5%), neck (70.9%), shoulders (60.0%), and upper back (54.5%). These findings aligned with several studies that have identified similar patterns among dental professionals, primarily attributed to prolonged static postures and repetitive movements inherent in dental practices [9, 13].

3.3. Association between MSDs and demographic factors

Neck pain was highly prevalent (70.9%), with females reporting a higher prevalence (76.9%) compared to males (23.1%), although this difference was not statistically significant ($p = 0.519$) (Table 3). Similar gender-based findings have been reported in the existing literature, indicating that anatomical and physiological differences may influence female susceptibility to MSDs [19]. Shoulder pain exhibited a significant association with gender ($p = 0.032$), being more prevalent among females (84.8%) than among males (15.2%). This notable gender difference likely reflects anatomical and physiological disparities between the sexes, which may influence muscular endurance and susceptibility to repetitive strain [8]. Lower back pain, the most frequently reported condition at 74.5%, showed no notable associations with demographic factors. This prevalence was consistent with global findings among dental professionals, who were frequently affected by lower back pain due to prolonged static postures and awkward positioning during clinical procedures [8]. The prevalence of upper back pain (54.5%) also showed no significant demographic associations. This high prevalence reflected findings from other studies, which emphasised the persistent ergonomic strain caused by sustained static postures commonly encountered in dental practice, thereby reinforcing the need for early ergonomic interventions [10].

Elbow pain exhibited the lowest prevalence at 9.1% and demonstrated no significant associations with demographic variables. This low prevalence suggested that ergonomic risk factors specific to

elbow strain were comparatively less prominent in dental settings than in other occupations, a finding supported by previous studies reporting relatively fewer elbow complaints among dental professionals [14]. Wrist and hand pain was reported by 43.6% of students and did not show significant associations with demographic characteristics. These findings align with existing literature that identifies repetitive hand movements during dental procedures as key contributors to wrist and hand discomfort, highlighting the need for preventive ergonomic strategies targeting upper extremity strain [12].

Tab.2. Prevalence of MSDs for 12 months and 7 days among respondents

No.	MSDs	n (%)		
		Pain in 12 months	Pain that interfered with daily tasks in the past 12 months	Pain in the last 7 days
1	Neck pain	39 (70.9)	8 (14.5)	10 (18.2)
2	Shoulder's pain	33 (60.0)	7 (12.7)	10 (18.2)
3	Elbow's pain	5 (9.1)	1 (1.8)	3 (5.5)
4	Wrist/Hand pain	24 (43.6)	5 (9.1)	7 (12.7)
5	Upper back pain	30 (54.5)	5 (9.1)	10 (18.2)
6	Lower back pain	41 (74.5)	9 (16.4)	16 (29.1)
7	One/Both leg pain	21 (38.2)	6 (10.9)	9 (16.4)
8	Hip/Buttock pain	13 (23.6)	5 (9.1)	4 (7.3)
9	One/Both knee pain	9 (16.4)	5 (9.1)	5 (9.1)
10	Ankle/Feet pain	14 (25.5)	5 (9.1)	3 (5.5)

Tab.3. Distribution of musculoskeletal disorders (MSDs) prevalence and association with demographic factors (gender, academic year, physical activity) among dental students

Body region	Total (%)	Gender (%)	p-value	Academic year (%)	p-value	Physical activity (%)	p-value
Neck	70.9	Female: 76.9, Male: 23.1	0.519	Year 3: 33.3, Year 4: 35.9, Year 5: 30.8	0.734	Low: 30.8, Moderate: 51.3, High: 17.9	0.906
Shoulder	60.0	Female: 84.8, Male: 15.2	0.032*	Year 3: 39.4, Year 4: 36.4, Year 5: 24.2	0.986	Low: 27.3, Moderate: 51.5, High: 21.2	0.990
Elbow	9.1	Female: 80.0, Male: 20.0	0.768	Year 3: 40.0, Year 4: 40.0, Year 5: 20.0	0.996	Low: 20.0, Moderate: 60.0, High: 20.0	0.937
Wrist/ Hand	43.6	Female: 79.2, Male: 20.8	0.502	Year 3: 29.2, Year 4: 50.0, Year 5: 20.8	0.269	Low: 29.2, Moderate: 50.0, High: 20.8	0.868
Upper back	54.5	Female: 70.0, Male: 30.0	0.509	Year 3: 40.0, Year 4: 43.3, Year 5: 16.7	0.487	Low: 26.7, Moderate: 56.7, High: 16.7	0.849
Lower back	74.5	Female: 75.6, Male: 24.4	0.683	Year 3: 41.5, Year 4: 36.6, Year 5: 22.0	0.839	Low: 22.0, Moderate: 53.7, High: 24.4	0.832
Leg	38.2	Female: 76.2, Male: 23.8	0.775	Year 3: 38.1, Year 4: 38.1, Year 5: 23.8	0.974	Low: 28.6, Moderate: 47.6, High: 23.8	0.877
Hip/ Buttock	23.6	Female: 69.2, Male: 30.8	0.596	Year 3: 23.1, Year 4: 53.8, Year 5: 23.1	0.438	Low: 30.8, Moderate: 46.2, High: 23.1	0.870
Knee	16.4	Female: 66.7, Male: 33.3	0.564	Year 3: 22.2, Year 4: 22.2, Year 5: 55.6	0.046*	Low: 33.3, Moderate: 44.4, High: 22.2	0.850
Feet	25.5	Female: 64.3, Male: 35.7	0.300	Year 3: 35.7, Year 4: 42.9, Year 5: 21.4	0.903	Low: 7.1, Moderate: 57.1, High: 35.7	0.199

*Significant at $p < 0.05$

Leg pain was reported by 38.2% of respondents, with no significant demographic associations observed. This moderate prevalence may be related to prolonged sitting or standing, which are well-established ergonomic risks in dentistry, further underscoring the importance of posture variation and scheduled breaks to alleviate musculoskeletal strain [15]. Hip and buttock pain was reported by 23.6% of participants, with no significant associations detected. This moderate prevalence supported the need for ergonomically supportive seating to minimise prolonged loading and stress on the pelvic region during clinical procedures.

Knee pain, reported by 16.4% of respondents, was significantly associated with the academic year (p= 0.046), with Year 5 students reporting a higher prevalence (55.6%) compared to those in Years 3 and 4 (22.2% each). This finding reflected the cumulative strain associated with increased clinical exposure and workload across academic progression [11]. Foot pain was reported by 25.5% of participants, with no statistically significant associations with demographic factors. Discomfort in the feet may have resulted from extended standing durations or inadequate footwear during clinical sessions, reinforcing the importance of ergonomic footwear and regular recovery periods to reduce fatigue and musculoskeletal stress [4].

3.4. Ergonomic awareness

All students reported having good (52.7%) or excellent (47.3%) ergonomic awareness (Table 4), indicating the effectiveness of ergonomic education within the dental curriculum. Although ergonomic awareness showed no significant association with gender (p= 0.702), a significant association was noted with academic year (p= 0.046), indicating a heightened awareness of ergonomics among students advancing from Year 3 to Year 5 (Table 5).

This finding corroborates prior research emphasising improved ergonomic awareness among senior dental students, attributable to increased exposure and structured education during their clinical training [20]. Overall, these results highlight the importance of targeted ergonomic training and interventions in reducing the risk of MSDs among dental students. The integration of proactive strategies within dental curricula could substantially promote professional sustainability and diminish the long-term consequences of MSDs in dental practice.

Tab.4. Prevalence of ergonomic awareness level among respondents

Variable	Ergonomic Awareness Level		
	Poor	Good	Excellent
n	0	29	26
(%)	(0.0)	(52.7)	(47.3)

Although all respondents rated their ergonomic awareness as good or excellent, over 40% still reported experiencing MSD symptoms in the past year. This reveals a notable gap between their theoretical understanding and practical implementation. Several factors may contribute to this inconsistency. Initially, awareness alone may not lead to consistent behavioural practice, particularly in high-pressure clinical settings where time pressure and patient care priorities often overshadow ergonomic concerns. Additionally, institutional obstacles such as fixed clinic layouts, lack of adjustable tools, or overcrowded workspaces can hinder students from adopting proper ergonomic methods. Moreover, without real-time ergonomic feedback or reinforcement during clinical training, students may struggle to self-correct poor postures or habits.

These observations suggest that, despite cognitive awareness, behavioural change and environmental support remain inadequate. Overcoming this gap requires moving from purely knowledge-based teaching to behaviour-focused interventions, including faculty role-modelling, ergonomic audits, and practice-oriented evaluations.

Tab.5. Association between ergonomics awareness level and selected factors (gender, academic year)

Awareness level	Gender		Academic year		
	F	M	Y3	Y4	Y5
Poor	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Good	21 (51.2)	8 (57.1)	16 (72.7)	9 (42.9)	4 (33.3)
Excellent	20 (48.8)	6 (42.9)	6 (27.3)	12 (57.1)	8 (66.7)
X^2	0.147		6.162		
p-value	0.702		0.046*		

F= Female; M= Male; Y3= Year 3; Y4= Year 4; Y5= Year 5
*Significant at p< 0.05

The high prevalence of MSDs observed among dental students in this study aligns with global trends reported across dental schools in both developed and developing countries, including Saudi Arabia, Germany, and Canada, where musculoskeletal discomfort is consistently linked to excessive clinical workload and poor ergonomics during training [21, 22]. This global consistency reinforces the notion that MSDs among dental students are not merely localised issues but represent a widespread occupational hazard embedded within the structural design of dental education. Nevertheless, the ongoing prevalence of musculoskeletal disorders (MSDs), despite a high level of ergonomic awareness among our respondents, indicates that the current training programs may be insufficient.

To bridge the gap between awareness and implementation, several practical ergonomic interventions can be integrated into dental education. First, ergonomic training should go beyond lectures and be integrated into clinical practice through real-time posture assessments, observational feedback, and reflective checklists. Faculty supervisors should be trained to actively reinforce ergonomic behaviours during clinical sessions. Second, institutions should carry out ergonomic audits of their clinical environments to confirm the availability of adjustable equipment, appropriate lighting, and a spatial layout that encourages safe practice. Third, integrating micro-break protocols and stretching routines into clinic schedules can reduce cumulative physical stress. Additionally, simulation-based training, which utilises posture monitoring and ergonomic correction tools, provides an effective platform for experiential learning and developing good habits. Together, these approaches can create a culture of proactive ergonomics that not only raises awareness but also promotes lasting behavioural change.

3.5. Limitation

This study has several limitations. First, the sample size (n= 55) was smaller than intended, which may have affected the statistical power and the broad applicability of the results. Additionally, a response rate of 59% suggests possible non-response bias, as students with MSD symptoms may have been more inclined to participate. Second, the cross-sectional design limits causal inference between ergonomic awareness and musculoskeletal symptoms. Third, the study relied entirely on self-reported data, which is inherently prone to recall bias and social desirability bias. Moreover, the study did not distinguish between chronic and acute MSD symptoms in its analysis, potentially affecting the clarity of the clinical significance. These limitations should be kept in mind when interpreting the results and designing future research.

4. Conclusion

This study provides valuable insights into the high prevalence of musculoskeletal disorders (MSDs) among dental students at Universiti Sains Malaysia (USM), with the lower back, neck, shoulders, and upper back being the most frequently affected regions. Although students generally reported good to excellent levels of ergonomic awareness, the persistent occurrence of MSD symptoms reveals a critical disconnect between knowledge and practice. This suggests that ergonomic awareness alone is insufficient to mitigate physical strain without behavioural reinforcement and systemic support. Gender and academic year emerged as significant demographic factors, with female students and those in advanced academic years reporting higher MSD incidences, likely due to cumulative clinical workload and prolonged ergonomic stress. While physical activity level was not significantly associated with MSD occurrence, its known benefits for musculoskeletal health warrant further investigation.

These findings underscore the need for comprehensive, practice-oriented interventions that extend beyond conventional awareness programs. Dental schools should incorporate structured ergonomic training throughout all academic years, complemented by simulation-based learning that reinforces posture monitoring and correction. Real-time feedback during clinical sessions, routine ergonomic audits, and faculty modelling of proper ergonomic behaviour are crucial strategies for long-term improvement.

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