# The Effect of Individuals' Personality Traits on the Perceived Effort Assessed by Visual Analogue Scale: An Experimental Study

Hadi Daneshmandi[1], PhD;
Alireza Choobineh[1], PhD;
Zeinab Rasouli Kahaki[2], PhD;
Mojgan Zoaktafi[3], MSc; Atefeh
Hosseini[4], PhD

[1]Research Center for Health Sciences, Institute of Health, Shiraz University of Medical Sciences, Shiraz, Iran
[2]Deputy Health Center, Qom University of Medical Sciences, Qom, Iran
[3]Department of Industrial and Enterprise Systems Engineering, University of Illinois at Urbana-Champaign, USA
[4]Department of Psychology, School of Educational Sciences and Psychology, Islamic Azad University (Marvdasht Branch), Marvdasht, Iran

**Correspondence:**
Alireza Choobineh, PhD;
Research Center for Health Sciences, Institute of Health, Shiraz Univ. Med. Sci., P. O. Box: 71645-111, Shiraz, Iran
**Tel:** +98 71 37251001-5 (291)
**Email:** alrchoobin@sums.ac.ir

**Abstract**

**Background:** This study aimed to examine the effect of individuals' personality traits on the perceived effort.

**Methods:** This experimental study was conducted from October 2022 to December 2022 on 30 students using general health questionnaire (GHQ-28), Raven's intelligence quotient (IQ) test, visual analogue scale (VAS), revised neuroticism, extraversion, openness to experience (NEO) personality inventory, and Jamar hand dynamometer (JHD).

**Results:** A significant positive correlation was found between the exerted force to the JHD (EF-JHD) and perceived effort rated on horizontal VAS (PE-H/VAS) and vertical VAS (PE-V/VAS) in the individuals with low levels of 'neuroticism'. Considering 'extraversion' and 'agreeableness' factors of the NEO test, the correlation coefficient between EF-JHD, and PE-H/VAS and PE-V/VAS was higher in the individuals with medium levels compared to those with high levels. This relationship was reverse for the 'openness to experience' and 'conscientiousness' factors. The results demonstrated a significant strong positive correlation between PE-H/VAS and PE-V/VAS (r=0.97). Multiple linear regression analysis revealed a moderate positive correlation between EF-JHD and PE-H/VAS and between EF-JHD and PE-V/VAS.

**Conclusion:** Individuals' personality traits are recommended to be considered in assessing the perceived effort by VAS.

## Introduction

Visual analogue scale (VAS) is a psychometric scale to assess individuals' attitudes and subjective feelings. VAS has been used for the evaluation of some types of disorders, social sciences investigations, and market research.[1] It is a useful tool for measuring various subjective phenomena and provides an easy, convenient, and rapidly administered measurement strategy.[2] Literature has shown that VAS has been used to assess pain/discomfort,[3] incontinence,[4] body image,[5] people's moods,[6] and quality of life.[7] Gift stated that VAS is a valid, reliable, and sensitive self-report measure for assessing subjective experience when used properly.[8] The use of VAS as a graphic rating scale for the assessment of subjective feelings dates back to 1921[9] although it was not widely used at that time.[10]

VAS is generally presented as a single horizontal or vertical line of 100 mm with anchor words at either end.[11] The subject is asked to mark his/her perceived level of the desired parameter, such as perceived effort (for a specified time frame), on the line.[1, 12] Then, the rater scores the tool by measuring the distance, in millimeters, from the 'left' anchor to

the mark identified as the subject's level of the desired parameter (e.g. perceived effort).[12] The simplicity of its construction and use has been considered the main advantage of VAS.[11] Another advantage of this scale is that responses are not restricted to a certain number of answer options, and very fine gradations can also be measured.[13]

In various studies, VAS has been used to evaluate different subjective parameters. Bond and Pilowsky were the first researchers who applied VAS to assess the subjective experience of pain/discomfort intensity.[14] Zusman also declared that VAS was a simple and adequate measure of pain/discomfort intensity.[15] Moreover, De Boer et al. used VAS to assess the patients' quality of life. Their findings revealed that VAS was a valid tool for the evaluation of quality of life.[16] Currently, VAS has become a common tool to examine stress among workers.[17] Ueda et al. pointed out that VAS was useful for monitoring exercise intensity.[18] Some studies have also reported that VAS could be used to rate perceived effort.[19]

Peet et al. concluded that people with different levels of depression could not be considered as homogeneous regarding their mode of expression on VAS. Therefore, they recommended that this issue should be taken into account in the research design and interpretation of the results in the studies using VAS.[20]

Collectively, VAS is an attractive tool to investigate individuals' feelings because it is easy to use and quick to administer. It is also useful for introducing health states.[21] Some studies have revealed that people's personality traits (reflecting people's patterns of thoughts, feelings, and behaviors)[22] could affect self-perceived phenomena, such as health outcomes.[23] However, the impact of personality traits on the perceived effort assessed by VAS is unclear.

In ergonomic studies, VAS has been widely used to assess individuals' perceived effort and pain/discomfort.[24-26] Based on our observations in previous studies, the rating of VAS by Iranian individuals may suffer from poor validity.[27-29] Therefore, it was hypothesized that VAS rating which assesses perceived effort or pain/discomfort in individuals was different based on their personality traits. Hence, this study was conducted to examine VAS rating for assessment of perceived effort based on personality traits among Iranian individuals.

## Methods

### Participants

This is an experimental study. Based on the previous studies,[30] 30 students (10 males and 20 females) were selected using a simple random sampling method based on the table of random numbers. Individuals with psychiatric disorders (general health score >24 based on the general health questionnaire (GHQ-28)) and severe musculoskeletal disorders (MSDs) as well as those who consumed psychotropic drugs were excluded from the study.

All participants voluntarily took part in the study after receiving oral information about the aims/protocol of the research and signing an informed consent form. The study was approved by the Ethics Committee of the National Institute for Medical Research Development (NIMAD). Additionally, the study was conducted in accordance with the Helsinki Declaration of 2013.[31]

### Data Gathering Tools

In this study, the required data were collected using questionnaires and experimental assessment tools as follows:

### Questionnaires

**Demographic questionnaire:** This questionnaire included questions on age, weight, height, sex, and marital status.

**General health questionnaire (GHQ-28):** GHQ-28 was developed by Goldberg in 1978; since then, it has been translated into 38 languages. It is a screening tool for detecting individuals who are at risk of developing psychiatric disorders. The items of GHQ-28 can be scored from 0 to 3. Goldberg stated that people with general health scores ≤23 should be classified as non-psychiatric, while those with scores >24 may be classified as psychiatric.[32] The psychometric properties of the Persian version of GHQ-28 were examined and approved by Noorbala et al.[33] Based on the GHQ-28, non-psychiatric participants were included in the present study.

**Boston carpal tunnel syndrome questionnaire (BCTQ):** The BCTQ is a disease-specific measure of self-reported symptom severity and functional status. The scale for the severity of the symptoms ranged from 11 (no symptoms) to 55 (worst possible symptoms), while that for functional status ranged from 8 (normal) to 40 (complete impairment). The total score of symptom severity was categorized into five groups: no symptoms (total score: 1-11), mild (total score: 12-22), moderate (total score: 23-33), severe (total score: 34-44), and very severe (total scores: 45-55). The total scores of functional status were also grouped into the following categories: no difficulty (total score: 8), mild difficulty (total score: 9-16), moderate difficulty (total score: 17-24), severe difficulty (total score: 25-32), and very severe difficulty (total score: 33-40).[34] Based on the BCTQ, the participants with 'no symptoms' and 'normal' functional status were included in the present study.

**Raven's IQ test:** Raven's Progressive Matrices

(RPM/simply as Raven's matrices) is a non-verbal group test. This test contains 60 items to be used in measuring abstract reasoning and has been regarded as a non-verbal estimate of fluid intelligence.[35] Raven's IQ test was originally developed by Raven in 1936.[36] The psychometric properties of Raven's IQ test in Iranian people have been surveyed and approved by Rahmani.[37] This test was used to measure the IQ level of the participants in the present study.

**Visual analog scale (VAS):** VAS is a single item measure, i.e. an instrument measuring the whole construct at once. VAS most commonly consists of a 100 mm horizontal or vertical line anchored with two opposite labels. Subjects are required to mark a score on the scale using a slash.[38] This tool was used to measure the participants' perceived efforts in the current study.

**Revised NEO personality inventory:** The revised Neuroticism-Extraversion-Openness Personality Inventory (NEO PI-I) is a personality questionnaire that examines a person's big five personality traits (i.e., neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness). In the 1970s, Costa and McCrae carried out a study on age-related changes in personality.[39] A shortened version of NEO PI-R, namely the NEO five-factor inventory (NEO-FFI), has also been published. It contained 60 items and took 10 to 15 minutes to be filled out. The NEO-FFI was revised in 2004.[40] Haghshenas[41] and Garousi Farshi[42] stated that this version of NEO inventory was valid and reliable for assessing personality traits among Iranians. Each item of this inventory could be scored from 1 to 5, with the total score ranging from 12 to 60 for each factor. Accordingly, scores 12-23.99, 24-47.99, and 48-60 were considered low, medium, and high levels, respectively. This inventory was used to measure the participants' big five personality factors in the present study.

*Experimental Assessment*

**Handgrip test:** The Jamar dynamometer is a widely recognized tool for measuring grip strength. Grip strength was measured using the Jamar hand dynamometer (JHD/Sammons Preston model: 563213). Standard testing procedures of the Jamar dynamometer were done with he subjects seated with their shoulder adducted and neutrally rotated, elbow flexed at 90°, and the forearm and wrist in a neutral position. Values were measured in kilograms.[43] More details are explained below in "Stage II".

*Implementation of the Study*

The required data were gathered in two stages as follows:

**Stage I:** First, based on the GHQ-28 and BCTQ, the participants with general health scores ≤23 and 'no symptoms' and 'normal' functional status were identified and included in the study (n=30: 10 males and 20 females). Then, the participants were asked to complete the demographic questionnaire. Their IQs were also examined by the Raven test. Additionally, the NEO personality test was carried out to assess their personality traits. Figure 1 shows a participant while performing the IQ and NEO tests.

**Stage II:** The participants exerted maximum force grip on the JHD with a neutral wrist/hand posture (Figure 2). Then, they were asked to exert 25%, 50%, and 75% of the maximum force grip randomly and blindly. Afterward, they were required to rate their 'perception of the exerted force' on the VAS (horizontal and vertical scales) for each trial. It is worth noting that horizontal and vertical VASs were presented immediately and separately (blindly) to the individuals after force exertion to the JHD. Blind protocol was performed, so that rating the perceived effort on the first VAS (horizontal or vertical) did not affect the rating of the perceived effort on the second VAS. The order of presenting the scales to the participants in each trial was determined based on random coin tosses. There was a one-minute rest between each trial. The means of the Exerted Force to the JHD (EF-JHD), perceived effort rating on horizontal VAS (PE-H/VAS), and perceived effort rating on vertical VAS (PE-V/VAS) were calculated for the three mentioned trials. These means (i.e., EF-JHD, PE-H/VAS, and PE-V/VAS) were used to examine their relationships with the individuals' personality traits. Therefore, EF-JHD, PE-H/VAS, and PE-V/VAS
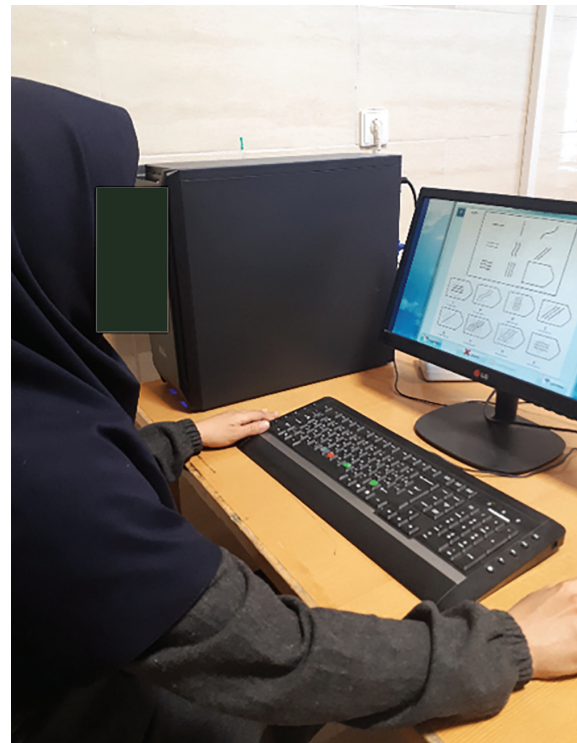


**Figure 1:** A subject while performing the IQ and NEO tests in the lab

**Figure 2:** A subject while exerting force to JHD (force exerted in neutral wrist/hand posture)

were related to the means of the 25%, 50%, and 75% of the maximum force grip, respectively. Figure 2 shows a subject while performing this stage.

All tests were performed from 8 to 12 AM. It should be noted that all tests were performed in an almost constant lab condition in terms of comfort and environmental conditions, such as light, noise, and temperature.

*Statistical Analysis*

The data were analyzed using the Statistical Package for Social Sciences 16 (SPSS Inc., Chicago, IL, USA). To test the normality of the data, we used Kolmogorov-Smirnov, Shapiro-Wilk, and Skewness and Kurtosis tests. Descriptive statistics (mean, standard deviation, number, and percent), Pearson's correlation coefficient (for assessing the correlation between EF-JHD and PE-H/VAS and PE-V/VAS), and multiple linear regression (for modeling EF-JHD, PE-H/VAS, and PE-V/VAS) were used to analyze the data. A P-value less than 0.05 was considered statistically significant.

## Results

The personal characteristics of the participants are presented in Table 1.

The means, standard deviations, minimums, and maximums of EF-JHD, PE-H/VAS, and PE-V/VAS are displayed in Table 2.

The distribution of the participants in the three levels (low, medium, and high) of the five factors of the NEO personality test (neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness) is shown in Table 3.

The correlations between EF-JHD, PE-H/VAS, and PE-V/VAS in the three levels of the 'neuroticism' factor of the NEO test are presented in Table 4. Accordingly, EF-JHD showed a significant positive association with PE-H/VAS and PE-V/VAS among the individuals with low levels of 'neuroticism'.

The correlations between EF-JHD, PE-H/VAS, and PE-V/VAS in the three levels of the 'extraversion' factor of the NEO test are presented in Table 5. The findings indicated that the correlation coefficients between EF-JHD, PE-H/VAS, and PE-V/VAS were higher among the individuals with medium levels of the 'extraversion' factor compared to others.

The correlations between EF-JHD, PE-H/VAS, and PE-V/VAS in the three levels of the 'openness to

**Table 1:** Some personal details of the participants (N=30)

| Quantitative variable | | Mean±SD |
|---|---|---|
| Age (years) | | 27.93±4.97 |
| BMI (kg.m$^{-2}$) | | 23.02±3.64 |
| Exercise in week (hours) | | 5.2±2.58 |
| IQ | | 109.89±16.79 |
| Qualitative variable | | No. (%) |
| Sex | Male | 10 (33.3) |
| | Female | 20 (66.7) |
| Marital status | Single | 25 (83.33) |
| | Married | 5 (16.67) |

BMI: Body mass index; IQ: Intelligence quotient

**Table 2:** Descriptive statistics of the participants' EF-JHD, PE-H/VAS, and PE-V/VAS (N=30)

| Variable | Mean±SD | Min-Max |
|---|---|---|
| EF-JHD (N) | 274.30±10.02 | 117.6-556.64 |
| PE-H/VAS (mm) | 50.19±7.71 | 30.67-62.67 |
| PE-V/VAS (mm) | 51.10±8.61 | 29-64.33 |

EF-JHD: Exerted force assessed by JHD; PE-H/VAS: Perceived effort rating on horizontal VAS; PE-V/VAS: Perceived effort rating on vertical VAS

**Table 3:** Distribution of the participants in the three levels of the five factors of the NEO personality test (N=30)

| NEO subscale | Low | Medium | High |
|---|---|---|---|
| | No. (%) | No. (%) | No. (%) |
| Neuroticism | 3 (10) | 16 (53.3) | 11 (36.7) |
| Extraversion | - | 10 (33.3) | 20 (66.7) |
| Openness to experience | - | 9 (30) | 21 (70) |
| Agreeableness | - | 9 (30) | 21 (70) |
| Conscientiousness | - | 7 (23.33) | 23 (76.67) |

**Table 4:** The correlations between EF-JHD, PE-H/VAS, and PE-V/VAS based on the 'neuroticism' factor of the NEO test (N=30)

| | Neuroticism | PCC | PE-H/VAS | PE-V/VAS |
|---|---|---|---|---|
| EF-JHD* | Low (n=3) | r | 0.881 | 0.923 |
| | | P[a] | 0.020* | 0.009* |
| | Medium (n=16) | r | 0.469 | 0.441 |
| | | P[a] | 0.037* | 0.052 |
| | High (n=11) | r | 0.602 | 0.525 |
| | | P[a] | 0.398 | 0.475 |

[a]Pearson's correlation coefficient. *P<0.05. PCC: Pearson's correlation coefficient; EF-JHD: Exerted force assessed by JHD; PE-H/VAS: Perceived effort rating on horizontal VAS; PE-V/VAS: Perceived effort rating on vertical VAS

**Table 5:** The correlations between EF-JHD, PE-H/VAS, and PE-V/VAS based on the 'extraversion' factor of the NEO test (N=30)

| | Extraversion | PCC | PE-H/VAS | PE-V/VAS |
|---|---|---|---|---|
| EF-JHD* | Low (n=0) | r | - | - |
| | | P[a] | - | - |
| | Medium (n=10) | r | 0.939 | 0.925 |
| | | P[a] | 0.018* | 0.024* |
| | High (n=20) | r | 0.497 | 0.460 |
| | | P[a] | 0.012* | 0.021* |

[a]Pearson's correlation coefficient. *P<0.05. PCC: Pearson's correlation coefficient; EF-JHD: Exerted force assessed by JHD; PE-H/VAS: Perceived effort rating on horizontal VAS; PE-V/VAS: Perceived effort rating on vertical VAS

**Table 6:** The correlations between EF-JHD, PE-H/VAS, and PE-V/VAS based on the 'openness to experience' factor of the NEO test (N=30)

| | Openness to experience | PCC** | PE-H/VAS[†] | PE-V/VAS[‡] |
|---|---|---|---|---|
| EF-JHD* | Low (n=0) | r | - | - |
| | | P[a] | - | - |
| | Medium (n=9) | r | 0.215 | 0.210 |
| | | P[a] | 0.609 | 0.618 |
| | High (n=21) | r | 0.664 | 0.627 |
| | | P[a] | 0.001* | 0.002* |

[a]Pearson's correlation coefficient. *P<0.05. PCC: Pearson's correlation coefficient; EF-JHD: Exerted force assessed by JHD; PE-H/VAS: Perceived effort rating on horizontal VAS; PE-V/VAS: Perceived effort rating on vertical VAS

experience' factor of the NEO test are presented in Table 6. Based on the Table, the correlations between EF-JHD, PE-H/VAS, and PE-V/VAS were higher in the participants with high levels compared to those with medium levels of the 'openness to experience' factor.

The correlations between EF-JHD, PE-H/VAS, and PE-V/VAS in the three levels of the 'agreeableness' factor of the NEO test are shown in Table 7. As the Table depicts, the correlation coefficient between EF-JHD, PE-H/VAS, and PE-V/VAS was higher among the individuals with medium levels of the 'agreeableness' factor compared to the others.

The correlations between EF-JHD, PE-H/

VAS, and PE-V/VAS in the three levels of the 'conscientiousness' factor of the NEO test are presented in Table 8. Accordingly, the correlations between EF-JHD, PE-H/VAS, and PE-V/VAS were higher among the participants with high levels of the 'conscientiousness' factor compared to others.

The results of Pearson's correlation analysis demonstrated a significant strong positive correlation between PE-H/VAS and PE-V/VAS (r=0.97, P<0.001). The results of multiple linear regression analysis also revealed a moderate positive correlation between EF-JHD and PE-H/VAS (r=0.531, P=0.003) as well as between EF-JHD and PE-V/VAS (r=0.502, P=0.005), which were defined as:

**Table 7:** The correlations between EF-JHD, PE-H/VAS, and PE-V/VAS based on the 'agreeableness' factor of the NEO test (N=30)

| | Agreeableness | PCC** | PE-H/VAS† | PE-V/VAS‡ |
|---|---|---|---|---|
| EF-JHD* | Low (n=0) | r | - | - |
| | | Pª | - | - |
| | Medium (n=9) | r | 0.980 | 0.979 |
| | | Pª | 0.028* | 0.032* |
| | High (n=21) | r | 0.465 | 0.435 |
| | | Pª | 0.015* | 0.023* |

ªPearson's correlation coefficient. *P<0.05. PCC: Pearson's correlation coefficient; EF-JHD: Exerted force assessed by JHD; PE-H/VAS: Perceived effort rating on horizontal VAS; PE-V/VAS: Perceived effort rating on vertical VAS

**Table 8:** The correlations between EF-JHD, PE-H/VAS, and PE-V/VAS based on the 'conscientiousness' factor of the NEO test (N=30)

| | Conscientiousness | PCC** | PE-H/VAS† | PE-V/VAS‡ |
|---|---|---|---|---|
| EF-JHD* | Low (n=0) | r | - | - |
| | | Pª | - | - |
| | Medium (n=7) | r | 0.440 | 0.319 |
| | | Pª | 0.382 | 0.538 |
| | High (n=23) | r | 0.534 | 0.510 |
| | | Pª | 0.007* | 0.011* |

ªPearson's correlation coefficient. *P<0.05. PCC: Pearson's correlation coefficient; EF-JHD: Exerted force assessed by JHD; PE-H/VAS: Perceived effort rating on horizontal VAS; PE-V/VAS: Perceived effort rating on vertical VAS

*Equation (1)*
   EF-JHD=(9.717×PE-H/VAS)-9.734

*Equation (2)*
   EF-JHD=(9.036×PE-V/VAS)-7.138

In these equations, EF-JHD, PE-H/VAS, and PE-V/VAS represented the 'exerted force assessed by JHD', 'perceived effort rating on horizontal VAS', and 'perceived effort rating on vertical VAS', respectively.

## Discussion

The present study was carried out to determine the effect of subjects' personality traits on their perceived effort assessed by VAS. The mean age of the participants was 27.93±4.97 years. In addition, one-third of the participants (33.3%) were male and 66.7% were female. Besides, the mean score of the participants' IQ was 109.89, which was at the average level based on the current Wechsler IQ classification.[44]

The mean scores of EF-JHD, PE-H/VAS, and PE-V/VAS were 274.30±10.02 (N), 50.19±7.71, and 51.10±8.61, respectively. Based on the results, most of the participants were in the medium level in the 'neuroticism' factor and the high level in other factors of the NEO personality test (i.e., extraversion, openness to experience, agreeableness, and conscientiousness). Moreover, a significant positive correlation was observed between EF-JHD, PE-H/VAS, and PE-V/VAS in the individuals with low levels of 'neuroticism'. This could be attributed to the fact that people with low levels of 'neuroticism' are secure, hardy, and relaxed even under stressful conditions.[45] Considering the participants with medium levels of 'neuroticism', only the correlation between EF-JHD and PE-H/VAS was statistically significant (r=0.469, p=0.037). However, no significant relationship was observed between EF-JHD, PE-H/VAS, and PE-V/VAS among the participants with high levels of 'neuroticism'. This could be because individuals with high levels of 'neuroticism' are sensitive, emotional, and prone to experiencing upsetting feelings.[45] This can, in turn, affect their feelings and perceptions of the surrounding environmental circumstances. Therefore, the use of VAS may not be suitable for these individuals.

The present study findings indicated a significant correlation between EF-JHD, PE-H/VAS, and PE-V/VAS in the participants with medium and high levels of 'extraversion'. In this context, the correlation was highly significant among the participants at medium levels (0.9-1.0), but less significant among those at high levels (0.3-0.5).[46] Chiorri et al. reported that higher levels of 'extraversion' were associated with higher levels of perceived workload.[47] Morgan[48] and Robertson et al.[49] also disclosed that 'extraversion' was inversely related to the rating of perceived exertion (RPE scale). According to these authors, this might be linked with a higher pain tolerance in extroverted people.

The present study results showed higher correlations between EF-JHD, PE-H/VAS, and PE-V/VAS in the participants with high levels of the 'openness to experience' factor compared to those with medium levels of this factor. This could be attributed to the fact that individuals with high levels of this factor are open to new experiences, have broad interests, and are very imaginative.[45] However, the correlation coefficients were negligible (0.0-0.3) in the participants at medium levels and moderate (0.5-0.7) than those at high levels.[46]

The findings of the current study indicated a higher correlation between EF-JHD, PE-H/VAS, and PE-V/VAS among the participants with medium levels of the 'agreeableness' factor compared to others. This correlation was very high in the individuals at medium levels (0.9-1.0), but low among those at high levels (0.5-0.7).[46] In this context, it has been proved that individuals with low levels of 'agreeableness' are hardheaded, skeptical, proud, and competitive and express their anger directly, but people with high levels of 'agreeableness' are compassionate, good-natured, and eager to cooperate and avoid conflict.[45]

The present study findings revealed higher correlations between EF-JHD, PE-H/VAS, and PE-V/VAS in the participants with high levels of the 'conscientiousness' factor compared to others. This could be attributed to the fact that people with high levels of 'conscientiousness' are conscientious and well-organized, have high standards, and strive to achieve goals.[45] The correlation coefficients were low (0.3-0.5) in the participants with medium levels of 'conscientiousness' and moderate (0.5-0.7) among those with high levels of the factor.[46]

The results of Pearson's correlation coefficient showed a significant strong positive correlation between PE-H/VAS and PE-V/VAS (r=0.97, P<0.001). This was in line with the findings of other studies, which indicated that both horizontal and vertical VAS were equally valid measures.[50] This was also in the same line with the findings of the research by Scott and Huskisson, which revealed a correlation coefficient of 0.99 between the vertical and horizontal orientations of VAS.[51]

The results of multiple linear regression analysis demonstrated relationships between EF-JHD PE-H/VAS (r=0.531), and PE-V/VAS (r=0.502). The equations might be used to estimate the exerted force via VAS. The results showed that the rating on the PE-H/VAS was closer to the gold standard (exerted force to the JHD) in comparison to PE-V/VAS. However, close correlations were observed between EF-JHD, PE-H/VAS, and PE-V/VAS. In this regard, some research findings have indicated that the vertical VAS was more sensitive and easier to use by patients, especially by those who were under stress with a narrowed visual field.[8]

The present study findings demonstrated that personality traits (derived from the NEO test) might affect the perceived effort assessed by VAS. In this context, Yadollahi et al. concluded that some personality traits, such as agreeableness, were the predictors of labor pain intensity assessed via the numerical pain-rating scale (NPRS).[52] Furthermore, Chiorri et al. showed that all personality traits, except for extraversion, significantly interacted with at least one workload source (derived from NASA-task load index) among 'flying column police officers'.[47] Zheng et al. also indicated that altruism, neuroticism, and openness dimensions of personality traits significantly affected different Chinese pedestrians' behavioral dimensions.[53] Finally, Li and Yu reported a light relationship between the grip force and subjective hand force exertion assessed by the CR-10 scale (category-ratio scale).[54]

*Strengths and Limitations*

This study was carried out among non-psychiatric students. Therefore, the observed differences did not result from mental disorders, and the findings were most likely because of personality traits on the perceived effort. On the other hand, the results might not be generalized to psychiatric individuals. Moreover, the study followed an experimental design. Thus, the researchers recommend the issue should be addressed in future studies. Also, in the current study, the sample size was small. Therefore, caution should be taken when generalizing the results of the study. Moreover, this study was performed among students. Therefore, the results might not be generalizable to other populations with different age ranges.

## Conclusion

All in all, all personality trait factors (i.e., neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness) could be effective in the perceived effort assessed by VAS. Hence, personality traits are recommended to be considered in assessment of the perceived effort by VAS. Indeed, the results of multiple linear regression analysis revealed moderate relationships between EF-JHD, PE-H/VAS, and PE-V/VAS. Therefore, the equations presented in the 'Results' section of the manuscript might be used to estimate the exerted force via VAS.

## Authors' Contribution

## Acknowledgement

## Funding

This study was financially supported by the National Institute for Medical Research Development (NIMAD) via grant No. 958730.

**Conflict of Interest:** None declared.

## References

1   Flynn D, van Schaik P, van Wersch A. A comparison of multi-item Likert and visual analogue scales for the assessment of transactionally defined coping function. J Psychol Assess. 2004;20(1):49. doi:10.1027/1015-5759.20.1.49.

2   Wewers ME, Lowe NK. A critical review of visual analogue scales in the measurement of clinical phenomena. Res Nurs Health. 1990;13(4):227-36. doi: 10.1002/nur.4770130405. PMID: 2197679.

3   Schwenk W, Mall J, Neudecker J, Müller J. One visual analogue pain score is sufficient after laparoscopic cholecystectomy. Br J Surg. 2002;89(1):114-5. doi: 10.1046/j.0007-1323.2001.01980.x. PMID: 11851675.

4   Van Kampen M, De Weerdt W, Van Poppel H, De Ridder D, Feys H, Baert L. Effect of pelvic-floor re-education on duration and degree of incontinence after radical prostatectomy: a randomised controlled trial. Lancet. 2000;355(9198):98-102. doi: 10.1016/S0140-6736(99)03473-X. PMID: 10675166.

5   O'bichere A, Wilkinson K, Rumbles S, Norton C, Green C, Phillips R. Functional outcome after restorative panproctocolectomy for ulcerative colitis decreases an otherwise enhanced quality of life. Br J Surg. 2000;87(6):802-7. doi: 10.1046/j.1365-2168.2000.01404.x. PMID: 10848862.

6   Bernhard J, Sullivan M, Hürny C, Coates A, Rudenstam C. Clinical relevance of single item quality of life indicators in cancer clinical trials. Br J Cancer. 2001;84(9):1156. doi: 10.1054/bjoc.2001.1785. PMID: 11336464; PMCID: PMC2363885.

7   Sloan JA, Loprinzi CL, Kuross SA, Miser AW, O'Fallon JR, Mahoney MR, et al. Randomized comparison of four tools measuring overall quality of life in patients with advanced cancer. J Clin Oncol. 1998;16(11):3662-73. doi: 10.1200/JCO.1998.16.11.3662. PMID: 9817289.

8   Gift AG. Visual analogue scales: measurement of subjective phenomena. Nurs Res. 1989;38(5):286-7. PMID: 2678015.

9   Hayes M. Experimental development of the graphics rating method. Psychol Bull. 1921;18:98-9.

10  Atiken R. Measurements of feelings using visual analogue scale. Proc R Soc Med. 1969;62:989-93. PMID: 4899510; PMCID: PMC1810824.

11  Flaherty S. Pain measurement tools for clinical practice and research. AANA J. 1996;64(2):133-40. PMID: 9095685.

12  Finch E, Brooks D, Stratford P, Mayo N. Physical rehabilitation outcome measures: a guide to enhanced clinical decision making. 2nd ed. Hamilton, Ont: BC Decker; 2002.

13  Reips UD. How internet-mediated research changes science. In: Barak A, editor. Psychological aspects of cyberspace: Theory, research, applications. Cambridge: University Press; 2008.

14  Bond M, Pilowsky I. Subjective assessment of pain and its relationship to the administration of analgesics in patients with advanced cancer. J Psychosom Res. 1966;10(2):203-8. doi: 10.1016/0022-3999(66)90064-x. PMID: 4165548.

15  Zusman M. The absolute visual analogue scale (AVAS) as a measure of pain intensity. Aust J Physiother. 1986;32(4):244-6. doi: 10.1016/S0004-9514(14)60658-9. PMID: 25025223.

16  De Boer A, Van Lanschot J, Stalmeier P, Van Sandick J, Hulscher JB, De Haes J, et al. Is a single-item visual analogue scale as valid, reliable and responsive as multi-item scales in measuring quality of life? Qual Life Res. 2004;13(2):311-20. doi: 10.1023/B:QURE.0000018499.64574.1f. PMID: 15085903.

17  Lesage F-X, Berjot S, Deschamps F. Clinical stress assessment using a visual analogue scale. Occup Med (Lond). 2012;62(8):600-5. PMID: 22965867.

18  Ueda T, Nabetani T, Teramoto K. Differential perceived exertion measured using a new visual analogue scale during pedaling and running. J Physiol Anthropol. 2006;25(2):171-7. doi: 10.2114/jpa2.25.171. PMID: 16679714.

19  Grant S, Aitchison T, Henderson E, Christie J, Zare S, Mc Murray J, et al. A comparison of the reproducibility and the sensitivity to change of visual analogue scales, Borg scales, and Likert scales in normal subjects during submaximal exercise. Chest. 1999;116(5):1208-17. doi: 10.1378/chest.116.5.1208. PMID: 10559077.

20  Peet M, Ellis S, Yates R. The effect of level of depression on the use of visual analogue scales by normal volunteers. Br J Clin Pharmacol. 1981;12(2):171-8. doi: 10.1111/j.1365-2125.1981.tb01197.x. PMID: 7306432; PMCID: PMC1401874.

21  Torrance GW, Feeny D, Furlong W. Visual analog scales: do they have a role in the measurement of preferences for health states? Med Decis Making. 2001;21(4):329-34. doi: 10.1177/0272989X0102100408. PMID: 11475389.

22  Diener E, Lucas RE. Personality traits. In: Biswas-Diener R, Diener E, editors. Noba textbook series: Psychology. Champaign, IL: DEF publishers; 2018.

23  Goodwin R, Engstrom G. Personality and the perception of health in the general population. Psychol Med. 2002;32(2):325-32. doi: 10.1017/s0033291701005104. PMID: 11866326.

24  Daneshmandi H, Kee D, Kamalinia M, Oliaee M, Mohammadi H. An ergonomic intervention to relieve

musculoskeletal symptoms of assembly line workers at an electronic parts manufacturer in Iran. Work. 2018;61(4):515-21. doi: 10.3233/WOR-182822. PMID: 30475781.

25  Desouzart G, Matos R, Melo F, Filgueiras E. Effects of sleeping position on back pain in physically active seniors: A controlled pilot study. Work. 2015;53(2):235-40. doi: 10.3233/WOR-152243. PMID: 26835867.

26  Erdinc O, Hot K, Ozkaya M. Turkish version of the Cornell Musculoskeletal Discomfort Questionnaire: Cross-cultural adaptation and validation. Work. 2011;39(3):251-60. doi: 10.3233/WOR-2011-1173. PMID: 21709361.

27  Besharati A, Daneshmandi H, Zareh K, Fakherpour A, Zoaktafi M. Work-related musculoskeletal problems and associated factors among office workers. Int J Occup Saf Ergon. 2020;26(3):632-8. doi: 10.1080/10803548.2018.1501238. PMID: 30015596.

28  Daneshmandi H, Choobineh A, Ghaem H, Alhamd M, Fakherpour A. The effect of musculoskeletal problems on fatigue and productivity of office personnel: a cross-sectional study. J Prev Med Hyg. 2017;58(3):252-58. PMID: 29123372; PMCID: PMC5668935.

29  Daneshmandi H, Choobineh A, Ghaem H, Hejazi N. Proper sit–stand work schedule to reduce the negative outcomes of sedentary behavior: a randomized clinical trial. Int J Occup Saf Ergon. 2021;27(4):1039-1055. doi: 10.1080/10803548.2019.1679972. PMID: 31603033.

30  Price DD, McGrath PA, Rafii A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. Pain. 1983;17(1):45-56. doi: 10.1016/0304-3959(83)90126-4. PMID: 6226917.

31  World Medical Association (WMA). World Medical Association Declaration of Helsinki. Retrieved March 15, 2013.

32  Goldberg D. Manual of the general health questionnaire. Windsor: NFER Nelson; 1978.

33  Noorbala A, Mohammad K. The validation of general health questionnaire-28 as a psychiatric screening tool. Hakim. 2009;11(4):47-53.

34  Levine DW, Simmons BP, Koris MJ, Daltroy LH, Hohl GG, Fossel AH, et al. A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome. J Bone Joint Surg Am. 1993;75(11):1585-92. doi: 10.2106/00004623-199311000-00002. PMID: 8245050.

35  Bilker WB, Hansen JA, Brensinger CM, Richard J, Gur RE, Gur RC. Development of abbreviated nine-item forms of the Raven's standard progressive matrices test. Assessment. 2012;19(3):354-69. doi: 10.1177/1073191112446655. PMID: 22605785; PMCID: PMC4410094.

36  Raven JC. Mental tests used in genetic studies: The performance of related individuals on tests mainly educative and mainly reproductive. Unpublished master's thesis, University of London. 1936.

37  Rahmani J. The reliability and validity of Raven's Progressive Matrics test among the studentsof azad Khorasgan university. Knowledge & Research in Applied Psychology. 2008;0(34):61-74.

38  Crossley KM, Bennell KL, Cowan SM, Green S. Analysis of outcome measures for persons with patellofemoral pain: which are reliable and valid? Arch Phys Med Rehabil. 2004;85(5):815-22. doi: 10.1016/s0003-9993(03)00613-0. PMID: 15129407.

39  Costa Jr PT, McCrae RR. Age differences in personality structure: A cluster analytic approach. J Gerontol. 1976;31(5):564-70. doi: 10.1093/geronj/31.5.564. PMID: 950450.

40  McCrae RR, Costa PT. A contemplated revision of the NEO Five-Factor Inventory. Pers Individ Dif. 2004;36(3):587-96. doi:10.1016/S0191-8869(03)00118-1.

41  Haghshenas H. Personality psychology. 2nd ed. Shiraz: Shiraz University of Medical Sciences Publication; 2014.

42  Garousi farshi M. The new approach in personality assessment (Persian). 1st ed. Tabriz: Jameeh; 2001.

43  Hand Grip Dynamometer. 2015. Available from: http://www.biometricsltd.com/hand-grip-dynamometer.htm.

44  Wechsler D. The measurement and appraisal of adult intelligence. 4th ed. Baltimore, MD, US: Williams & Wilkins Co; 1958.

45  Henry J. Creativity and perception in management. 1st ed. The Open University: SAGE Publications Ltd; 2001.

46  Hinkle DE, Wiersma W, Jurs SG. Applied statistics for the behavioral sciences. 5th ed. Boston: Houghton Mifflin; 2003.

47  Chiorri C, Garbarino S, Bracco F, Magnavita N. Personality traits moderate the effect of workload sources on perceived workload in flying column police officers. Front Psychol. 2015;6:1835. doi: 10.3389/fpsyg.2015.01835. PMID: 26640456; PMCID: PMC4661321.

48  Morgan WP. Psychological components of effort sense. Med Sci Sports Exerc. 1994;26(9):1071-7. PMID: 7808238.

49  Robertson R, Noble B. Perception of physical exertion: methods, mediators, and applications. Exerc Sport Sci Rev. 1997;25:407-52. PMID: 9213100.

50  Gift A, Plaut S, Jacox A. Psychologic and physiologic factors related to dyspnea in subjects with chronic obstructive pulmonary disease. Heart Lung. 1986;15(6):595-601. PMID: 3639857.

51  Scott J, Huskisson E. Vertical or horizontal visual analogue scales. Ann Rheum Dis. 1979;38(6):560. doi: 10.1136/ard.38.6.560. PMID: 317239; PMCID: PMC1000420.

52  Yadollahi P, Khormaie F, Makvandi S, Soofi A, Ariashekouh A, Hashemifard T. The relationship

between personality traits and labor pain intensity. International Journal of Community Based Nursing & Midwifery. 2013;1(4):224-9.

53 Zheng T, Qu W, Ge Y, Sun X, Zhang K. The joint effect of personality traits and perceived stress on pedestrian behavior in a Chinese sample. PLoS one. 2017;12(11):e0188153. doi: 10.1371/journal.pone.0188153. PMID: 29190750; PMCID: PMC5708679.

54 Li KW, Yu R. Assessment of grip force and subjective hand force exertion under handedness and postural conditions. Appl Ergon. 2011;42(6):929-33. doi: 10.1016/j.apergo.2011.03.001. PMID: 21439549.