RISK ASSESSMENT SUICIDALITY SCALE (RASS)-BASED ON-LINE CALCULATOR TARGETING EARLY PREVENTION OF SUICIDES IN GENERAL POPULATION: FROM COMET-G STUDY RESULTS TOWARDS INTEGRATION OF THE SCREENING TOOL INTO ROUTINE CLINICAL PRACTICE

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SUMMARY

Background: Suicide is a major global health concern, particularly among young people. This study evaluates an online suicide risk calculator based on the Risk Assessment of Suicidality Scale (RASS), which is designed to enhance accessibility and early detection of suicide risk.

Methods: The study involved 444 participants who completed the RASS via an online calculator. Results were compared with data from the COMET-G study's Russian sample (n=7572). Descriptive statistics, correlation analysis, and two-way ANOVA were used to analyze the data.

Results: The mean age of participants was 22.71 years (SD=7.94). The mean total RASS standardized score was 837.7 (SD=297.8). There was a significant negative correlation between age and RASS scores (r=-0.463, p<0.0001). The online calculator sample showed significantly higher RASS scores compared to the COMET-G sample, with 71% of online users scoring above the 90th percentile of the COMET-G sample.

Conclusion: Our study demonstrated the advantage of the on-line suicidality risk calculator based on the RASS scale as a sensitive tool in detecting suicidal behaviours and measuring the severity of suicidality risks, offering a capability for broad reach and immediate assessment during clinical conversation between doctor and patient. Moreover, the RASS on-line psychometric instrument, when being freely distributed among the general population over internet sources, enabled to attract vulnerable groups of respondents with significantly higher suicidality risks. Future research should focus on integrating such tools into comprehensive suicide prevention programs and developing appropriate follow-up monitoring strategies for high risk-cases.

Key words: *COMET-G study - extreme suicide risk - on-line calculator - population study - Risk Assessment Suicidality Scale (RASS) - suicidality - suicide prevention program - suicide risks*

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INTRODUCTION

Suicide represents a profound global health crisis, impacting millions of individuals and their families each year. According to the World Health Organization (WHO), over 700,000 people die by suicide annually, making it one of the leading causes of death worldwide (World Health Organization 2021). This crisis transcends geographical, socioeconomic, and demographic boun-daries, though certain populations are particularly vulnerable. Statistics reveal that young people, individuals with mental health disorders, and those undergoing severe stress or traumatic experiences are at heightened risk. In particular, the incidence of suicide is notably high among adolescents and young adults, as well as among individuals suffering from depression, substance abuse, or other mental health conditions (Pompili 2009). Since many at-risk individuals do not receive the timely intervention

they need, in addressing this challenge, the development and utilization of effective tools to assess suicidal risk are crucial (Franklin et al. 2017). One such tool is the Risk Assessment of Suicidality Scale (RASS), which was specifically designed to evaluate multiple factors associated with suicidal behavior (Fountoulakis et al. 2012). Unlike traditional clinical assessments that often focus solely on clinical characteristics, the RASS emphasizes self-reported behaviors and experiences. This approach provides a more comprehensive picture of an individual's risk and allows for the assessment of various dimensions of suicidality, such as suicidal intention, willingness to live, and history of self-harm and suicidal attempts. The RASS has demonstrated its effectiveness through a rigorous development and validation processes, including a factor analysis identifying key components such as intention, will to life, and history of suicidal behavior (Fountoulakis et al. 2012). Studies using the RASS, including the large-scale quasi-epidemiological COMET-G study comprising data from over 55,000 participants across 40 countries, have shown the scale's utility in different populations, and has provided comprehensive information on the distribution of RASS scores in diverse populations (Fountoulakis et al. 2022a,b, Imran et al. 2021, Panfil et al. 2022, Syunyakov et al. 2022). However, despite the availability of such tools, not all individuals at risk will seek help from mental health professionals. Barriers such as social stigma, lack of access to mental health services, and personal reluctance to acknowledge their difficulties can prevent individuals from receiving the help they need (Sifat et al. 2023, Voelker et al. 2021). Therefore, there is a critical need for accessible and user-friendly instruments that can help individuals evaluate their own risk and make informed decisions about seeking professional help. To address this need, we have developed an online suicide risk calculator based on the RASS. This digital tool aims to provide an accessible, anonymous, and efficient means for individuals to self-assess their own suicide risk. By leveraging the RASS framework, the online calculator offers immediate feedback and guidance, thereby potentially reaching a broader audience and facilitating early intervention. By providing a free, easily accessible and anonymous platform for risk assessment, the calculator aims to bridge the gap between individuals at risk and their attainment of mental health services. In so doing, RASS has the potential to enable identification of vulnerable populations and enhance the overall effectiveness of suicide prevention efforts.

Our study seeks to evaluate this new tool - an online suicide risk calculator based on the RASS. The primary objective is to compare total RASS scores between populations from a previous quasi-population study and those using the online calculator. We hypothesized that, due to the phenomenon of selection bias, a freely accessible, dedicated online tool for suicide risk assessment will attract significantly more patients with high suicide risk. This self-selection process is expected to result in a higher proportion of high-risk individuals using the online calculator compared to the general population or participants in controlled studies.

METHODS

Population and Sample Acquisition

This study utilized an online survey to collect data from participants using an anonymized online suicide risk calculator based on the Risk Assessment of Suicidality Scale (RASS) (Fountoulakis et al. 2012). The link to the bilingual (Russian and English) calculator (https://icern.org/rass/) was disseminated via news agencies, and then reposted across various social networks including influential Telegram channels to reach a broad and diverse Russian-speaking population. Participants voluntarily accessed the survey and provided informed consent before completing the questionnaire. Only those who aged at least 18 years who completed all fields of the survey, and provided their consent were included in the study, thereby ensuring a complete dataset for analysis.

The sample for comparison was acquired from the Russian national database of COMET-G study, which comprises 7,777 individuals. Since the database for of RASS-online calculator compiled male and female responses, to achieve better compatibility we limited study sample to the 7,572 cases in the COMET-G database self-identifying as either male or female.

Due to the anonymous nature of the survey, ethical committee approval was not required.

Statistical Analysis

The primary endpoint of the study was the RASS mean total standardized score. Descriptive statistics were used to summarize the data, including means, standard deviations, medians, and interquartile ranges (IQR) for continuous variables, and frequencies and percentages for categorical variables. To compare age differences between genders, we performed a Kruskal-Wallis test, which also served to examine differences in RASS scores between males and females. We conducted Pearson correlation analysis was conducted to examine the relationship between age and the standardized RASS total score.

To compare the RASS-online calculator sample with the COMET-G Russian sample, we performed a two-way ANOVA. This analysis examined the effects of sample type (online calculator vs. COMET-G) and sex on RASS total standardized scores. The model included main effects for sample type and sex, as well as their interaction. Effect sizes were calculated using partial eta-squared (R^2) for the overall model and Cohen's f for individual effects.

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For visualization purposes, we depicted the distributions of RASS total standardized scores for both samples using histograms and cumulative frequency distribution graphs. These graphical representations were used to identify and compare the percentiles of scores between the two samples. All statistical analyses were performed using Lumivero XLSTAT software (Lumivero (2024). XLSTAT statistical and data analysis solution. https://www.xlstat.com/en.), with a significance level set at $\alpha=0.05$.

RESULTS

Study Sample

The study included 444 participants (254 females, 57.2%; 190 males, 42.8%) of mean age of 22.71 years (SD=7.94) and median age 19 years (IQR: 18-25). Female participants (mean = 22.59 years, SD=8.06) and median of 19 years (IQR: 18-22.75) were slightly older than the males (mean = 22.87, SD=7.78) and median of 20 years (IQR: 18-23.75)) (H=7.044, p=0.008, ε^2=0.021, Kruskal-Wallis test).

Overall, the mean total RASS standardized score was 837.65 (SD=297.83) with a median of 960 (IQR: 723.75-1041.25). Females exhibited slightly higher scores (mean = 845.25, SD=296.47, median = 970, IQR: 731.25-1050) compared to males (mean = 819.61, SD = 300.26, median = 947.5, IQR: 686.25-1000 (H=1.856, p=0.173, ε^2=0.005, Kruskal-Wallis test).

Pearson correlation analysis showed a significant negative correlation between age and the standardized RASS (Risk Assessment Suicidality Scale) total score (r=-0.463, p<0.0001).

Table 1 contains item-by-item results for the distributions of RASS-scale responses. The majority of participants expressed a significant fear of dying, with nearly half of females (48.76%, n=118) and males (50.00%, n=51) indicating they feared death "much." This results highlights the pervasive anxiety surrounding mortality among the study population.

The lifetime history of suicide attempts revealed that nearly half of females (48.35%, n=117) and over half of males (56.86%, n=58) had attempted suicide at least once, illustrating a high incidence of severe actions related to suicidal ideation among the participants. Additionally, a substantial proportion of participants felt that they might be better if they were dead. Specifically, 27.69% (n=67) of females and 32.35% (n=33) of males admitted to feeling this "very much", suggesting a notable prevalence of severe distress or hopelessness among the respondents. Conversely, positive attitudes towards being alive were also relatively prevalent. Approximately 40.50% (n=98) of females and 43.14% (n=44) of males felt it is "very much" a wonderful thing to be alive, indicating a generally positive outlook on life among a significant proportion of the participants. Participants frequently reported feelings of life not being worth living, with about 25.21% (n=61) of females and 27.45% (n=28) of males experiencing this sentiment "very much." In contrast, roughly 30% of both genders did not feel this way at all, indicating a varied perspective on life's value within the sample. When asked about thoughts of self-harm, a significant majority of participants reported having no such thoughts (64.46% of females, n=156 and 61.76% of males, n=63). However, about 25% of both genders admitted to making plans on how to end their lives (25.21% of females, n=61 and 23.53% of males, n=24). Regarding suicide ideation, a notable proportion of participants had never thought about committing suicide (61.16% of females, n=148 and 51.96% of males, n=53). Nevertheless, about 20% of both genders admitted to frequent suicidal thoughts and planning (20.25% of females, n=49 and 21.57% of males, n=22). A substantial proportion (around 26% of females, n=64 and 28% of males, n=29) reported not enjoying life at all. A similar proportion of participants from both sexes indicated feeling tired of life, with 26.03% (n=63) of females and 25.49% (n=26) of males reporting feeling this way "very much". A history of deliberate self-harm on 2-3 occasions was reported by 19.83% (n=48) of females and 29.41% (n=30) of males.

Comparison of RASS-online calculator and COMET-G Russian samples

A two-way ANOVA was conducted to examine the effects of sample and sex on RASS total standardized scores. The overall model was significant (F(3, 7912) = 267.199, p<0.0001), explaining 9.2% of the variance in RASS scores (R²=0.092). The main effect of study type was significant (F(1, 7912) = 653.499, p<0.0001), indicating a substantial difference in RASS scores between the two studies. This effect accounted for 9.2% of the explained variance. However, neither the main effect of sex (F(1, 7912) = 1.170, p=0.280) nor the interaction between study and sex (F(1, 7912) = 0.580, p=0.446) were statistically significant. This suggests that RASS scores did not significantly differ between males and females, and the effect of sample was consistent across both sexes. The effect size for the sample variable was large (Cohen's f = 0.318), while the effects of sex and the interaction were negligible (Cohen's f = 0.011 and 0.009, respectively).

The distributions of the RASS total standardized scores for the online calculator sample (n=344) and COMET-G study Russian sample (n=7,572) are illustrated in Figure 1. The COMET-G Russian sample shows a concentration of scores in the lower range, with a peak around 200-400, and declining density for higher scores.

Table 1. Distribution of responses to RASS-online calculator items by gender

Variable / response		Sex				Total	
		Female		Male			
		n	%	n	%	n	%
Are you afraid that you are going to die?	Not at all	15	6.20%	3	2.94%	18	5.23%
	A little bit	90	37.19%	40	39.22%	130	37.79%
	Much	118	48.76%	51	50.00%	169	49.13%
	Very much	19	7.85%	8	7.84%	27	7.85%
Do you ever think that it would be better if you were dead?	Not at all	97	40.08%	35	34.31%	132	38.37%
	A little bit	44	18.18%	19	18.63%	63	18.31%
	Much	34	14.05%	15	14.71%	49	14.24%
	Very much	67	27.69%	33	32.35%	100	29.07%
Do you think that it is a wonderful thing that you are alive?	Not at all	75	30.99%	31	30.39%	106	30.81%
	A little bit	31	12.81%	10	9.80%	41	11.92%
	Much	38	15.70%	17	16.67%	55	15.99%
	Very much	98	40.50%	44	43.14%	142	41.28%
Have you felt that it's not worth living?	Not at all	67	27.69%	32	31.37%	99	28.78%
	A little bit	62	25.62%	24	23.53%	86	25.00%
	Much	52	21.49%	18	17.65%	70	20.35%
	Very much	61	25.21%	28	27.45%	89	25.87%
Do you think of harming yourself physically?	Not at all	156	64.46%	63	61.76%	219	63.66%
	A little bit	45	18.60%	19	18.63%	64	18.60%
	Much	41	16.94%	20	19.61%	61	17.73%
Do you often think of committing suicide if you have the chance?	Not at all	148	61.16%	53	51.96%	201	58.43%
	A little bit	45	18.60%	27	26.47%	72	20.93%
	Much	49	20.25%	22	21.57%	71	20.64%
Do you make plans concerning the method to use in order to finish your life?	Not at all	134	55.37%	55	53.92%	189	54.94%
	A little bit	47	19.42%	23	22.55%	70	20.35%
	Much	61	25.21%	24	23.53%	85	24.71%
I am thinking of suicide but I won't do it	Not at all	96	39.67%	37	36.27%	133	38.66%
	A little bit	88	36.36%	26	25.49%	114	33.14%
	Much	58	23.97%	39	38.24%	97	28.20%
Do you enjoy life?	Not at all	64	26.45%	29	28.43%	93	27.03%
	A little bit	34	14.05%	9	8.82%	43	12.50%
	Much	32	13.22%	11	10.78%	43	12.50%
	Very much	112	46.28%	53	51.96%	165	47.97%
Are you feeling tired from your life?	Not at all	106	43.80%	50	49.02%	156	45.35%
	A little bit	47	19.42%	17	16.67%	64	18.60%
	Much	26	10.74%	9	8.82%	35	10.17%
	Very much	63	26.03%	26	25.49%	89	25.87%
Have you ever hurt yourself in any way deliberately during your whole life so far?	Never	163	67.36%	66	64.71%	229	66.57%
	Once	31	12.81%	6	5.88%	37	10.76%
	2–3 times	48	19.83%	30	29.41%	78	22.67%
Have you ever attempted suicide during your whole life so far?	Never	125	51.65%	44	43.14%	169	49.13%
	Once	117	48.35%	58	56.86%	175	50.87%
Total		242	100.00%	102	100.00%	344	100.00%

In contrast, the RASS-online calculator sample displays a more even distribution across the score range, with a notable peak at higher scores (900-1000). This distribution pattern suggests that the online calculator attracted a higher proportion of individuals with elevated suicide risk compared to the general population represented in the COMET-G Russian sample. The higher density of scores in the upper range for the RASS-online calculator sample indicates that this tool may be effective in reaching individuals who are at greater risk, potentially due to self-selection bias among those choosing to use the online assessment.

The cumulative frequency distribution graph (Figure 2) reveals significant differences between the COMET-G sample and the RASS-online calculator sample in terms of suicide risk scores. Particularly notable are the
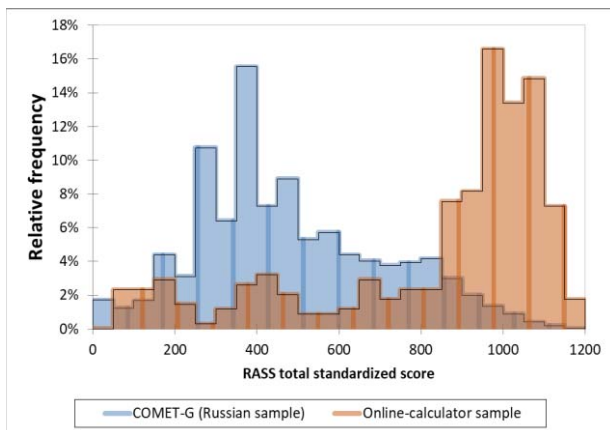
Figure 1. RASS total standardized score distribution in the Online calculator sample and Russian sample of COMET-G study

comparisons at the 90th and 95th percentiles of the COMET-G sample. At the 90th percentile of the COMET-G sample, which corresponds to a RASS total standardized score of 815, we observe that 71% of the RASS-online calculator sample scored above this threshold. Even more striking is the comparison at the 95th percentile. The RASS score of 895, which represents the cut-off for the top 5% of scores in the COMET-G sample, was exceeded by 62% of the RASS-online calculator sample.

DISCUSSION

This study aimed to evaluate the effectiveness of an online suicide risk calculator based on the Risk Assessment of Suicidality Scale (RASS) and compare its results in a self-selected population with prior results from the COMET-G quasi-population study. Our findings strongly support the hypothesis that, due to selection bias, a freely accessible, dedicated online tool for suicide risk assessment attracts significantly more individuals with high suicide risk.

The cumulative frequency distribution analysis revealed striking differences between the COMET-G sample and the RASS-online calculator sample. At the 90th percentile of the COMET-G sample (RASS score of 815), 71% of the RASS-online calculator sample scored above this threshold. Even more notably, 62% of the online calculator sample exceeded the 95th percentile score (895) of the COMET-G sample. These threshold results indicate that the online calculator attracted a disproportionate number of high-risk individuals, with nearly two-thirds of users reporting levels of suicide risk that would be considered extreme in the general population.

The significant negative correlation found between age and RASS total standardized scores (r=-0.463, p<0.001) aligns with previous findings of COMET-G study in Russia (Syunyakov et al. 2022). This trend for
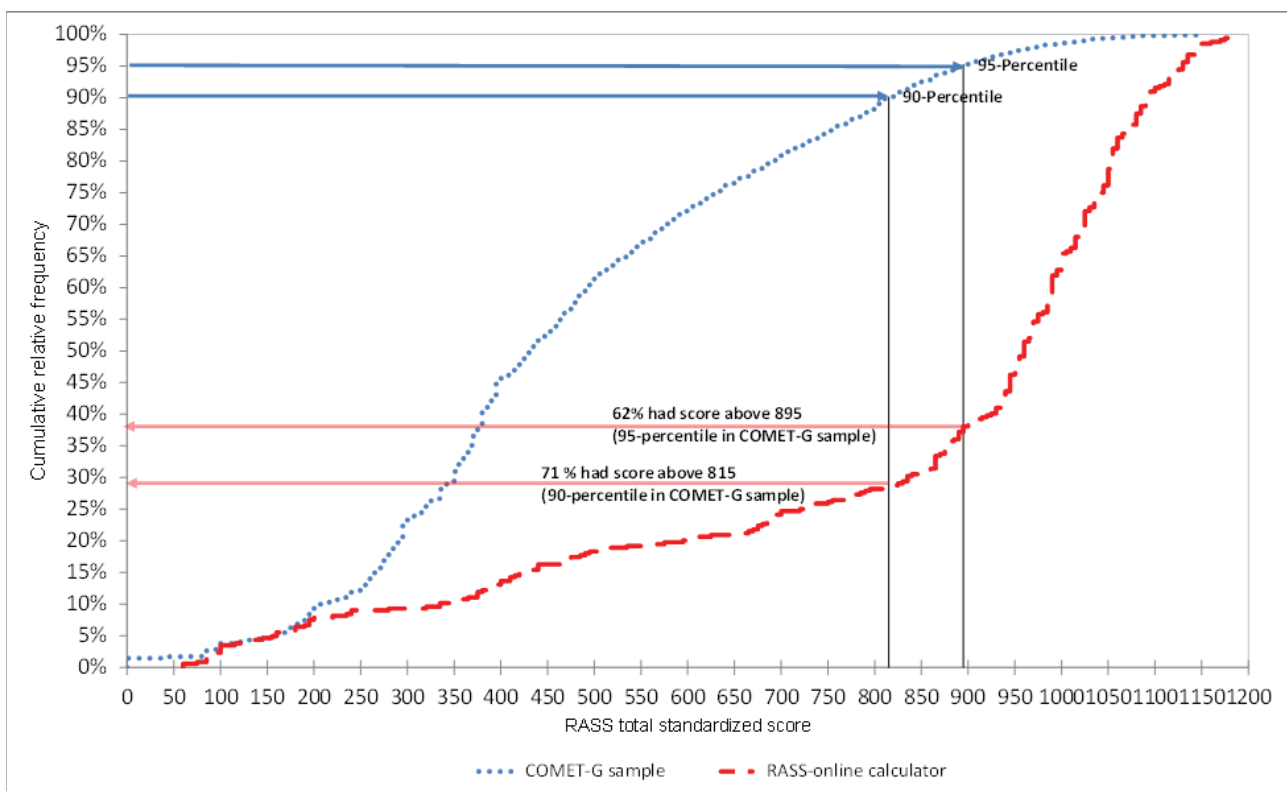

Figure 2. Cumulative frequency distribution graph comparing two samples: the COMET-G sample (represented by a blue dotted line) and the RASS-online calculator sample (represented by a red dashed line)

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higher suicide risk among younger individuals is consistent with several other studies. For instance, Nock et al. (2008) reported that the risk of suicidal thoughts and behaviors is highest among young adults (Nock et al. 2008). Similarly, Crosby et al. (2011) found that suicide attempts are more common in adolescents and young adults compared to older age groups (Crosby et al. 2011). More recently, Fazel and Runeson (2020) highlighted that suicides, indeed, is the leading cause of mortality in young adulthood in many countries (Fazel & Runeson 2020). This consistent pattern across studies underscores the critical importance of targeting suicide prevention efforts towards younger populations, who appear to be particularly vulnerable to suicidal ideation and behaviors. The higher engagement of younger individuals with our online tool further emphasizes the potential of digital platforms in reaching this high-risk group, suggesting that age-appropriate, technology-based interventions could play a crucial role in early detection and prevention strategies.

These marked group differences in score distributions strongly suggest the occurrence of self-selection bias, where individuals with higher levels of suicidal ideation or risk were more inclined to seek out and use the online assessment tool. This finding aligns with previous research indicating that online mental health resources often attract individuals with higher levels of distress or symptomatology (Titov et al. 2020).

Interestingly, our study found no significant gender differences in RASS scores, contrasting with traditional suicide statistics in Russia that show higher rates of completed suicides among men (Jukkala et al. 2015). This discrepancy may reflect differences between suicidal ideation and completed suicides, or it may indicate changing patterns in suicidal behavior and help-seeking among different genders.

The online calculator's propensity to attract high-risk individuals demonstrates the potential of such digital tools for reaching vulnerable populations who might not seek traditional mental health services due to stigma or access barriers (Sifat et al. 2023, Voelker et al. 2021). However, this bias also presents challenges in terms of providing immediate support and intervention for these high-risk individuals identified through online screening.

Our findings have significant implications for suicide prevention strategies. We contend that online tools can play a crucial role in identifying at-risk individuals, particularly among younger populations who may be more comfortable with digital interfaces. However, results also highlight the urgent need for robust follow-up systems and accessible mental health resources to support those identified as high-risk through these online platforms.

CONCLUSION

In keeping with our hypothesis, the dedicated online suicidality risk calculator tool attracted respondents with higher suicide risk scores compared to the general population sample from COMET-G. This was evident in the distribution of RASS scores, with a notably larger proportion of online users falling into the upper ranges. This finding highlights the potential value of online tools in suicide risk assessment, particularly in reaching younger, potentially vulnerable populations. Response strategies to manage high-risk cases and appropriate follow-up systems should be developed and implemented to the healthcare system. Future studies should focus on exploration of integration these free, easily accessible and promoted in social media tools into comprehensive suicide prevention programs.

Limitations

Although we compared two different samples - the RASS on-line calculator and COMET-G population study sample - both were collected using similar online methods, which may have introduced comparable biases. Regarding selection bias, it should be noted that we intentionally exploitted its potential as a design element for identifying at-risk populations. Nevertheless, there is a possibility that selection bias may limit the generalizability of our findings to a broader population. Another significant limitation arises from our reliance on self-reported data, which may be subject to recall and social desirability biases, potentially affecting the accuracy of the risk assessments. Despite these limitations, we feel that our study offers valuable insights into the potential of online tools for identifying at-risk populations and lays groundwork for future research in this critical area of public health.

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