

Ear Molding Therapy: Laypersons' Perceptions, Preferences, and Satisfaction with Treatment Outcome

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Background: This study investigates laypersons' perceptions of congenital ear deformities and preferences for treatment, particularly with ear molding therapy—an effective, noninvasive, yet time-sensitive treatment.

Methods: Laypersons were recruited via crowdsourcing to view photographs of normal ears or one of the following ear deformities, pre- and post-molding: constricted, cryptotia, cupped/lopped, helical rim deformity, prominent, and Stahl. Participants answered questions regarding perceptions and treatment preferences for the ear. Statistical analyses included multiple linear and logistic regressions and Wilcoxon signed-rank tests.

Results: A total of 983 individuals participated in the study. All deformities were perceived as significantly abnormal, likely to impair hearing, and associated with lower psychosocial quality of life (all $P < 0.001$). For all deformities, participants were likely to choose ear molding over surgery despite the logistical and financial implications of ear molding (all $P < 0.02$). Participants were significantly more satisfied with the outcome of ear molding in all deformities compared with control, except constricted ears (all $P < 0.002$, except $P_{\text{constricted}} = 0.073$). Concern for hearing impairment due to ear deformity was associated with increased likelihoods of seeing a physician ($P < 0.001$) and choosing ear molding despite treatment logistics and costs (all $P < 0.001$).

Conclusions: Laypersons perceived all ear deformities as abnormal and associated with low psychosocial quality of life. Despite logistical and financial implications, laypersons generally desired molding therapy for ear deformities; treatment outcomes were satisfactory for all deformities except constricted ears. Timely diagnosis of this condition is crucial to reaping the benefits of ear molding therapy. (*Plast Reconstr Surg Glob Open* 2020;8:e2902; doi: [10.1097/GOX.0000000000002902](https://doi.org/10.1097/GOX.0000000000002902); Published online 15 July 2020.)

INTRODUCTION

Congenital auricular deformities refer to architectural anomalies of the newborn's pinna, in which normal auricular components are fully developed yet mechanically

distorted, for example, due to in utero and/or intrapartum compression of the ear.¹ Major types of auricular deformation include cryptotia, prominent, constricted (technically speaking, constricted ears are malformations due to varied degrees of cartilaginous and soft-tissue deficiency but may also have a deformational component^{2,3}), Stahl, cup/lop, helical rim deformities, and combinations of ≥ 2 of these deformities.² Unlike ear malformations, which result from aberrant embryologic development, auricular deformities are not associated with other organogenetic anomalies and thus have excellent prognosis.⁴⁻⁸ However, ear deformities are not “benign.” Several studies indicated poor psychosocial

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The Children's Hospital of Philadelphia has a patent pending for the intellectual property associated with the InfantEar system.

This study was approved by the Institutional Review Board for research at the Children's Hospital of Philadelphia.

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and behavioral outcomes in children with untreated ear deformations and mitigation of such adverse outcomes after correction of the deformity, emphasizing the importance of timely diagnosis and treatment of this condition.^{9–12}

Ear molding offers a noninvasive solution to congenital auricular deformities. Studies have shown that ear molding is safe, effective, and a confers high overall satisfaction among parents.^{13–17} Ear molding in infancy has the added benefit of preventing the need for, and the potential complications of, surgical otoplasty.¹³ However, to be effective, ear molding therapy must begin within the first few weeks of life, when high circulating levels of maternal estrogen render the auricular cartilage malleable.^{14,18–20} Hence, the cornerstone of this treatment modality remains early recognition of ear deformities and timely initiation of therapy, both of which rely heavily on parents’ judgment and perceived need for treatment, as well as recommendations made by frontline medical professionals who examine the infants early on in their lives.

Limited evidence existed in the current literature regarding laypersons’ perceptions of various types of ear deformity and differences in the perceived need for treatment. Aspects of ear molding therapy that deter parents from seeking and initiating treatment for their children remain unknown. This study aims to address these literature gaps by gathering public opinions using a crowdsourcing platform (Amazon’s Mechanical Turk; Amazon.com, Inc., Seattle, Wash.).

PATIENTS AND METHODS

Participants

Lay participants were recruited via Amazon’s Mechanical Turk (Amazon.com, Inc.). Inclusion criteria included ≥18

years of age, currently living in the United States, and lifetime task approval rating of >95%. After a participant with a unique Mechanical Turk account completed the survey, the survey would no longer be listed as available to that account, preventing repeated completion. Each participant was compensated \$0.25 for completing the survey according to established guidelines.²¹

Subjects of Observation

For each of the following auricular deformities—(1) constricted, (2) cryptotia, (3) cup/lop, (4) helical rim, (5) prominent, and (6) Stahl—we identified 3 patients with mild, moderate, and severe deformity; a total of 18 patients with auricular deformities were included. Clinical severity was determined by the senior authors of this study. All patients included were treated with the InfantEar neonatal ear molding system (TalexMedical, Villanova, Pa.) at our institution between 2016 and 2018. Pre- and postmolding photographs of the affected ears and 2 photographs of a completely normal ear—for a total of 38 images—were subjects of observation for the study. Because the photographs included only the patient’s ear without face, head, or any identifying features, the Institutional Review Board for Research at the Children’s Hospital of Philadelphia granted an exemption for the study.

Survey

Surveys were built and administered electronically on REDCap (Vanderbilt University, Nashville, Tenn.), a secure web instrument for developing and managing online surveys and databases. All survey forms asked the same questions (Fig. 1), but presented different ear types. Each participant randomly received only one survey form, which

The figure displays three pages of a survey form.
 Page 1 (left): Titled 'Ear Survey', it includes a photo of an ear and questions 1-12. Question 1 asks about the abnormality of the ear on a scale of 1-10. Question 2 asks about the likelihood of hearing impairment. Questions 3-12 are Likert scales from 'Highly unlikely' to 'Highly likely'. Question 13 asks about doctor preferences.
 Page 2 (middle): Titled 'Confidential', it includes questions 4-12 and 16. Questions 4-12 are Likert scales. Question 16 asks about the cost of non-surgical treatment.
 Page 3 (right): Titled 'Confidential', it includes question 13, two photos of ears (before and after treatment), and questions 14-16. Question 14 asks about satisfaction with the result. Question 15 asks about insurance coverage. Question 16 asks about the likelihood of avoiding surgery later in life.
 The survey is administered on REDCap, as indicated by the logo at the bottom of each page.

Fig. 1. Example of a survey form. Each participant viewed one and only survey corresponding to a single type of ear deformity. Numerical values for multiple-choice ordinal responses are the following: questions 3–12 and 16—highly unlikely = 1, highly likely = 5; question 14—highly unsatisfied = 1, highly satisfied = 5.

Table 1. Statistical Analysis Details

Objective	Statistical Analysis	Details
Verifying laypersons' responses to the normal control ear	One-proportion z tests One-sample Wilcoxon signed-rank tests	<ul style="list-style-type: none"> • Comparing proportions of binary responses with a null proportion of 0.5 • Bonferroni-method–corrected P values for multiple comparisons • Comparing nonbinary ordinal outcomes with the following null responses: <ul style="list-style-type: none"> ◦ $\mu_o = 5$, for the 10-level abnormality item ◦ $\mu_o = 3$ (“Neutral”), for the 5-level items • Bonferroni-method–corrected P values for multiple comparisons
Defining latent variables underlying survey items	Exploratory factor analysis	<ul style="list-style-type: none"> • Mixed correlation matrix was created with Pearson, polychoric, tetrachoric, and biserial correlations of all 16 items of the survey. • Factorability of survey items was examined with: <ul style="list-style-type: none"> ◦ Kaiser–Meyer–Olkin test, using a measure of sampling adequacy cut-off of 0.60 ◦ Bartlett test of sphericity • No. factors were determined using parallel analysis. • Extraction method: MinRes²³ • Rotation method: oblique (direct oblimin)²⁴ • Variables with factor loadings equal to or greater than the recommended cut-off of 0.710 were linearly combined by addition to create new, latent variables.^{*25,26}
Investigating differences in laypersons' responses to different ear types	Multiple regressions Tukey honest significance test	<ul style="list-style-type: none"> • Multiple regressions controlling for: <ul style="list-style-type: none"> ◦ Participant's age, sex, and parental status (for all survey items) ◦ Additionally, participant's concern for hearing impairment (for treatment decision items only, which included questions 8–13 and 15–16) • Types of regression: <ul style="list-style-type: none"> ◦ Linear regressions for factor analysis-derived latent outcomes ◦ Binary logistic regressions for dichotomous outcomes ◦ Ordinal logistic regressions for single-item ordinal outcomes • Post hoc pairwise comparisons among ear types with respect to each outcome • Correcting for family-wise error rate
Assessing laypersons' tendency to treat ear deformities, relative to the “neutral” response	One-sample Wilcoxon signed-rank test	<ul style="list-style-type: none"> • Comparing responses to treatment preference items (questions 8–12, 14, and 16), with the neutral response ($\mu_o = 3$) • Bonferroni-method–corrected P values for multiple comparisons

*Latent variables are unobservable variables that are not directly measured but are constructed mathematically to explain the commonality of a set of related observable variables.²⁷

MinRes, minimum residual.

showed either (1) one pair of images (pre- and post-ear molding) for 1 of the 6 congenital auricular deformities or (2) a “control” pair of images of a completely normal ear. These forms were not listed on Mechanical Turk. Instead, Mechanical Turk pseudorandomized and redirected participants to a single arm of the survey on REDCap, preventing any participant from completing >1 arm. After providing age, sex, and parental status, participants answered 16 questions regarding perceptions and treatment preferences for the presented ear (Fig. 1); completion of all questions was required to submit the survey. Questions 3–7 were based on components of the Derriford Appearance Scale 59.²² Derriford Appearance Scale 59 is a validated questionnaire used to assess psychologic distress and daily life dysfunction due to appearance-related problems. The questionnaire demonstrated high internal consistency, test–retest reliability, and sensitivity to postoperative changes in the treatment of facial conditions, rendering itself suitable for the objectives of this study.²²

Statistical Analysis

Table 1 presents the details of the statistical analysis. Statistical analyses were performed using 1-proportion z tests; 1-sample Wilcoxon signed-rank tests; exploratory factor analysis; multiple linear, binary logistic, and ordinal logistic regressions; and Tukey honest significance test.^{23–27} Corrections for multiple comparisons were applied. All significance levels were 2-tailed and set at 0.05. R Studio 1.2 (The R Foundation for Statistical Computing, Vienna, Austria) was used for statistical analysis.

RESULTS

Descriptive Statistics for Demographics and Responses of Participants

A total of 983 Amazon's Mechanical Turk respondents participated in the study. Median age of participants was 34 years (Q1 = 29, Q3 = 39 years). Of all participants, 389 (39.6%) were men and 594 (60.4%) were women; 428 (43.5%) respondents were parents. Regarding ear type, 51 (5.2%), 157 (16.0%), 154 (15.7%), 157 (16.0%), 156 (15.9%), 154 (15.7%), and 154 (15.7%) participants completed surveys on normal, constricted, cryptotia, cup/lop, helical rim deformity, prominent, and Stahl ears, respectively. Tables 2 and 3 present descriptive statistics for demographic factors and responses to survey questions of participants looking at different ear types.

Responses to Normal Control Ear

Responses to normal control ear were listed in Table 2. Participants viewing the normal ear rated it on Likert-type scales as normal appearing [median abnormality score (Q1, Q3) = 1 (1, 3); scale = 1–10; $\mu_o = 5$; $P < 0.001$] and unlikely to subject the infant to bullying, embarrassment, unattractive feelings, difficulty making friends, or social anxiety (all median scores = 1; scale = 1–5; $\mu_o = 3$; $P < 0.001$ for all). Significantly fewer participants had concern about hearing impairment for the normal ear (5 participants, 9.8% versus 46 participants, 90.2%; $P < 0.001$).

On 5-level Likert-type scales, participants reported to be unlikely to seek treatment for the normal ear, choose nonsurgical treatment, begin ear molding early, use ear molding device continuously for 4–6 weeks, visit a provider

Table 2. Descriptive Statistics for Interval and Ordinal Survey Items: Median, Q1, and Q3

	Scale	Normal, Median (Q1, Q3)	Constricted, Median (Q1, Q3)	Cryptotia, Median (Q1, Q3)	Cup/Lop, Median (Q1, Q3)	Helical Rim, Median (Q1, Q3)	Prominent, Median (Q1, Q3)	Stahl, Median (Q1, Q3)
Age	Ratio	33 (28, 36)	33 (29, 39)	35 (30, 40)	33 (29, 39)	34 (28, 38)	34 (30, 38)	34 (30, 39)
Level of ear abnormality	1–10	1 (1, 3)	6 (4, 8)	5 (4, 7)	6 (4, 7)	6 (4, 7)	5 (3, 7)	5.5 (3.25, 7)
Likely to be bullied	1–5	1 (1, 2)	4 (3, 4)	4 (3, 4)	4 (2, 4)	4 (2, 4)	3 (2, 4)	4 (2, 4)
Likely to feel embarrassed	1–5	1 (1, 1.5)	4 (3, 4)	4 (3, 4)	4 (3, 4)	4 (3, 4)	3 (2, 4)	4 (3, 4)
Likely to feel unattractive	1–5	1 (1, 1.5)	4 (3, 4)	4 (3, 4)	4 (3, 4)	4 (3, 4)	3 (2, 4)	4 (3, 4)
Difficult to make friends	1–5	1 (1, 1)	3 (2, 4)	2 (2, 3)	2 (1, 3)	2 (2, 3)	2 (1, 3)	2 (2, 3)
Likely to have social anxiety	1–5	1 (1, 1)	4 (3, 4)	3 (2.25, 4)	3 (2, 4)	3 (2, 4)	3 (2, 4)	3 (2, 4)
Likely to seek treatment	1–5	1 (1, 1)	4 (3, 5)	4 (3, 4)	4 (2, 5)	3 (2, 4)	3 (2, 4)	3 (2, 4)
Likely to choose nonsurgical treatment	1–5	1 (1, 3)	4 (4, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)
Likely to begin ear molding early	1–5	1 (1, 3)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (2, 4)
Likely to accept continuous device use for 4–6 wk	1–5	1 (1, 3)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)
Likely to accept biweekly device adjustment	1–5	1 (1, 3)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (3, 5)
Satisfaction level with ear molding outcome	1–5	3 (3, 4)	4 (3, 5)	5 (4, 5)	5 (4, 5)	5 (4, 5)	5 (4, 5)	5 (3, 5)
Likely to pay \$2500 out-of-pocket for ear molding	1–5	2 (1, 3)	4 (3, 5)	4 (3, 5)	4 (3, 5)	4 (2, 5)	4 (2.25, 5)	4 (2.25, 5)

Q1, first quartile; Q3, third quartile.

Table 3. Descriptive Statistics for Binary Survey Items: Number and Percentage of Participants with a Particular Response When Observing Each Ear Type

	Normal, n (%)	Constricted, n (%)	Cryptotia, n (%)	Cup/Lop, n (%)	Helical Rim, n (%)	Prominent, n (%)	Stahl, n (%)
Being a parent	28 (54.9)	88 (56.1)	98 (63.6)	96 (61.1)	88 (56.4)	78 (50.6)	79 (51.3)
Male gender	21 (41.2)	59 (37.6)	67 (43.5)	67 (42.7)	58 (37.2)	63 (40.9)	54 (35.1)
Concern for hearing impairment (Yes/maybe)	5 (9.8)	117 (74.5)	100 (64.9)	65 (41.4)	76 (48.7)	84 (54.5)	64 (41.6)
Consulting a dentist	0 (0)	2 (1.3)	2 (1.3)	3 (1.9)	3 (1.9)	2 (1.3)	1 (0.6)
Consulting a pediatrician	30 (58.8)	86 (54.8)	79 (51.3)	92 (58.6)	88 (56.4)	83 (53.9)	82 (53.2)
Consulting a plastic surgeon	22 (43.1)	85 (54.1)	87 (56.5)	85 (54.1)	97 (62.2)	66 (42.9)	84 (54.5)
Consulting an otolaryngologist	38 (74.5)	122 (77.7)	103 (66.9)	114 (72.6)	111 (71.2)	112 (72.7)	107 (69.5)
Choosing ear molding without complete insurance coverage	11 (21.6)	105 (66.9)	123 (79.9)	106 (67.5)	102 (65.4)	86 (55.8)	92 (59.7)

biweekly to adjust device ($\mu_0 = 3$; $P < 0.001$ for all), and pay \$2500 out-of-pocket for ear molding ($\mu_0 = 3$; $P = 0.022$). Participants felt “neutral” about the sham outcome of ear molding (in which pre- and posttreatment photographs are identical) for the normal ear ($\mu_0 = 3$; $P = 1$). Significantly fewer participants were willing to pay for ear molding without complete insurance coverage for the normal ear (11 participants, 21.6% versus 40 participants, 78.4%; $P < 0.001$). Number of participants who did and did not choose to see a plastic surgeon for the normal ear did not significantly differ from each other (22 participants, 43.1% versus 29 participants, 56.9%; $P = 1$).

Exploratory Factor Analysis of Latent Constructs Underlying Survey Responses

Supplemental Digital Content 1 presents the correlation plot for survey question responses (see figure, Supplemental Digital Content 1, which displays the correlations between responses to survey questions regarding perceptions and treatment preferences for congenital ear deformities, <http://links.lww.com/PRSGO/B432>). Because Kaiser–Meyer–Olkin measure of sampling adequacy was 0.86 (greater than the cut-off of 0.60) and Bartlett test of sphericity was significant [$\chi^2(171) = 1.38 \times 10^4$; $P < 0.001$], survey items were considered reasonably factorable. Exploratory factor analysis revealed 2

significant latent variables. The first latent variable consisted of (1) being bullied, (2) feeling embarrassed, (3) feeling unattractive, (4) difficulty making friends, and (5) having social anxiety (factor loadings = 0.855, 0.932, 0.931, 0.722, and 0.850, respectively; $R^2 = 0.958$). This latent variable likely represented predicted psychosocial problems related to ear deformity. The second latent variable consisted of (1) willingness to seek early nonsurgical treatment, (2) willingness to use ear molding device continuously for 4–6 weeks, and (3) willingness to see a physician biweekly for device adjustment for up to 4–6 weeks (factor loadings = 0.926, 0.908, and 0.957, respectively; $R^2 = 0.969$). This latent variable likely depicted the willingness to treat ear deformity nonsurgically with ear molding despite treatment logistics. Other survey items either did not load into any factors or had factor loadings lower than the cut-off of 0.710.

Laypersons’ Perceived Levels of Appearance, Functional, and Psychosocial Impacts by Type of Congenital Ear Deformity

Regarding appearance abnormality, after controlling for participant’s age, parental status, and sex, all 6 types of congenital ear deformity—constricted, cryptotia, cup/lop, helical rim, prominent, and Stahl—were perceived as significantly more abnormal-appearing than normal control

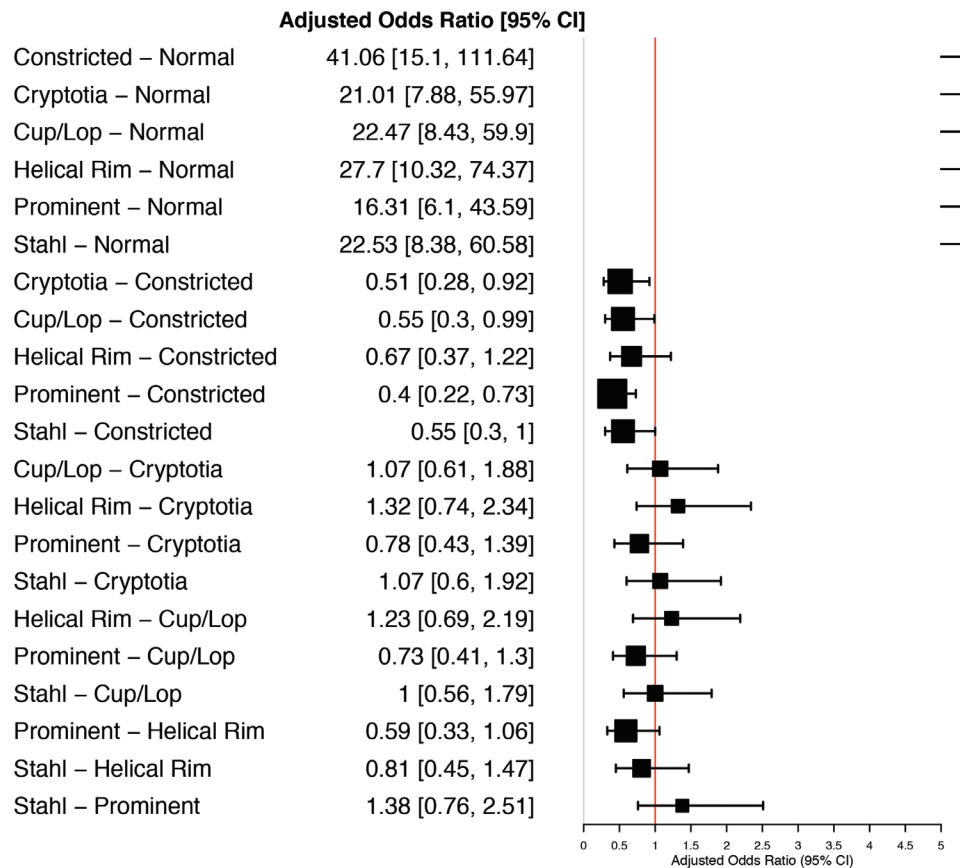


Fig. 2. Pairwise comparisons between different ear types with respect to perceived level of abnormality after controlling for participant’s age, parental status, and sex. CI, confidence interval.

ears [Fig. 2; adjusted odds ratio (AOR) = 16.31–41.06; $P < 0.001$ for all]. Pairwise comparisons between 6 ear types showed that constricted ears appeared significantly more abnormal than did cryptotia, cup/lop, or prominent ears (AOR = 1.95, 1.83, and 2.52; $P = 0.013$, $P = 0.04$, and $P < 0.001$, respectively). There existed no other significant pairwise differences in perceived level of abnormality by type of deformity ($P > 0.05$).

Regarding hearing impairment, laypersons were more likely to associate all types of deformity with hearing impairment compared with normal-appearing ears (Fig. 3; $P < 0.001$ for constricted, cryptotia, helical rim, and prominent deformities; $P = 0.003$ for cup/lop and Stahl ears). Children with constricted ears were deemed significantly more likely to have hearing impairment than those with cup/lop, helical rim, prominent, or Stahl deformity (Fig. 3; AOR = 4.25, 3.10, 2.50, and 4.14; $P < 0.001$, $P < 0.001$, $P = 0.004$, and $P < 0.001$, respectively). Cryptotia was more likely perceived to involve hearing impairment than cup/lop or Stahl deformities [AOR = 2.64 (1.32–5.28) and 2.57 (1.28–5.18); $P = 0.001$ for both].

Regarding psychosocial adversity, which comprised 5 domains of being bullied, feeling embarrassed, feeling unattractive, having social anxiety, and having difficulty making friends, all types of deformity were associated with significantly higher predicted levels of psychosocial problems compared with normal ears (Fig. 4; $P < 0.001$

for all). Children with prominent ears were perceived to experience significantly lower levels of psychosocial problems than those with constricted, cryptotia, cup/lop, or Stahl ears (Fig. 4; adjusted mean difference = -2.80, -1.98, -1.81, and -1.74; $P < 0.001$, $P = 0.006$, $P = 0.017$, and $P = 0.027$, respectively).

Laypersons’ Treatment Preferences and Satisfaction Level with the Outcome of Ear Molding Therapy

Participants generally rated higher than “neutral” in terms of treatment tendencies and satisfaction with ear molding outcome (Tables 2, 4). Prominent, Stahl, and helical rim deformities uniquely did not elicit a higher-than-neutral tendency to seek treatment (Table 4).

Laypersons were significantly more likely to see a physician and discuss treatment options for all types of ear deformity compared with normal ears (Fig. 5; $P < 0.001$ for all). However, laypersons were not more likely to see a plastic surgeon for any type of deformity than for normal ears (Fig. 6; $P > 0.3$ for all). Pairwise differences in treatment tendencies and choice of plastic surgeons existed among several ear types (Figs. 5, 6).

Regarding laypersons’ preference for nonsurgical treatment, both before and after being informed of the logistics of ear molding therapy (early initiation, treatment duration, and device adjustment), participants were significantly more likely to choose ear molding for all types

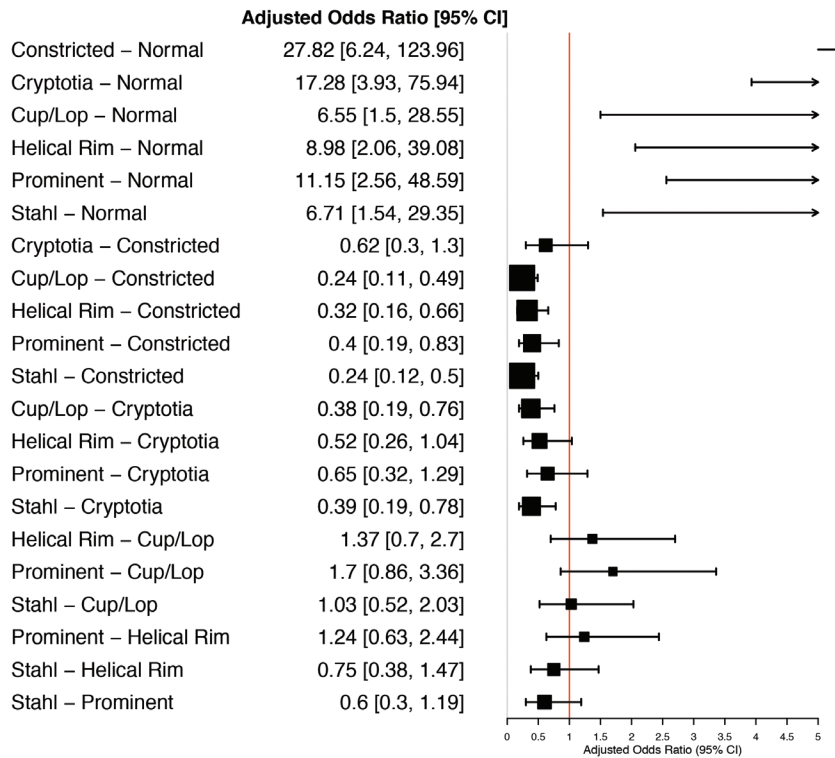


Fig. 3. Pairwise comparisons between different ear types with respect to concern for hearing impairment after controlling for participant’s age, parental status, and sex. CI, confidence interval.

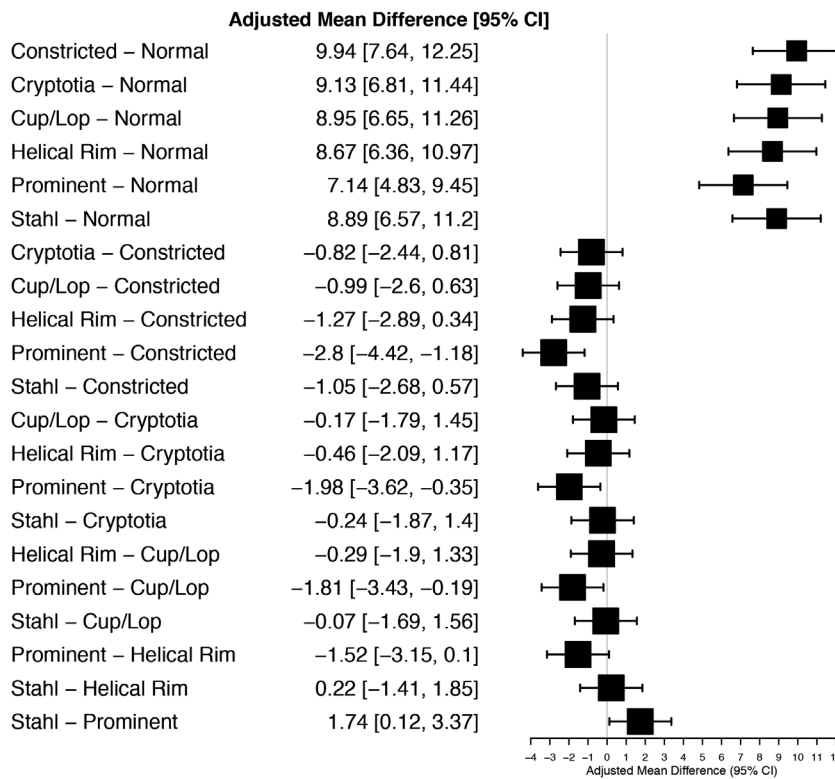


Fig. 4. Pairwise comparisons between different ear types with respect to predicted psychosocial quality of life after controlling for participant’s age, parental status, and sex. CI, confidence interval.

Table 4. Corrected P Values for 1-sample Wilcoxon Signed-rank Tests Comparing Responses to Treatment Preference Items with the “Neutral” Response ($\mu_0 = 3$; scale = 1–5)

	Constricted	Cryptotia	Cup/Lop	Helical Rim	Prominent	Stahl
Likely to seek treatment	<0.001*	0.002*	0.012*	1	1	1
Likely to choose nonsurgical treatment	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
Likely to begin ear molding therapy early	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.016*
Likely to accept continuous device use for 6–8 wk	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.009*
Likely to accept biweekly device adjustment	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.002*
Satisfied with ear molding outcome	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
Likely to pay \$2500 out-of-pocket for ear molding	<0.001*	<0.001*	<0.001*	0.001*	<0.001*	<0.001*

*Statistically significant at an α level of 0.05.

of ear deformity than for controls (Figs. 7, 8; $P < 0.001$ for all). However, no significant pairwise differences existed between different deformity types (Figs. 7, 8).

Regarding satisfaction level with ear molding outcome, laypersons were significantly more satisfied with the outcomes for 5 out of 6 deformity types—cryptotia, cup/lop, helical rim, prominent, and Stahl—compared with controls (Fig. 9; AOR = 4.04, 4.75, 4.05, 3.48, and 3.06; $P < 0.001$ for all). Treatment outcome for constricted ears trended toward, yet failed to achieve, a significant level of cosmetic satisfaction compared with controls [AOR = 2.13 (0.96–4.72); $p = 0.073$]. Pairwise comparisons between deformity types showed a significantly lower satisfaction level for constricted ears compared with cryptotia, cup/

lop, or helical rim deformity (Fig. 9; AOR = 0.53, 0.45, and 0.53; $P = 0.039, 0.004, \text{ and } 0.037$, respectively).

Regarding the financial implications of ear molding therapy, participants were significantly more likely to opt for this treatment for all types of deformity compared with controls, despite having incomplete insurance coverage (Fig. 10; $P_{\text{prominent}} = 0.035, P_{\text{Stahl}} = 0.003, P_{\text{constricted}} = 0.002$, and $P < 0.001$ for cryptotia, cup/lop, and helical rim deformities) or having to pay \$2500 out-of-pocket per ear for this treatment (Fig. 11; $P \leq 0.001$ for all). Participants displayed a higher tendency to choose ear molding for cryptotia compared with prominent or Stahl deformities in the event of incomplete insurance coverage [AOR = 2.90 (1.33–6.31) and 2.23 (1.02–4.89); $p = 0.001$ and

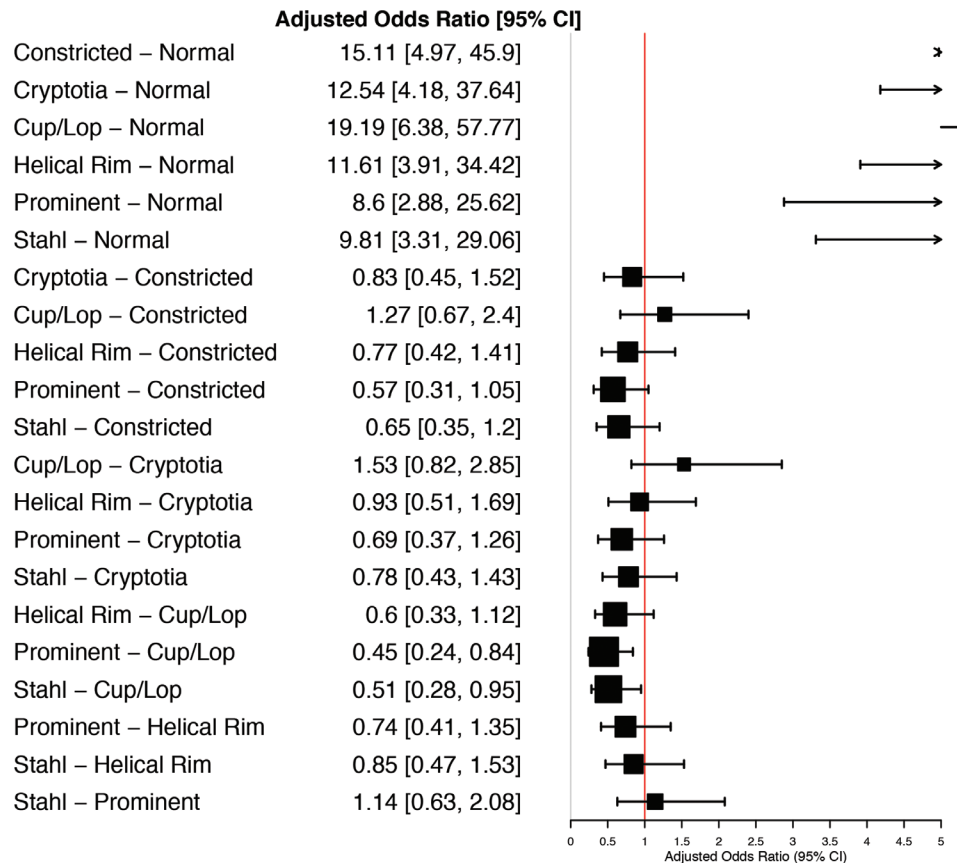


Fig. 5. Pairwise comparisons between different ear types with respect to willingness to seek treatment after controlling for participant’s age, parental status, sex, and concern for hearing impairment. CI, confidence interval.

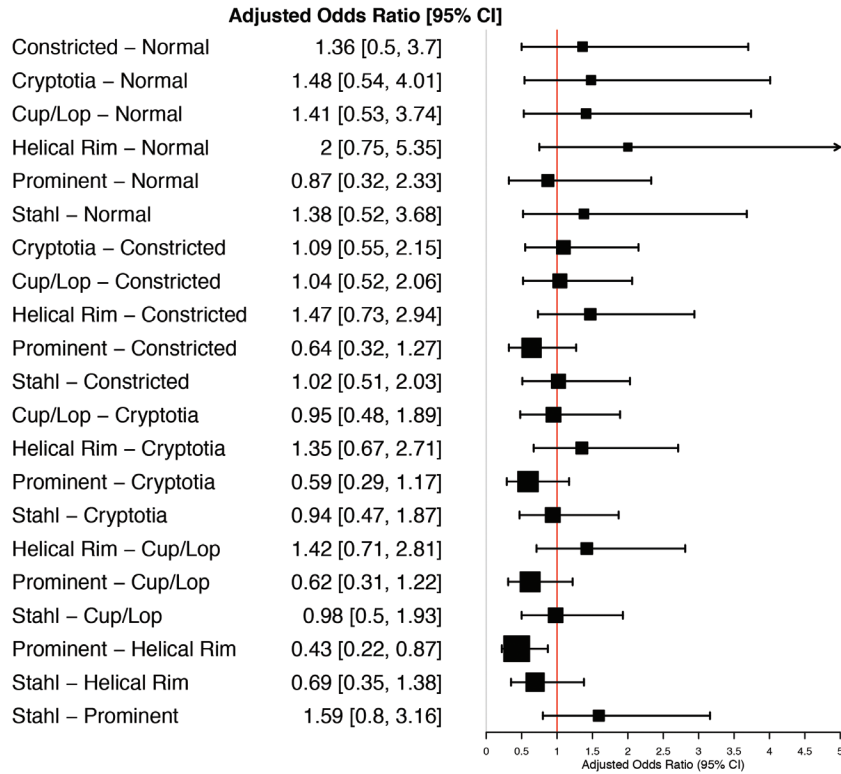


Fig. 6. Pairwise comparisons between different ear types with respect to willingness to consult a plastic surgeon for treatment options after controlling for participant’s age, parental status, sex, and concern for hearing impairment. CI, confidence interval.

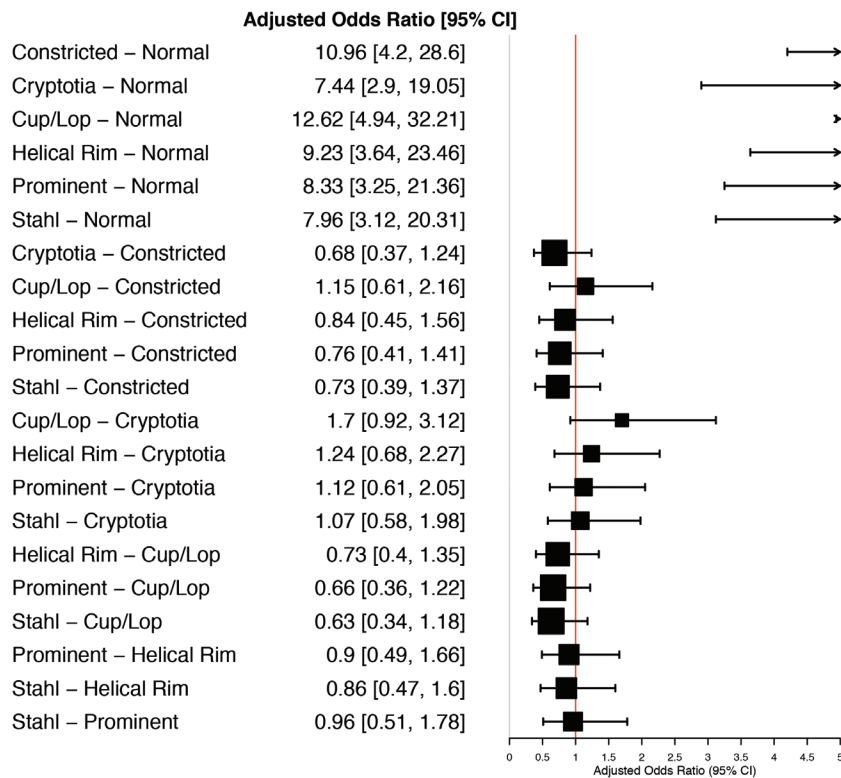


Fig. 7. Pairwise comparisons between different ear types with respect to participant’s willingness to choose nonsurgical over surgical treatment after controlling for participant’s age, parental status, sex, and concern for hearing impairment. CI, confidence interval.

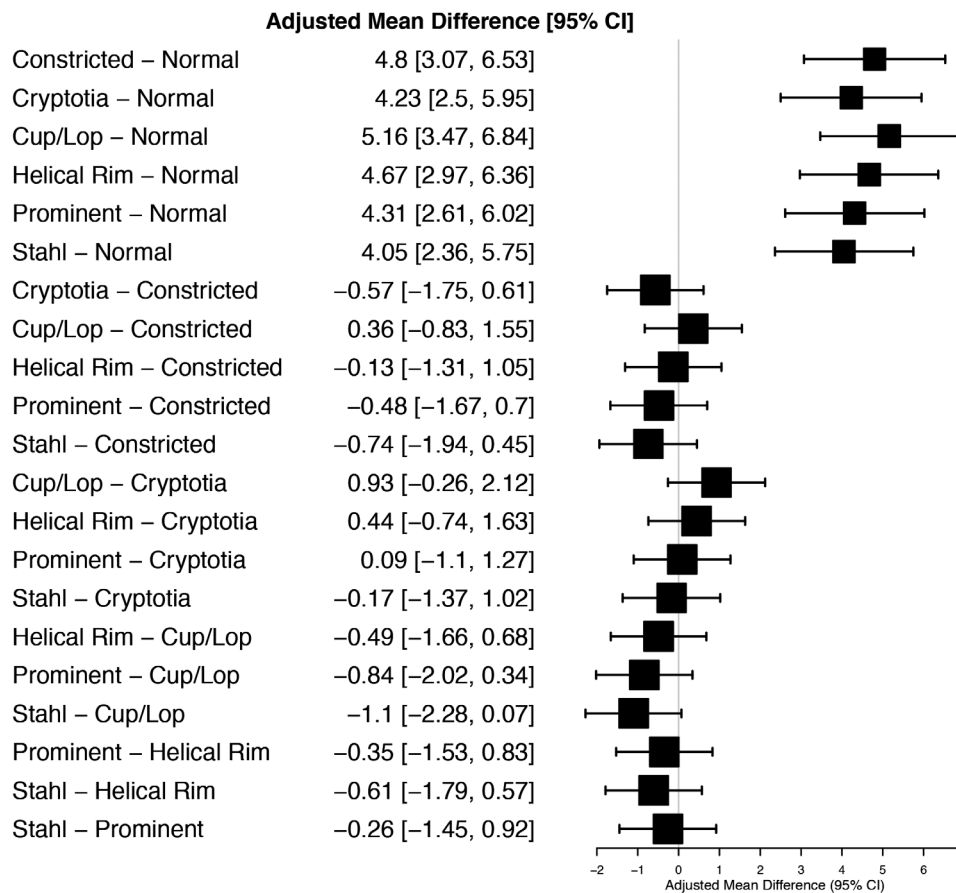


Fig. 8. Pairwise comparisons between different ear types with respect to participant’s willingness to choose ear molding given the logistics of treatment after controlling for participant’s age, parental status, sex, and concern for hearing impairment. CI, confidence interval.

0.04, respectively]. Pairwise, the willingness to pay \$2500 out-of-pocket per ear for molding therapy did not significantly differ among the 6 types of deformities ($P > 0.1$ for all).

Participant’s demographic factors had variable effects on perceptions and treatment preferences for ear deformities, whereas concern for hearing impairment was strongly associated with greater desires to treat (Table 5).

DISCUSSION

Despite the physiologic benignity of congenital auricular deformities, our results indicate that laypersons perceived all types of auricular deformity as abnormal appearing and likely to interfere with hearing and psychosocial quality of life. Furthermore, different deformity types seemed to influence these perceptions to different extents, with constricted ears on the more severe end and prominent ears on the milder end of the spectrum. The relatively higher public-perceived severity of constricted ears, though interesting, did not surprise us. Constricted ears have both deformational and malformational components, given their cartilaginous and soft-tissue deficiencies—particularly in Tanzer type IIB and above.^{2,3} In contrast, other ear types have adequate cartilage, soft tissue, and skin, and primarily suffer from conformational

distortion.² The malformational element may explain the greater abnormality of constricted ears in the layperson’s eyes. However, which features of the malformation aggravated layperson’s perceptions about constricted ears remain to be investigated.

Treatment and timeliness of treatment cannot be understated in congenital ear deformities. Consistent with lay perceptions about the psychosocial impact of this condition discovered in the current study, untreated ear deformities have been associated with low self-esteem, social isolation, mood disorders, and behavioral problems.^{11,28} Up to 88% of affected individuals reported to be teased about their appearance, predominantly at school.²⁸ With the downtrending age at the start of schooling, children with untreated ear deformities are subject to stigmatization by peers at even earlier ages.²⁹ Previous studies showed that correction of the deformity significantly improved psychosocial outcomes and interestingly, improved these outcomes to greater extents when performed at younger ages.^{9,11,28} Therefore, treatment of congenital ear deformities not only proves effective at mitigating stigma-related psychosocial issues, but also warrants being done early to minimize exposure to stigmatization and residual psychosocial problems later in life.

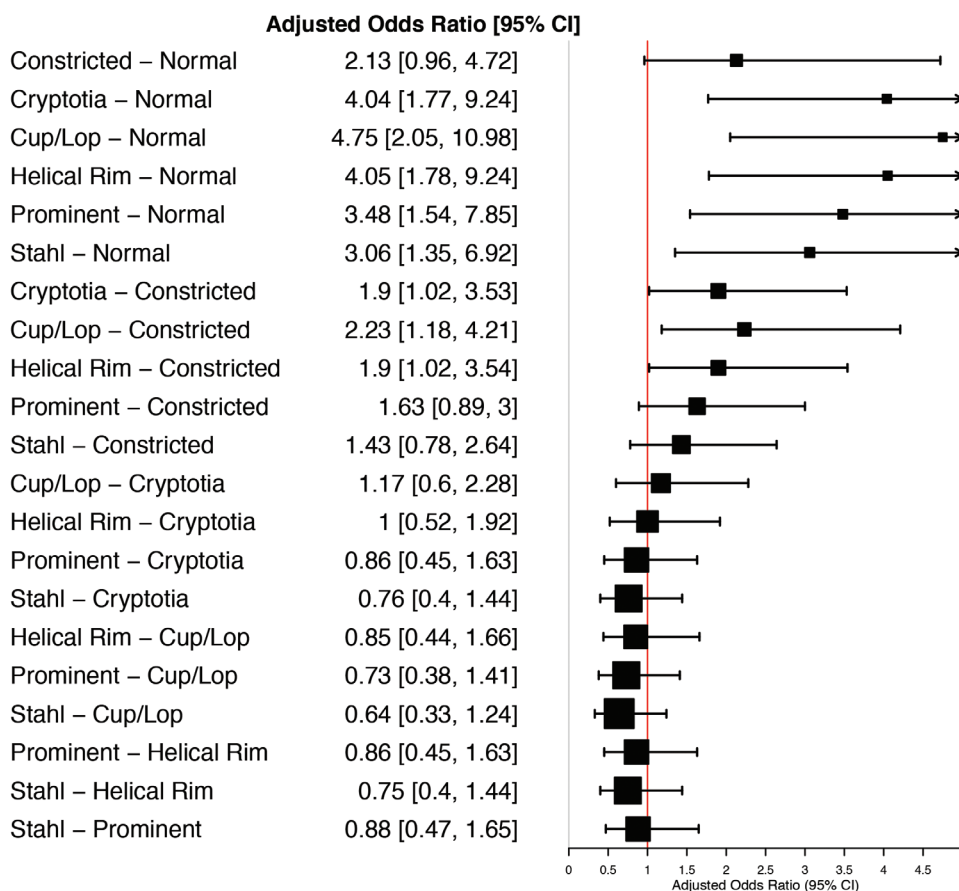


Fig. 9. Pairwise comparisons between different ear types with respect to level of satisfaction with the outcome of ear molding after controlling for participant’s age, parental status, sex, and concern for hearing impairment. CI, confidence interval.

In addition, early diagnosis and intervention are crucial to reaping the advantages of ear molding therapy. Noninvasive treatment for congenital ear deformities must be initiated within a brief window of time after birth. Even though no consensus has been established on the upper limit for age at ear molding initiation—with most recommendations ranging from 1 week to 3 months after birth—studies to date concurred that the earlier ear molding is started, the higher success rate is achieved, and the shorter treatment duration is required.^{13,14,19,30–32} If this short window of time for utilizing ear molding is missed, patients may need to undergo surgical otoplasty if they later desire to correct the auricular deformity. Surgical otoplasty, while also an effective treatment for congenital auricular anomalies that can be done in patients of older ages, has higher rates of residual deformity and complications compared with ear molding.^{13,14,33}

Concordant with their perceptions of all congenital ear deformities as abnormal, participants demonstrated a significantly greater tendency to discuss treatment options with physicians for all types of deformity compared with both the “neutral” response and the normal ear. Interestingly, our data show that plastic surgeons were not the layperson’s physicians of choice for ear deformities. This finding has an important implication: medical professionals

other than plastic surgeons should be equipped with up-to-date knowledge about the natural course of this condition and treatment options to make timely diagnosis and recommendations. Contrary to previous popular beliefs, congenital ear deformities spontaneously resolved in only 30% of cases.¹⁴ Waiting for spontaneous resolution risks missing the golden window for nonsurgical treatment and increasing residual stigma-based psychosocial impacts for the other 70% of patients. Plastic surgeons should make conscious efforts to educate and raise awareness on the importance of early intervention for congenital ear deformities. Simultaneously, laypersons’ belief that auricular deformations are associated with abnormal hearing indicates a knowledge gap that necessitates the role of pediatric providers in proactively educating and reassuring families about the functional significance of this condition to reduce caregiver’s level of stress.

Level of satisfaction with ear molding outcome was significantly higher than both the “neutral” response and the normal control for all types of deformities, except for constricted ears, which failed to differ from normal control in terms of treatment satisfaction. Constricted ears were also associated with significantly lower posttreatment satisfaction compared with cryptotia, cup/lop, and helical rim deformities. As discussed previously, constricted ears have both

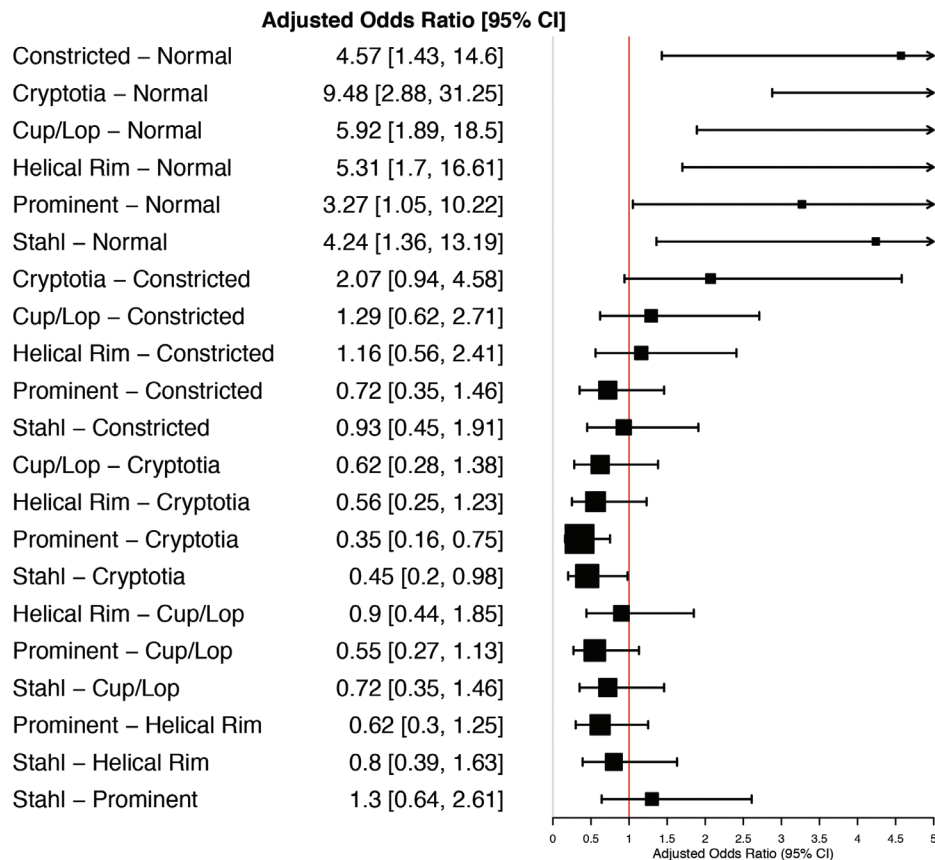


Fig. 10. Pairwise comparisons between different ear types with respect to willingness to choose ear molding without complete insurance coverage after controlling for participant’s age, parental status, sex, and concern for hearing impairment. CI, confidence interval.

deformational and malformational components. Ear molding effectively corrects the former but not the latter, resulting in overall less satisfactory results.^{2,15,16} The partial effect of molding therapy on constricted ears suggests a potential role for “adjuvant” or “neoadjuvant” auricular molding, in which ear molding is used to minimize the complexity and invasiveness of surgical otoplasty for cases unlikely to be addressed adequately with a molding-only approach.

Nevertheless, our data show that for all types of deformity, laypersons were more likely to choose nonsurgical treatment, accept the logistics of ear molding, and pay up to \$2500 out-of-pocket per ear for molding therapy, relative to both normal ears and the “neutral” response. Given the psychosocial consequences of untreated auricular deformities, the high-utility, low-risk profile of ear molding, the time-sensitive nature of treatment initiation, and laypersons’ interest in this therapeutic modality when given the information, we highly encourage increasing public awareness and education about congenital ear deformities and the option of ear molding treatment, as well as implementing pathways to accelerate diagnosis and facilitate timely intervention. A 2012 pilot study by the Mayo Clinic aimed at identifying congenital ear deformities during newborn hearing screening exemplified such a pathway.³⁴

Our study has several limitations. First, the photographs contained exclusively ears and no other parts of the head

and face. Although using single-element stimuli minimizes confounding and effect modification, these visual stimuli do not accurately reflect how observers look at subjects in real life. Second, our study provides an understanding of the lay public’s perceptions, which may not represent the actual experience that patients with ear deformities have. Third, posttreatment outcomes in this study did not account for variations in device, technique, and practitioner; hence, outcome-related results should be generalized with caution. Fourth, due to the already extensive nature of the main study outcomes, we did not investigate the influence of demographic factors, such as being parents of children with ear deformities and household income, on the primary endpoints. We speculate that having children with ear deformities would raise the threshold for abnormality. An unpublished study from our group on layperson perceptions of positional plagiocephaly found that parents who do or do not have children with disabilities tended to have normalized perceptions of moderately and severely plagiocephalic infant heads, supporting our speculation about the responses of parents of children with ear deformities.³⁵ Higher income may increase the willingness to pay for ear molding treatment, as suggested by health economics literature.^{36,37} Nevertheless, future studies should confirm these hypotheses. Finally, even though Amazon Mechanical Turk provides a robust and

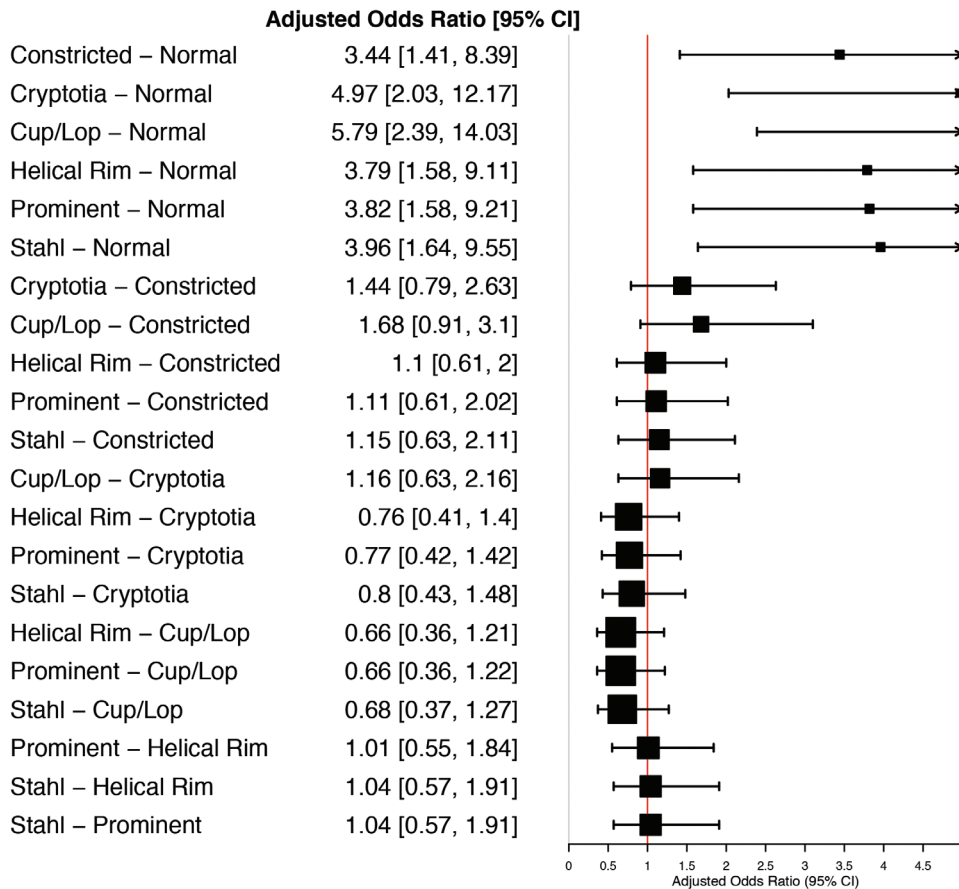


Fig. 11. Pairwise comparisons between different ear types with respect to willingness to choose ear molding after being informed of the estimated cost of treatment after controlling for participant’s age, parental status, sex, and concern for hearing impairment. CI, confidence interval.

Table 5. Influences of Participant’s Age, Sex, Parental Status, and Concern for Hearing Impairment on Perceptions and Treatment Preferences

	Higher Age		Being a Parent		Female Gender		Concern for Hearing Impairment	
	AOR (95% CI)	P	AOR (95% CI)	P	AOR (95% CI)	P	AOR (95% CI)	P
Level of abnormality	1.00 (0.98–1.02)	0.834	1.18 (0.94–1.50)	0.159	0.80 (0.64–1.00)	0.055	—	—
Concern for hearing impairment	1.00 (0.98–1.02)	0.860	0.91 (0.69–1.21)	0.526	0.70 (0.53–0.92)	0.011*	—	—
Poorer psychosocial quality of life†	0.01 (–0.01 to 0.03)	0.512	0.15 (–0.12 to 0.43)	0.284	–0.22 (–0.49 to 0.04)	0.100	—	—
Seeking treatment	1.03 (1.01–1.05)	0.001*	1.29 (1.01–1.65)	0.040*	0.93 (0.73–1.17)	0.521	3.47 (2.71–4.45)	<0.001*
Choosing nonsurgical treatment	1.02 (1.00–1.04)	0.045*	1.00 (0.78–1.28)	0.989	1.35 (1.06–1.71)	0.013*	1.35 (1.06–1.72)	0.016*
Choosing ear molding despite logistics†	0.05 (0.01–0.1)	0.019*	0.09 (–0.50 to 0.68)	0.762	0.39 (–0.19 to 0.96)	0.185	1.61 (1.03–2.20)	<0.001*
Consulting a plastic surgeon	1.04 (1.02–1.07)	<0.001*	0.83 (0.63–1.09)	0.188	1.17 (0.90–1.53)	0.250	1.12 (0.86–1.47)	0.403
Satisfied with ear molding outcome	1.02 (1.00–1.04)	0.066	0.91 (0.70–1.17)	0.447	1.32 (1.03–1.68)	0.026*	—	—
Choosing ear molding without complete insurance coverage	1.03 (1.01–1.05)	0.012*	1.09 (0.81–1.46)	0.570	0.83 (0.62–1.10)	0.201	2.10 (1.58–2.80)	<0.001*
Paying \$2500 out-of-pocket for ear molding	1.03 (1.01–1.05)	<0.001*	1.04 (0.82–1.33)	0.726	1.03 (0.82–1.31)	0.791	1.65 (1.30–2.10)	<0.001*

*Statistically significant at an α level of 0.05.

†Adjusted mean difference and the corresponding 95% CI were computed and reported instead of adjusted odds ratio. CI, confidence interval.

cost-effective method of subject recruitment for a number of research areas, including plastic surgery, readers should keep in mind that Mechanical Turk samples do not necessarily accurately represent the intended population.^{38–44} Mechanical Turk samples tend to be of younger age, higher education, and lower income compared with the general US population.⁴⁵ Hence, results from this study must be generalized to the general population with caution, as demographic differences may bias responses. However, the most likely alternative would be convenience samples such as college samples, which are even less diverse and less representative than Mechanical Turk and most likely would not be as cost-effective and robust in terms of sample size.⁴⁵ Therefore, we believe that Mechanical Turk, while not a magic bullet, stood out as the optimal recruitment method for this study.

CONCLUSIONS

Laypersons perceived all 6 congenital ear deformities as abnormal and likely to cause adverse psychosocial outcomes. Despite the logistical and financial implications of ear molding therapy, the general public favored this treatment option over surgery and deemed its outcome satisfactory, except for constricted ears. Early identification and referral for treatment are crucial to reaping the benefits of this noninvasive yet highly effective therapy.

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