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Comparative Clinical Efficacy and Safety of Botulinum Toxin Type A and Type B in Cosmetic and Medical Applications: A Cross-Sectional Study

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Abstract

Background

Botulinum toxin type A (BoNT-A) and type B (BoNT-B) are widely used for cosmetic and medical indications due to their neuromuscular blocking properties. Although both toxins share a similar mechanism of action, differences in pharmacological characteristics have raised questions regarding their comparative efficacy, safety, and clinical applications. Direct comparative data across multiple outcome measures remain limited, particularly in Middle Eastern populations.

Methods

A comparative cross-sectional study was conducted involving 126 patients who received either BoNT-A or BoNT-B injections for cosmetic (e.g., facial wrinkles) or medical (e.g., hyperhidrosis, migraine, spasticity) purposes. This study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies. Data were collected using a structured electronic questionnaire. Toxin type was verified through medical records and clinic documentation. Outcome measures included incidence and severity of adverse effects, degree of clinical improvement, patient satisfaction, duration of effect, time to onset, and indication type. Statistical analysis was performed using chi-square and Fisher's exact tests, with significance set at $p < 0.006$ after Bonferroni correction for multiple comparisons. Comparative analyses were restricted to participants with documented exposure to a single confirmed toxin serotype (n = 67).

Results

No statistically significant differences were observed between BoNT-A and BoNT-B across any evaluated parameter: incidence of adverse effects ($p = 0.950$, Cramer's V = 0.02), severity of adverse effects ($p = 0.909$, Cramer's V = 0.03), patient satisfaction ($p = 0.870$, Cramer's V = 0.02), duration of effect ($p = 0.791$, Cramer's V = 0.04), degree of clinical improvement ($p = 0.937$, Cramer's V = 0.02), time to onset ($p = 0.821$, Cramer's V = 0.03), or type of indication (cosmetic vs. medical, $p = 0.673$, Cramer's V = 0.05). Both toxin types demonstrated comparable efficacy and safety profiles. The majority of participants (85.7%) received treatment for cosmetic indications. Adverse effects were reported by 31.75% of participants, most commonly mild and transient headache or injection-site pain.

Conclusion

In this cross-sectional study, no statistically significant differences were detected between BoNT-A and BoNT-B across the evaluated outcomes. These findings should be interpreted as exploratory and do not constitute evidence of clinical equivalence. The choice between the two toxins should be guided by

clinical context, practitioner experience, availability, and individual patient factors rather than expectations of substantial differences in therapeutic performance.

Introduction

Botulinum neurotoxins (BoNTs) are among the most potent biological substances known and have become well established as important therapeutic agents in modern clinical practice. Derived from Clostridium botulinum, these neurotoxins act by inhibiting acetylcholine release at the neuromuscular junction, leading to temporary and reversible muscle relaxation. Among the seven identified serotypes (A–G), botulinum toxin type A (BoNT-A) and type B (BoNT-B) are the most extensively studied and clinically utilized formulations [1].

BoNT-A is currently the predominant serotype used worldwide, particularly in aesthetic medicine for the treatment of facial wrinkles and fine lines, in addition to several medical indications such as muscle spasticity, dystonia, chronic migraine, and hyperhidrosis. In contrast, BoNT-B is primarily used in selected therapeutic indications and in patients who develop reduced responsiveness or resistance to BoNT-A, potentially due to neutralizing antibody formation. Although BoNT-B has been explored in limited comparative and cosmetic settings, its use in contemporary aesthetic practice remains considerably less common than that of BoNT-A [2].

Despite sharing a similar mechanism of action, BoNT-A and BoNT-B differ in molecular structure, receptor-binding characteristics, pharmacodynamic properties, onset of action, duration of effect, and adverse effect profiles. Previous studies have reported potential differences between the two serotypes, including a relatively faster onset but shorter duration of action with BoNT-B and a higher frequency of certain autonomic adverse effects such as dry mouth. However, the clinical significance of these findings remains inconsistent across published studies [3].

Although numerous studies have independently evaluated the efficacy and safety of botulinum toxin formulations, direct comparative data examining patient-reported outcomes, safety profiles, and patterns of use in real-world clinical settings remain limited, particularly in Middle Eastern populations. Additional observational evidence may therefore contribute to a better understanding of the clinical performance of both toxin serotypes in routine practice [4].

Accordingly, the present study aimed to evaluate real-world patterns of use, safety, and patient-reported outcomes associated with botulinum toxin type A and type B across cosmetic and medical settings. The evaluated parameters included adverse effects, severity of improvement, patient satisfaction, duration of effect, onset time, and treatment indication [5].

Primary hypothesis: The primary hypothesis of this study was that there would be no statistically significant difference between BoNT-A and BoNT-B in terms of efficacy, safety, and patient-reported outcomes. Given the limited comparative data in our region, this analysis was designed as an exploratory comparative study rather than a confirmatory superiority trial.

Objective

This study aimed to evaluate real-world patterns of use, safety profiles, and patient-reported outcomes associated with botulinum toxin type A and type B in cosmetic and medical settings. The primary variables assessed included the incidence and severity of adverse effects, overall patient satisfaction, duration of effect, degree of clinical improvement, time to onset of effect, and treatment indication (cosmetic versus medical). The study further sought to provide observational data regarding the clinical performance and practical use of both toxin serotypes in routine practice and to explore potential differences in patient-reported outcomes between the two formulations.

Significance

The significance of this study lies in several aspects:

- Enhancing clinical knowledge: Limited observational data are available regarding real-world patterns of use and patient-reported outcomes associated with botulinum toxin type A and type B, particularly in Middle Eastern populations.

- Supporting clinical decision-making: The findings may assist clinicians in understanding the safety profiles, treatment patterns, and practical clinical use of both toxin formulations in routine healthcare settings.

- Improving patient satisfaction: Evaluating factors associated with treatment satisfaction and duration of effect may contribute to optimizing patient care and follow-up strategies.

- Contributing to the literature: This study provides regional observational data that may complement existing international evidence regarding botulinum toxin applications and outcomes.

- Evaluating cosmetic and medical applications: Assessing treatment indications and associated outcomes may provide additional insight into the real-world use of botulinum toxin formulations across cosmetic and therapeutic contexts.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Patients who received botulinum toxin type A or type B injections during the study period.

- Cosmetic cases, including facial and forehead wrinkles, or medical indications such as hyperhidrosis, muscle spasticity, or migraine.

- Availability of adequate clinical follow-up to assess all study variables (adverse effects, degree of improvement, duration of effect).

- Complete medical records allowing accurate classification of variables.

Exclusion Criteria:

- Patients who received other botulinum toxin types (other than A or B).

- Participants with unverified toxin type ("not sure") were excluded from comparative analyses. Participants reporting exposure to both toxin serotypes were retained for descriptive analyses but excluded from direct comparative analyses between BoNT-A and BoNT-B.

- Patients with complex neuromuscular disorders that hinder accurate assessment of improvement.

- Patients with known hypersensitivity to botulinum toxins or previous allergic reactions preventing fair clinical comparison.

- Cases in which follow-up was insufficient to fully assess the duration of effect within the defined evaluation period.

Methods

Study Design

A comparative cross-sectional study design was employed. Patients were selected according to predefined inclusion and exclusion criteria to ensure the accuracy and reliability of the findings. The study was conducted between January 2024 and March 2025. This study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies.

Participant Recruitment and Sampling Strategy

Participants were recruited using a convenience sampling approach from patients attending aesthetic and dermatology clinics in Damascus Governorate. All eligible patients presenting during the study period were invited to participate.

Data Collection

Data were collected using a structured electronic questionnaire distributed to patients attending clinics and cosmetic centers in Damascus Governorate. Collected variables included demographic characteristics (age, sex, occupation), incidence and severity of adverse effects, degree of clinical improvement, patient satisfaction, duration of effect, time to onset of effect, and type of indication (cosmetic versus medical).

Operational definitions for categorical outcome measures:

- Symptom severity: mild / moderate / severe / interfering with daily life.

- Degree of improvement: mild (<25% improvement), moderate (25–50%), marked (51–75%), or complete (>75%).

- Adverse effect severity: mild (no interference with daily activities), moderate (some interference), or severe (significant interference).

A total of 148 questionnaires were distributed electronically. Of these, 126 complete responses met the inclusion criteria and were included in the descriptive analysis, corresponding to a response rate of 85.1%.

Participant flow: Twenty-two questionnaires were excluded because of incomplete responses (n = 14), inability to verify toxin type (n = 5), or failure to meet the predefined eligibility criteria (n = 3). The remaining 126 participants were included in the descriptive analyses. For comparative analyses between BoNT-A and BoNT-B, only participants with documented exposure to a single confirmed toxin serotype were eligible. Participants reporting exposure to both toxin types during different treatment sessions, as well as cases with insufficient toxin classification, were excluded from comparative analyses. Consequently, 67 participants constituted the final analytical sample used for direct comparisons between BoNT-A and BoNT-B (Figure 1).

A STROBE checklist and participant flow diagram were prepared and submitted as supplementary material in accordance with journal requirements.

The type of botulinum toxin administered (type A or type B) was verified using medical records and clinic documentation rather than relying solely on patient self-reporting. All collected data were carefully reviewed and documented to minimize classification errors, duplication, and information bias.

Statistical Analysis

Descriptive statistics and frequency tables were used to present the distribution of study variables. Differences between botulinum toxin type A and type B were analyzed using the chi-square test when all expected cell counts were ≥5; otherwise, Fisher's exact test was applied. Effect sizes were calculated using Cramer's V for all comparisons.

Given the number of comparisons, we applied a Bonferroni correction, setting the significance threshold at $p < 0.006$ (0.05/8).

A post-hoc power analysis indicated that with a comparative analytical sample of 67 participants and an alpha level of 0.05, the study had adequate power to detect moderate effect sizes but remained underpowered to detect small differences between groups.

Missing data were handled using complete-case analysis; no imputation was performed. The number of cases analyzed for each variable is reported in the respective tables.

Multivariable logistic regression was used to assess the independent association between toxin type and each binary outcome, adjusting for age, sex, indication type, and baseline severity. Results are presented in supplementary Table S1.

Stratified analyses by indication type (cosmetic vs. medical) were performed and are presented in supplementary Table S2.

Statistical analysis was performed using SPSS software version 26. A p-value of less than 0.006 was considered statistically significant after Bonferroni correction.

Results

Participant Flow

Figure 1 illustrates the participant flow diagram. Of the 148 questionnaires distributed, 22 were excluded (incomplete responses: n=14; unverified toxin type: n=5; did not meet eligibility criteria: n=3). The remaining 126 participants were included in descriptive analyses. For comparative analyses between BoNT-A and BoNT-B, 59 participants were excluded due to exposure to both toxin types (n=14), insufficient toxin classification (n=45), resulting in a final comparative analytical sample of 67 participants.

Demographic Characteristics

Age Group: The majority of participants were aged 35–50 years (53.97%), followed by the 18–25-year age group (36.51%). This age distribution is consistent with the nature of cosmetic botulinum toxin treatment, as concern for aesthetic appearance increases with age and the onset of early signs of aging. These findings align with previous studies indicating that individuals aged 30–50 years constitute the largest group seeking cosmetic botulinum toxin treatments, with lower demand among younger and older age groups (Table 1).

Sex: The results demonstrated a marked predominance of female participants (97.62%) compared with males (2.38%). This trend reflects prevailing social and cultural norms, whereby cosmetic care is more common among women. These findings are consistent with existing literature indicating that females represent the majority of botulinum toxin users in most global studies (Table 1).

Marital Status: Most participants were married (59.52%), while approximately one-third were single (34.13%) (Table 1). Marital status was included as a sociodemographic characteristic to describe the study population and assess baseline participant distribution rather than to establish causal associations with treatment utilization or outcomes.

Educational Level: The majority of participants had a university-level education (73.81%), and 14.29% held postgraduate degrees (Table 1). Educational level was recorded as part of the demographic profile

of the study population and may reflect differences in health awareness, access to medical care, or healthcare-seeking behavior within the sampled population.

Employment Status: Participants included homemakers (42.06%), self-employed individuals (27.78%), students (10.32%), and government employees (15.08%) (Table 1). Employment status was evaluated as a descriptive demographic variable to characterize the study sample and identify potential differences in healthcare access and treatment utilization patterns.

Treatment Characteristics

Purpose of Treatment: Analysis showed that the majority of participants received botulinum toxin treatment for cosmetic purposes (85.71%), whereas medical indications such as hyperhidrosis and migraine were less frequently reported. These findings suggest that cosmetic indications were more commonly represented within the studied population. Similar distribution patterns have been described in previous studies, in which aesthetic applications constituted the predominant use of botulinum toxin in routine clinical practice (Table 1).

Type of Botulinum Toxin: Although many participants were personally unaware of the exact botulinum toxin formulation administered, toxin classification used for statistical analyses was verified through medical records and clinic documentation. Descriptive analyses included all eligible participants to characterize treatment patterns within the study population. Participants reporting exposure to both toxin serotypes during different treatment sessions were retained in descriptive analyses but were excluded from comparative analyses between BoNT-A and BoNT-B to avoid exposure misclassification. Likewise, cases with unverified toxin type were excluded from comparative comparisons. Comparative statistical analyses therefore included only participants with documented exposure to a single confirmed toxin serotype (Table 1).

Duration of the Condition: Results demonstrated variability in the duration of the condition, with most cases lasting less than one year or between one and three years, and a smaller proportion exceeding seven years. This variability reflects diverse treatment motivations and differing degrees of individual need for cosmetic or medical intervention (Table 1).

Severity of Symptoms Before Treatment: Approximately 45.24% of participants reported moderate symptoms, 32.54% mild symptoms, 17.46% severe symptoms, and 4.76% symptoms that interfered with daily life. This distribution indicates that treatment was applied across a wide spectrum of clinical severity, reflecting the inclusiveness of the study sample (Table 1).

Outcome Measures

Time to Onset of Effect: The time to noticeable treatment effect varied, with the largest proportion reporting onset within 3 days to one week (33.33%). A small subset of participants (3.17%) reported no noticeable improvement. These findings highlight interindividual variability in treatment response, which

may be influenced by factors such as dosage, toxin type, injection site, and individual biological characteristics (Table 1).

Degree of Improvement After Treatment: A substantial proportion of patients experienced marked improvement (46.83%), while 32.54% reported moderate improvement. These results indicate high treatment efficacy and are consistent with global studies documenting high satisfaction and improvement rates following botulinum toxin injections (Table 1).

Adverse Effects: Adverse effects were reported by 31.75% of participants, most commonly headache and pain or swelling at the injection site. The majority of these effects were mild and transient, reflecting the overall safety of botulinum toxin treatment and aligning with existing literature on its safety in both cosmetic and medical applications (Table 1).

Treatment Satisfaction and Continuity: Overall satisfaction was very high, with 58.73% of participants reporting being very satisfied, and the majority (84.13%) indicating an intention to continue treatment. These findings reflect successful fulfillment of patient expectations and are important for future treatment planning and follow-up strategies (Table 1).

Additional Variables: The most common number of treatment sessions was two to three sessions (44.44%), and the most frequently reported duration of effect was three to four months (29.37%). These findings provide valuable data for estimating optimal session scheduling and follow-up intervals for patients (Table 1).

Comparative Analysis Between BoNT-A and BoNT-B

Table 2 summarizes the comparative analysis between BoNT-A and BoNT-B across all outcome variables. No statistically significant differences were observed between the two toxin types for any of the evaluated parameters.

Stratified analyses by indication type (cosmetic vs. medical) showed no statistically significant differences between BoNT-A and BoNT-B within either subgroup (supplementary Table S2).

Multivariable logistic regression adjusting for age, sex, indication type, and baseline severity confirmed that toxin type was not an independent predictor of any outcome (supplementary Table S1).

Discussion

A methodological strength of the present study is that toxin classification was verified using clinical records and clinic documentation rather than relying solely on patient self-reporting, thereby minimizing recall bias and reducing the risk of exposure misclassification [32].

Relationship Between Botulinum Toxin Type and the Occurrence of Adverse Effects

Our study demonstrated no statistically significant difference in the incidence of adverse effects between botulinum toxin type A and type B ($p = 0.950$; Cramer's $V = 0.02$). This finding is consistent with previous clinical studies reporting comparable overall adverse event rates between the two toxin types in therapeutic settings [7,13,18]. Although certain autonomic adverse effects, such as dry mouth, have occasionally been reported more frequently with type B formulations, these differences have not consistently reached statistical significance in comparative studies [7,24]. The present findings therefore support the overall safety profiles of both toxin serotypes within the studied population, aligning with larger systematic reviews that have reported favorable safety profiles for both formulations when administered at recommended doses [8,30] (Table 2).

Relationship Between Botulinum Toxin Type and Severity of Adverse Effects

No statistically significant difference was identified in the severity of adverse effects between botulinum toxin type A and type B ($p = 0.909$; Cramer's $V = 0.03$). Previous evidence suggests that adverse effect severity is more strongly influenced by factors such as injection technique, administered dose, anatomical site, and individual patient sensitivity than by toxin serotype itself [21,22,30]. Accordingly, the current results indicate comparable tolerability profiles for both toxin types in routine clinical practice. These observations are consistent with prospective studies that have found no significant difference in discontinuation rates due to adverse effects between BoNT-A and BoNT-B [13,18] (Table 3).

Relationship Between Botulinum Toxin Type and Overall Patient Satisfaction

Analysis of overall patient satisfaction revealed no statistically significant difference between botulinum toxin type A and type B ($p = 0.870$; Cramer's $V = 0.02$). Patient satisfaction appeared to be more closely associated with perceived clinical improvement, physician expertise, and treatment expectations than with the specific toxin formulation administered [23,28]. These findings are consistent with previous studies reporting high satisfaction rates (typically exceeding 85%) following botulinum toxin treatment regardless of serotype, provided that appropriate dosing and injection techniques are employed [11,22,24]. Since botulinum toxin type A remains the predominant formulation in modern aesthetic medicine [2,17], the current findings should be interpreted as observational real-world data rather than evidence supporting equivalent cosmetic utilization of both toxin serotypes (Table 4).

Relationship Between Botulinum Toxin Type and Duration of Effect

The present study did not demonstrate a statistically significant difference in duration of effect between botulinum toxin type A and type B ($p = 0.791$; Cramer's $V = 0.04$). Although certain studies have suggested that type A may exhibit a relatively longer duration under specific dosing conditions, published findings remain inconsistent [7,24]. Variability in treatment duration may be related to injection technique, dose equivalency, and tissue responsiveness rather than inherent differences between toxin serotypes [4,16,26]. The observed duration of three to four months in the majority of our participants is consistent with the pharmacokinetic profiles reported in the literature for both toxin formulations in cosmetic and medical indications [10,22] (Table 5).

Relationship Between Botulinum Toxin Type and Degree of Clinical Improvement

No statistically significant difference in the degree of clinical improvement was observed between the two toxin types ($p = 0.937$; Cramer's $V = 0.02$). Both formulations demonstrated favorable outcomes across the indications included in this study, with marked or moderate improvement reported in approximately 79% of participants. Existing literature similarly indicates that treatment response is multifactorial and influenced by injection protocol, indication type, and individual biological variability rather than toxin serotype alone [7,16,26]. Given that botulinum toxin type B is primarily used in selected therapeutic contexts—particularly in patients who develop neutralizing antibodies to type A [2,14]—these findings should not be interpreted as evidence of equivalent routine cosmetic application between the two toxin types (Table 6).

Relationship Between Botulinum Toxin Type and Time to Onset of Effect

The results showed no statistically significant difference in time to onset of effect between botulinum toxin type A and type B ($p = 0.821$; Cramer's $V = 0.03$). Previous comparative studies have suggested that type B may demonstrate a slightly faster onset in selected clinical settings; however, these differences are generally modest and often fail to achieve statistical significance [7,24]. Biological and technical factors, including local diffusion, injection characteristics, and dose equivalency, may additionally influence onset time [4,16]. The majority of our participants (33.33%) reported onset within three days to one week, which aligns with the expected timeline described in the literature for both toxin formulations [10,22] (Table 7).

Relationship Between Botulinum Toxin Type and Type of Indication (Cosmetic vs Medical)

No statistically significant association was identified between toxin serotype and indication type (cosmetic versus medical) ($p = 0.673$; Cramer's $V = 0.05$). Within the current dataset, botulinum toxin type A was more commonly encountered overall, particularly in cosmetic settings, whereas type B was primarily observed in selected therapeutic applications. These findings reflect real-world treatment patterns within the studied population and are consistent with published data indicating that BoNT-A accounts for the vast majority of aesthetic botulinum toxin procedures worldwide, while BoNT-B is predominantly reserved for therapeutic indications, particularly in patients with BoNT-A resistance [2,14,24]. These observations should not be interpreted as evidence that botulinum toxin type B is routinely used in contemporary aesthetic practice (Table 8).

Expanded Discussion on Statistical Considerations

The small sizes of certain subgroups (e.g., medical indications) may have limited our ability to detect true differences, increasing the risk of Type II error. Conversely, multiple comparisons may have inflated the risk of Type I error, although the application of Bonferroni correction mitigates this concern. The absence of significant findings should not be interpreted as definitive equivalence. Comparative analyses were restricted to participants with confirmed exposure to a single botulinum toxin serotype.

Exclusion of participants exposed to both toxin types reduced the effective analytical sample size and may have limited the statistical power to detect small differences between groups.

Conclusion

In this cross-sectional study, no statistically significant differences were detected between BoNT-A and BoNT-B across the evaluated outcomes, including the incidence of adverse effects, degree of improvement, patient satisfaction, duration of effect, time to onset, and type of indication.

The present findings support the prevailing trend in the literature that botulinum toxin types A and B generally:

- Exhibit comparable core clinical efficacy without significant differences across multiple variables.

- May show minor variations in parameters such as onset speed or specific adverse effect profiles, but these differences are often not statistically decisive.

- Are selected primarily based on clinical context, practitioner experience, and availability rather than fundamentally different therapeutic effects, except in specific situations such as immunoresistance or prior adverse reactions.

These findings should be interpreted as exploratory and do not constitute evidence of clinical equivalence. Any minor differences reported in individual studies are more likely related to dosing, injection technique, or individual patient response rather than inherent distinctions between the toxin types.

Recommendations

1. Both botulinum toxin type A and type B can be used safely and effectively in medical and cosmetic applications when recommended doses and standard injection techniques are followed.

2. Future studies with larger sample sizes are recommended to detect any subtle differences between the two toxin types and to enable more robust equivalence testing.

3. Future studies should employ larger multivariable models incorporating additional clinical and treatment-related variables to further investigate predictors of treatment outcomes.

4. Long-term follow-up is advised to monitor antibody formation, particularly with type A, and to evaluate its impact on treatment efficacy.

5. Standardized measures of patient satisfaction and clinical improvement should be adopted to enhance comparability across studies and improve the generalizability of results.

Limitations

1. The current sample size (126 cases overall; 67 in the comparative analysis) may have been insufficient to detect subtle differences between botulinum toxin type A and type B. A post-hoc power analysis indicated that the study was underpowered to detect small effect sizes.

2. Interindividual variability in patient response to injections may have influenced clinical outcomes and could not be completely controlled.

3. Limitations in documenting certain subjective variables, such as severity of adverse effects and patient satisfaction, may have introduced measurement bias due to the use of non-validated scales.

4. Although toxin type was verified through medical records and clinic documentation, some participants were unable to identify the administered formulation themselves, reflecting limited patient awareness regarding specific commercial preparations.

5. The relatively short follow-up duration for some participants may have limited the assessment of long-term outcomes, duration of sustained efficacy, and the potential development of antibody-related resistance.

6. The cross-sectional design precludes assessment of causality or long-term outcomes.

7. The reliance on self-reported outcomes may introduce recall and social desirability bias.

8. The extreme gender imbalance (97.6% female) restricts the generalizability of our findings to male populations and to therapeutic indications with different demographic profiles.

9. The use of convenience sampling may introduce selection bias, as participants were recruited from specific clinics and may not represent the broader population of botulinum toxin users.

10. Comparative analyses were restricted to participants with confirmed exposure to a single botulinum toxin serotype. Exclusion of participants exposed to both toxin types reduced the effective analytical sample size and may have limited the statistical power to detect small differences between groups.

Declarations

Author Contributions

Sedra conceptualized the study, analyzed the data, and drafted the manuscript. Asia and Belal supervised the study and critically revised the manuscript. Haidar managed journal correspondence. All authors read and approved the final manuscript.

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Clinical Trial Number

Not applicable.

Declarations

Ethics Approval and Consent to Participate: This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of the Syrian Private University, Damascus, Syria. All participants were informed about the objectives, procedures, potential risks, and benefits of the study. Written informed consent was obtained from all participants prior to enrollment. Participants were also informed of their right to withdraw from the study at any time without any consequences.

Data Availability: The data supporting this study's findings cannot be made publicly available to protect patient confidentiality. However, anonymized or limited data may be shared with qualified researchers subject to approval by the ethics committee. Requests should be directed to the corresponding author's email.

Consent for Publication: Not applicable.

Competing Interests: The authors declare no competing interests.

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Tables

Tables 1 to 8 are available in the Supplementary Files section.

Figures

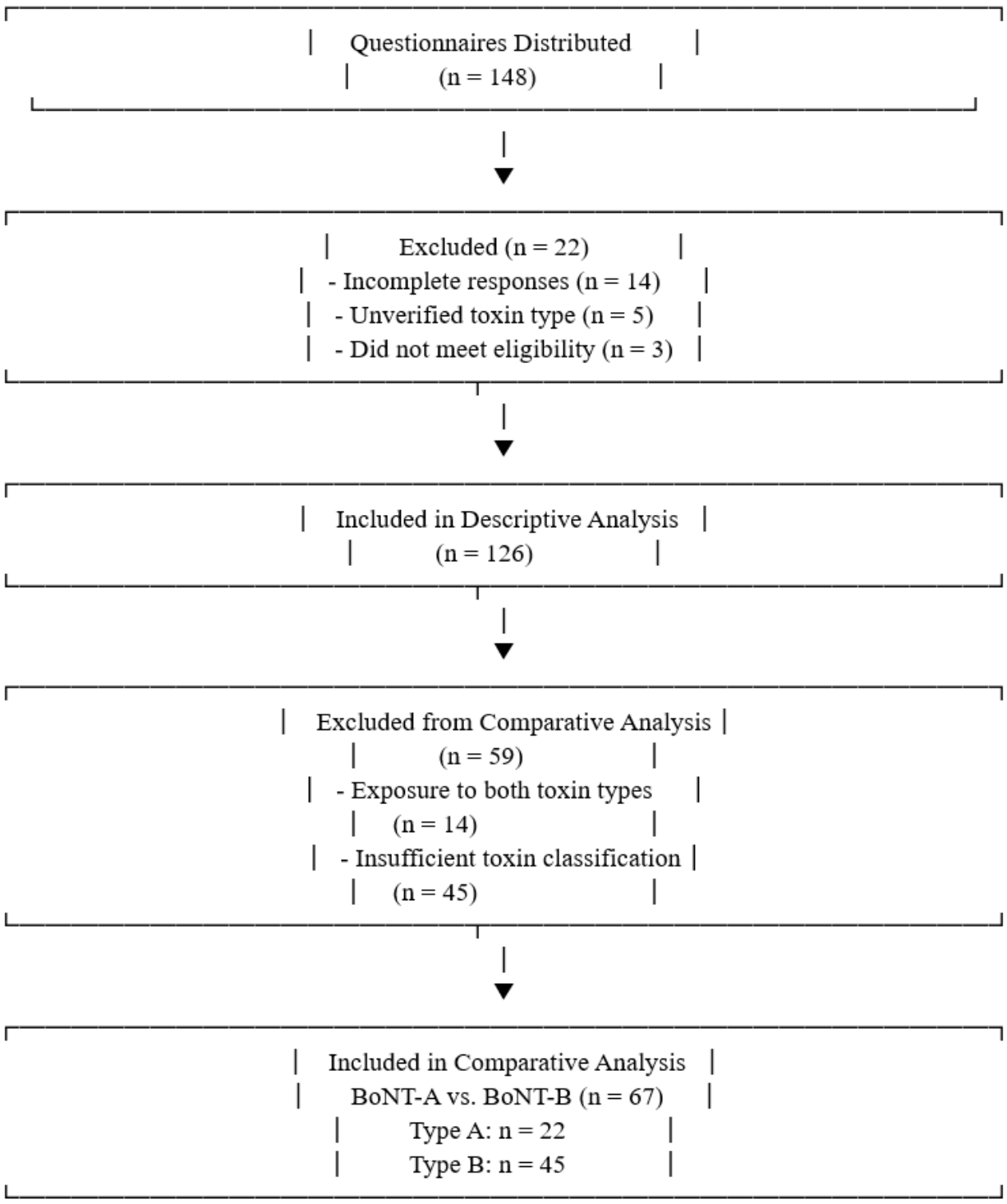


Figure 1

Participant Flow Diagram

Supplementary Files

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

- tableS2.docx
- tableS.docx