

Exploratory and Confirmatory Factor Analysis of the Jefferson Scale of Empathy among Chinese Medical Students

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Research article

Keywords: the Jefferson Scale of Empathy (students version), exploratory factory analysis, confirmatory factory analysis, Chinese medical students

Posted Date: September 16th, 2019

DOI: <https://doi.org/10.21203/rs.2.14461/v1>

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Abstract

Background: Empathy is critical for medical training, clinical practice, even the future professionalism of medical students. The Jefferson scale of empathy- Students version (JSE-S) was developed for estimating empathy among medical students and it's a psychometrically sound instrument. The purpose of the study is to develop a validated translation of JSE-S that used by Chinese medical students and to confirm the psychometric properties, underlying component and latent variable structure of the Chinese JSE-S. **Methods:** The JSE-S was translated into Chinese based on standardized guidelines. The sample was divided to two parts. The first half of the data was used for exploratory factor analysis (EFA) using principal component analysis(PCA) with oblique rotation(promax), and the latter was used for confirmatory factor analysis(CFA) using structural equation modeling(SEM). **Results:** 749 questionnaires (94.81%) were eligible. Cronbach's alpha coefficient of the JSE-S for the entire sample was 0.89. EFA indicated that three-component solution was acceptable, and the three components are "Perspective Taking", "Compassionate Care" and "Emotional Detachment" respectively. Item 18 was proposed to move to the third factor. CFA indicated that the three-factors model showed an acceptable goodness of fit. **Conclusions:** Reliability and validity of the Chinese JSE-S were satisfactory among Chinese medical students. The results supporting the underlying factor structure of the Chinese JSE-S.

Background

Currently, empathy was widely defined as an ability to perceive another person's internal frame of reference and to appreciate his or her feelings [1]. Some researchers suggested that physician empathy was a cognitive (rather than emotional) attribute that involves an understanding (rather than feeling) of the patient's inner experiences and perspectives, a capacity to communicate, and an intention to help [1, 2]. In fact, it is difficult to define empathy precisely in the context of patient care.

Empathy is usually confused with sympathy. Empathy is expressed consciously in a relationship and involves validation of experiences to ensure the accuracy of understanding and without judgmental bias. However, sympathy is mainly a spontaneous emotional state[3]. That is, the main distinction between "empathy" and "sympathy" is that the former emphasizes physicians share their understanding with their patients while the latter emphasizes physicians share their emotions with their patients [2].

Empathy is critical for medical training [4], clinical practice, even the future professionalism of medical students. It plays an essential role in doctor-patient relationships and has a positive effect on clinical outcomes [5, 6]. In China, the doctor-patient relationship is intense [7]. A great number of studies have shown that the level of empathy of medical students is decreasing with the increase of grade in medical school [8-11]. Many aspects of medical education may lead to a decline in empathy, such as a heavy academic burden, emphasizing the detachment and objectivity of science, and the fragmented doctor-patient relationship that has formed in a hurry [9, 10]. Therefore, empathy should be stressed in the core curriculum to improve the communication skills among medical students.

More and more standardized measurement tools were developed to evaluate the empathy level [12, 13]. Hojat and his teammates have made great contributions to the development of empathy measurement tools for physicians, medical students and other health professionals [1, 2, 14]. Initially, the tool called the Jefferson Scale of Physicians Empathy (JSPE), and now it was named as the Jefferson Scale of Empathy (JSE). The generic version of the scale was originally designed to assess medical students' orientations or attitudes of empathic relationships in the context of patient care [15, 16]. Now JSE is a widely used instrument for evaluating empathy, not only for medical students but also for physicians and other health professionals [2, 17]. Based on different populations, the JSE was categorized into three different versions. The first version named the JSE-Students (JSE-S), the second version named the JSE-Healthcare Professionals (JSE-HP) and the third version named JSE-HPS and it is developed for administration to students of all healthcare professions other than medical students.

The JSE-S covers 20 items and it was identified into three factors, "perspective taking (PT)", with ten items; "compassionate care (CC)", with eight items; and "standing on patients' shoes (SPS)", with two items. The scale has been translated into 45 languages and used in more than 70 countries [18]. Exploratory factor analytic studies of JSE by researchers in many countries have got the three aforementioned factors: Studies of 902 medical students [19] and 613 Taiwan nursing students [20], and another study of 1200 physicians [21] in China, a study of 333 nursing students in America [22], a study of 493 medical students in Korea [23], a study of 1022 medical students in Mexico [24], a study of 299 medical students in Brazil [25], a study of 476 medical students in Portugal [26], a study of 400 medical students in Japan [27] and a study of 181 medical students [28] and another study of 180 physicians [29] in Iran. However, some studies [30, 31] found that the four factors (the original 3-factor model plus a residual factor). And some studies [32, 33] showed that the two factors of PT and CC. A study in England [34] even suggested that "SPS" should be renamed to "emotional detachment".

There are only a few confirmatory factor analytic studies of the JSE. The current research results generally divided the JSE into a two-factor model or a three-factor model. Some studies found that the 3-factor model had a good model fit. One research involved 853 British medical students [34], one research involved 1187 Iranian medical students [35], and one study included 2612 medical students in USA [18] and one study included 1104 Spanish medical students. Conducted by Williams, a 2-factor model was established involving 330 Australian paramedical students [36].

There are a few studies to study JSE (Student-version) in China. The study is aimed to develop a validated translation of JSE-S that may be used by Chinese medical students and to confirm the psychometric properties, underlying component and latent variable structure of the Chinese JSE-S.

Methods

2.1 Design

A cross-sectional study.

2.2 Participants and setting

We performed this study in 2019. Finally, there were 790 medical students that came from different specialties (clinical medicine, nursing, and medical inspection) in the medical school of Wuhan University, Hubei, China. After excluding the unqualified samples, 749 samples were finally retained, the effective response rate was 94.81%. Wuhan University is a comprehensive university in central China. All students were invited to participate voluntarily and anonymously.

2.3 Measures

JSE-Student version (JSE-S) a self-report questionnaire that it was developed to estimate empathy in medical students. The JSE-S was translated into Chinese based on the standardized guidelines which included forward translation, back translation, cultural adaption, and pilot testing [37]. (1) A forward translation was performed by two bilingual psychological teachers. One translator was known of the conceptions in JSE-S while the other was not. Then two teachers combined their translations and ensured that the initial Chinese version of JSE-S matched with the English version in language and culture. (2) Then, the initial Chinese version of JSE-S was backtranslated to English by two other bilingual translators who did not know about the original JSE-S. One back translator is a professor of linguistics and the other one is a senior psychological teacher. Based on the comparison of the backtranslated JSE-S with the original English version, the initial Chinese version of JSE-S was further modified based on the consensus of the four translators. (3) Then, we invited four persons (a professor, a senior psychological teacher, a psychological graduate student and an English teacher majoring in linguistics) to evaluate each item, and expressed their views on the semantics, idioms, experience, concepts and cultural equivalence of the modified Chinese version of JSE-S. (4) In the case of consensus on all projects, a pre-Chinese version of JSE-S was produced. The instrument was administrated to 25 undergraduate medical students from Wuhan University in central China. Group discussion between these students for pretesting was moderated by the authors. All items of the pre-final Chinese version of JSE-S were understandable and not confusing, so JSE-S (Chinese version) was finalized.

We adopted a 5-point Likert scale, so the answer options are divided into five parts: strongly disagree, disagree, neutral, agree, strongly agree. There were 10 positive items whose responses were scored accordingly, from 1 (strongly disagree) to 5 (strongly agree), and 10 reverse items whose responses were scored accordingly, from 5 (strongly disagree) to 1 (strongly agree). The total score was obtained by summing all items (maximum score = 100), where higher values indicated higher degrees of empathetic orientation.

2.4 Procedures

The survey was conducted online, participation in the study was voluntary, and responses were anonymous. We attribute enough sample size to our efforts in calling and encouraging students in a friendly manner to cooperate in the study. Finally, we collected 790 questionnaires, and 749 were completed questionnaires, the effective response rate is 94.81%.

2.5 Statistical Analysis

Cronbach's alpha coefficient was calculated to examine internal consistency reliability, values higher than 0.70 were considered satisfactory. We also used Pearson correlation to examine relationships between scores of each item and the total score of JSE-S. Bartlett's and Kaiser-Meyer-Olkin (KMO) tests were used to determine whether factor analysis was useful for examining the factor structure before performing exploratory factor analysis (EFA). The purpose of performing EFA was to explore the underlying factor structures of JSE-S, principal component analysis (PCA) with oblique rotation (promax) to examine the association between the observed variables (items) and the latent variables (factors). When eigenvalues of each item were greater than one, the retained factors were considered satisfactory [38]. A factor loading value of 0.40 indicates an adequate relationship of each item to the underlying factor [39]. The confirmatory factor analysis (CFA) was performed to verify the construct validity by calculating model-fit indices and standardized factor loadings. For CFA, structural equation modeling (SEM) was used to confirm the latent variable structure of the scale [40]. Maximum likelihood estimation was used. In order to scale the latent variable, the regression coefficient for one item-to-latent variable path for each latent variable was set to 1.0. Model-fit indices including model χ^2 , χ^2/df , comparative fit index (CFI), incremental fit index (IFI), goodness-of-fit index (GFI), Tucker-Lewis index (TLI), root mean square error for approximation (RMSEA) were used for model goodness of fit assessment. Model fit is acceptable if $\chi^2/\text{df} \leq 4.0$ [41], CFI >0.90, IFI >0.90, GFI >0.90, TLI >0.90 and RMSEA <0.06 [42].

Except for the structural equation model, which is calculated using AMOS (version 24.0) were used. All other data analysis was performed by SPSS (version 20.0).

Results

3.1 Demographic characteristic of participants

As shown in Table 1, 749 students made up the sample. There are 337 males (44.99%) and 412 females (55.01%). As for specialties, 552 (73.70%) students majored in clinical medicine, 49 (6.54%) majored in medical inspection and 148 (19.76%) majored in nursing. Of the total sample, 57.81% came from junior grade (the fifth year to the second year), 36.45% from senior grade (the third year to the fifth year) and 5.74% from the school of postgraduate. 477 (63.68%) students had practice experiences. The mean age was 20.67 years old (standard deviation (SD)=1.88 years old) with a range from 17 to 28 years old. Mean score of the JSE-S in this sample was 81.66 (SD= 7.18).

3.2 Item statistics

The possible scores ranged from 0 to 100, and the actual scores ranged from 49 to 100. The quartile of the total score is 76, 81, 89, and 100, respectively. Item mean scores ranged from a low of 3.58 (SD=0.99) for item 8: "For more effective treatment, physicians must be attentive to their patients' personal experiences" to a high of 4.43 (SD=0.62) for item 4: "Understanding body language is as important as verbal communication in the physicianpatient relationship".

3.3 Item-total score correlations

As shown in Table 2, the item-total score correlations ranged from a low of 0.38 (item 1: “Physicians’ understanding of their patients’ feelings and the feelings of their patients’ families is a positive treatment factor”) to a high of 0.76 (item 15: “Empathy is a therapeutic skill without which the physician’s success is limited”). The median item-total score correlation was 0.65. All correlations were positive and significant in statistics ($p < 0.01$), indicating that all items contributed positively to the total score and direction of scoring was true.

3.4 Internal consistency reliability

We calculated Cronbach’s coefficient alpha and the results indicated a satisfactory internal consistency of the scale (Cronbach’s coefficient alpha = 0.89, 95% CI [0.88-0.90]). The Cronbach’s coefficient alpha reliability for items under factor 1 (perspective taking), factor 2 (compassionate care), and factor 3 (“standing on patient’s shoes” replaced by “emotional detachment”) was respectively 0.91 (95% CI [0.89-0.92]), 0.82 (95% CI [0.79-0.84]), and 0.71 (95% CI [0.65-0.76]).

3.5 Exploratory factor analysis

We reaffirmed the underlying components of the JSE-S (Chinese version) by using the exploratory factor analysis. Oblique rotation (promax) was performed to examine if previously reported factor patterns would remain unchanged. We extracted remained 3 factors of the eigenvalue which greater than 1. The Scree test also showed that the plot of the eigenvalues leveled off after extraction of the third factor. The KMO measure was 0.92 and Bartlett’s test was significant at $(0.05, 190) = 3536.02$ ($p < 0.01$), supporting the factorability of the data.

The three-component solution was also extracted as shown in Table 2, and it is slightly different from the previous results [2, 4]. The eigenvalues for the first, second and third retained factors were 7.97, 2.05, and 1.20, respectively. The first component, “Perspective Taking”, including eleven items, accounting for 39.82% of the variance. Ten items (out of 10 items under this factor in Hojat’s research [2]) had a coefficient greater than 0.40 on this factor. The item 20 (“I believe that empathy is an important therapeutic factor in medical treatment”) scored the highest factor coefficient (0.95). The second component, “Compassionate Care”, including seven items, accounted for 10.26% of the variance, and seven items (out of eight items under this factor in Hojat’s research [2]) had a coefficient greater than 0.40 on this factor. Item 18 (“It is acceptable for a physician to be touched by intense emotional relationships between patients and their families”) belonged to factor 2 originally now it was proposed to move to factor 3. The item 14 (“Emotion has no place in the treatment of medical illness”) had the largest factor coefficient (0.80), while the item 11 (“Patients’ illnesses can be cured only by medical or surgical treatment, therefore, physicians’ emotional ties with their patients do not have a significant influence in medical or surgical treatment”) had the lowest factor coefficient (0.44) on factor 2. The third component which was entitled as “Standing on Patient’s Shoes” explaining for 6.01% of the variance, two items of whom (out of two items under this factor in Hojat’s research [2]) had a coefficient greater than 0.40 on

this factor. In addition, item 18 was proposed to move to factor 3. The factor loadings were 0.85 (item 3 “It is difficult for a physician to view things from patient’ perspectives”), 0.84 (item 6 “Because people are different, it is difficult to see things from patients’ perspectives”) and 0.66 (item 18 “It is acceptable for a physician to be touched by intense emotional relationships between patients and their families”), respectively.

3.6 Confirmatory factor analysis

In the light of the modification indices generated by AMOS program [43], correlations between error variances were permitted. The items contained in each factor in different models are shown in Table 3. Based on our results, we compared the original model with a proposed model by Hojat. The model fit indices for original and proposed modes are listed in Table 4. After SEM was performed, the proposed model showed acceptable model fit indices and reached a satisfactory model fit ($\chi^2=411.93$, $\chi^2/df=2.48$, CFI=0.93, IFI=0.93, GFI=0.90, TLI=0.92, RMSEA=0.063). However, the results for original model was $\chi^2=492.41$, $\chi^2/df=2.95$, CFI=0.91, IFI=0.91, GFI=0.88, TLI=0.89, RMSEA=0.072, model fit is less good than the proposed model. Standardized [path coefficients](#) with the original model and the proposed model were shown in Figure 1. The [path coefficient](#) ranged from 0.47 to 0.89 in the proposed model, and all the [path coefficients](#) were statistically significant. Both the χ^2 difference test and the all model fit indices suggest that the proposed model is a better fit than the original model.

Discussion

The results showed that the reliability and validity of the JSE-S were satisfactory in Chinese medical students. Exploratory factor analysis (EFA) verified that the Chinese JSE-S had a three -factors solution of structure, and the findings about pattern of EFA were similar to most other studies in many countries, such as samples for physicians [2] and nurses [22] in America, physicians in Korea [44], Iran [29] and Italy [45], medical students in China [21], Mexico [24], Iran [35], Japan [46], Brazil [25], England [34]. Item-total score correlation was positive and all the correlation were significant in statistics, indicating that the scoring’s direction of all items was correct. Confirmatory factor analysis (CFA) using SEM i showed an acceptable goodness of fit of the three-factors model. We suggested that all 20 items should be maintained. In summary, our results verified the stability of the JSE-S, and Chinese JSE-S as a sound psychometric instrument, it can be used for evaluating empathy in Chinese medical students. That is, it is a good choice to select the JSE-S to measure medical student’s empathy for medical educators. This result is very meaningful for the evaluation of the effectiveness of the empathy curriculum project in Chinese medical university and college.

The distinction between our research and Hojat’s study [18] is that we proposed to move item 18 from the second factor to the third factor. The results were consistent with some previous studies [15, 34]. Two main factors (one major cognitive factor and one emotional factor) and a third trivial factor made up three-factors model. PT is viewed as a crucial ingredient of empathy [2, 6], CC was defined as a combination of empathy and enough degree of sympathy [6] and it was considered as a major dimension

of the doctor-patient relationship [2, 6, 27], and SPS only had two items. According to the results of SEM, we put item 18 and the third factor together. Therefore, in order to describe the content of the third factor more closely, we renamed the third factor from “SPS” to “Emotional Detachment (ED)” [34]. We also observed the distinction for item 18 are consistent with the findings of studies from other countries [15, 34], indicated that the differences may not focus on differences of cultural context. The reason for this distinction as follows, “Empathy” was viewed as a cognitive-emotional unit, the cognitive unit, and the emotional unit influenced each other, rather than as a sum of statistically independent units. Some researchers [26, 47] also point out everyone should take the care when studying the topic, we should focus on the point in the future research.

Limitations

Our sample only contains medical students from the School of Medicine, Wuhan University. Thus, the representativeness may be inadequate. Future research needs more students who are from different regions and different levels of medical colleges in China to participate. In addition, some methodological problems that caused by self-reported measures may influence our findings. We should explore some more accurate method that could reflect the respondents’ experiences and inner thoughts of their empathy.

Conclusions

The JSE-S (Chinese version) showed a satisfactory reliability and validity among Chinese medical students. Three-factors model was proposed and it included perspective taking, compassionate care, and emotional detachment. A sound instrument for evaluating empathy of medical students is very crucial. This model could help medical educators to make an effective project of enhancing empathy among medical students, even practicing physicians.

Declarations

Ethics approval and consent to participate

The ethics committee of Wuhan University School of Medicine (WUSM) reviewed it. In this study, participants did not have direct contact with investigators, and participants were anonymous and voluntary, and the survey did not have adverse psychological and physiological effects on participants, so the consent we obtained from the WUSM was verbal. The informed consent statement is uniformly informed to the students by the life teacher. After all the students in the medical school received the notice, we began to investigate the students who received informed consent. The research is a survey conducted by the Academic Affairs Office of the Medical Department of Wuhan University. The data collected are from the Academic Affairs Office. This study is supported by Wuhan University.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from the Academic Affairs Office of the Medical Department of Wuhan University but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the Academic Affairs Office of the Medical Department of Wuhan University.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable.

Authors' contributions

XyC designed the work, recruited medical students, collected and analyzed data, and wrote the manuscript; L-R, recruited medical students, collected data, and wrote the manuscript; Yh-G recruited medical students, collected data, and wrote the manuscript; YtZ, recruited medical students, collected and analyzed data, and wrote the manuscript; Ww-W, collected and analyzed data; XdT, recruited medical students, invited two English teachers to translate the scale, and revised the manuscript. All authors have read and approved the final manuscript.

Acknowledgments

We thank Prof. Mohammadreza Hojat for his invaluable comments in different stages of the study and we thank the students who completed the survey.

Author's information

Not applicable.

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Tables

Due to technical limitations, the tables have been placed in the Supplementary Files section.

Figures

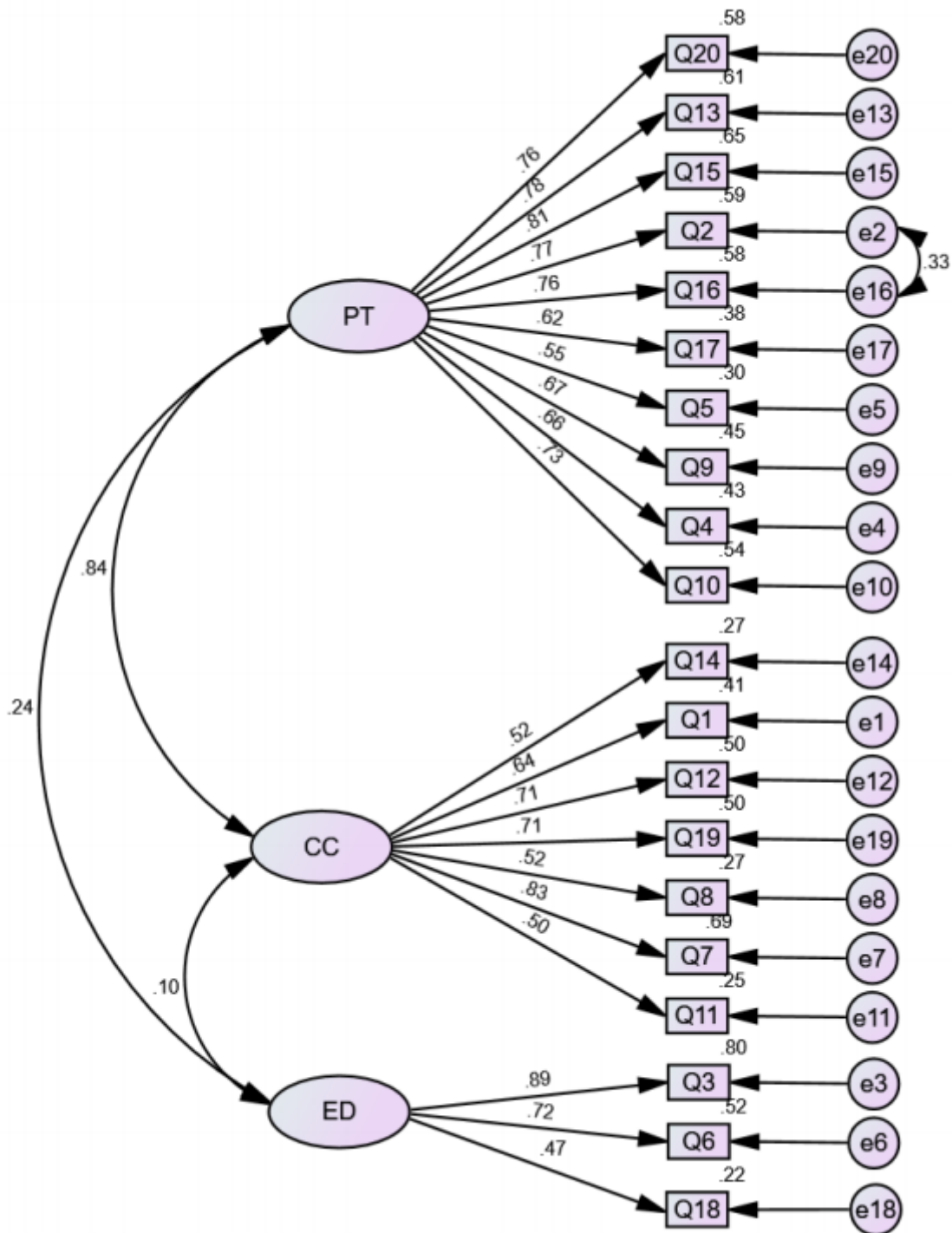


Figure 1

The proposed 20-items model of factorial structure of the JSE-S (n=375)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Tables.pdf](#)