International Journal of
Environmental Research and Public Health

MDPI

Article

Kinesiophobia and Pain Intensity Are Increased by a Greater Hallux Valgus Deformity Degree- Kinesiophobia and Pain Intensity in Hallux Valgus

Patricia Palomo-López [1], Ricardo Becerro-de-Bengoa-Vallejo [2], Marta Elena Losa-Iglesias [3], Daniel López-López [4], David Rodríguez-Sanz [2], Carlos Romero-Morales [5], César Calvo-Lobo [2,*] and Victoria Mazoteras-Pardo [2]

1 University Center of Plasencia, Universidad de Extremadura, 10600 Badajoz, Spain; patibiom@unex.es
2 Facultad de Enfermería, Fisioterapia y Podología, Universidad Complutense de Madrid, 28040 Madrid, Spain; ribebeva@ucm.es (R.B.-d.-B.-V.); davidrodriguezsanz@ucm.es (D.R.-S.); vmazoter@ucm.es (V.M.-P.)
3 Faculty of Health Sciences, Universidad Rey Juan Carlos, 28922 Alcorcon, Spain; marta.losa@urjc.es
4 Research, Health and Podiatry Group, Department of Health Sciences, Faculty of Nursing and Podiatry, Universidade da Coruña, 15403 Ferrol, Spain; daniellopez@udc.es
5 Faculty of Sport Sciences, Universidad Europea de Madrid, Villaviciosa de Odón, 28670 Madrid, Spain; carlos.romero@universidadeuropea.es
* Correspondence: cescalvo@ucm.es

Received: 1 December 2019; Accepted: 16 January 2020; Published: 18 January 2020

check for updates

Abstract: Background: Hallux valgus (HV) has been previously associated with psychological disorders. Thus, the purposes of this study were to associate kinesiophobia and pain intensity with HV deformity degrees, as well as predict kinesiophobia and pain intensity based on HV deformity and demographic features. Methods: A cross-sectional study was carried out recruiting 100 subjects, who were divided into HV deformity degrees, such as I-no HV (n = 25), II-mild (n = 25), III-moderate (n = 25), and IV-severe (n = 25) HV. Kinesiophobia total and domains (activity avoidance and harm) scores and levels were self-reported by the Tampa Scale of Kinesiophobia (TSK-11). Pain intensity was self-reported by the numeric rating scale (NRS). Results: Statistically significant differences ($p < 0.01$; $\eta^2 = 0.132$–0.850) were shown for between-groups comparison of kinesiophobia total and domain scores (activity avoidance and harm) and levels, as well as pain intensity among HV deformity degrees. Post hoc comparisons showed statistically significant differences with a large effect size ($p < 0.05$; $d = 0.85$–4.41), showing higher kinesiophobia symptoms and levels and pain intensity associated with greater HV deformity degrees, especially for III-moderate and/or IV-severe HV deformity degrees versus I-no HV and/or II-mild deformity degrees. Both statistically significant prediction models ($p < 0.05$) for kinesiophobia ($R^2 = 0.300$) and pain intensity ($R^2 = 0.815$) were predicted by greater HV deformity degree and age. Conclusions: Greater kinesiophobia symptoms and levels and pain were associated with higher HV deformity degrees, especially severe and/or moderate HV with respect to no and/or mild HV. The kinesiophobia and pain intensity were predicted by greater HV deformity degree and age.

Keywords: chronic pain; hallux valgus; musculoskeletal diseases; psychology

1. Introduction

The affectation of the toe body region may comprise up to 14% of the non-traumatic primary care consultations of the foot and ankle, being hallux valgus (HV) considered as one of the 10 most commonly documented non-traumatic conditions [1]. This condition may reach a prevalence of up to 23% in adults, showing an increase in female sex or higher age distribution [2]. HV may be defined as a complex deformity of the 1st metatarsophalangeal joint composed of great toe lateral drift and linked to joint subluxation [3]. Indeed, HV may impair quality of life related to foot health, increase depression, and alter muscle or connective tissue morphology of the plantar region, which seems to be linked to its degree of deformity [4–7].

Several psychological disorders, such as depression or sociability and vigor linked to general health-related quality of life alterations, have been associated with musculoskeletal conditions, which may increase with greater age ranges [8–13]. In addition, musculoskeletal disorders of the lower limbs may alter body stability, showing a greater instability in older adults [14–16]. Combining both factors, kinesiophobia and pain intensity seem to play a key role in musculoskeletal disorders prognosis [17–19]. Among these conditions, patellofemoral pain has been linked to greater higher kinesiophobia levels [20]. Currently, there is a lack of research studies detailing kinesiophobia and pain intensity in subjects suffering from HV deformity. Pain and kinesiophobia, defined as fear of movement under a painful condition [21,22], could be linked to a greater HV deformity degree as the higher HV deformity has been related to a worse foot health-related quality of life, greater depression, and presence of foot posture, pressure patterns, and function alterations [4–7,23,24].

Greater HV deformity degree has shown higher radiographic first metatarsophalangeal joint osteoarthritis severity in conjunction with physical and psychological conditions [4–7,23–25]. Thus, the purpose of this study was to find the association between kinesiophobia and pain intensity with HV deformity degrees. In addition, the secondary aim was to predict kinesiophobia and pain intensity based on HV deformity and demographic features. We hypothesized that higher kinesiophobia and pain intensity could be shown and predicted by a greater HV deformity degree.

2. Materials and Methods

2.1. Design

A cross-sectional study was performed according to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) criteria [26]. Thus, kinesiophobia and pain intensity were compared under different HV deformity degrees. Furthermore, the ethics committee of Extremadura University (code: 175/2019) approved this research, and all subjects signed the informed consent form before the beginning of the study. Finally, the Helsinki declaration and all human experimentation rules were respected [27].

2.2. Sample Size Calculation

Kinesiophobia score was used as the main outcome measurement to carry out the sample size calculation because prior lower limb musculoskeletal conditions were linked to higher kinesiophobia symptoms [20]. Kinesiophobia total score assessed with the Spanish validated version of the Tampa Scale of Kinesiophobia–11 items (TSK-11) [21,22] of a pilot study (n = 40 subjects) with 4 groups of HV deformity degree (n; TSK-11 mean ± SD), divided into I–no HV (n = 10 participants; 21.70 ± 5.41 points), II–mild (n = 10; 20.70 ± 4.62 points), III–moderate (n = 10; 22.60 ± 3.83 points), and IV–severe (n = 10; 24.80 ± 4.18 points) HV deformity degree, was used for the sample size calculation by the one-way, omnibus, and fixed-effects analysis of variance (ANOVA) F test using G*Power 3.1.9.2 software version. Indeed, a partial Eta-squared (η^2) of 0.109, an effect size of 0.349, an α error probability of 0.05, a number of 4 groups, and a power (1-β error probability) of 0.80 were used for this sample size calculation procedure. Thus, a total sample size of 96 subjects, 24 for each group, was calculated with an actual power of 0.813. Finally, a total sample size of 100 subjects, 25 for each group, was included in the present study.

2.3. Sample

A total sample of 100 subjects with different HV deformity degrees was recruited by a consecutive convenience sampling method in an outpatient clinic from March to November 2019 [4–7]. Inclusion criteria comprised subjects older than 18 years old, being healthy subjects for the control group classified as I degree–no HV presence (n = 25), as well as patients with HV deformity for cases groups, such as II degree–mild HV (n = 25), III degree–moderate HV (n = 25), and IV degree–severe HV (n = 25) [28,29].

Systemic diseases, neurological conditions, arthritis, neoplasm, autoimmune pathology, vascular alterations, neuropathic disorders or radiculopathies, sprains, fractures, tendinopathies, surgeries, presence of dysmetria with length difference greater than 1 cm between both lower extremities, mental disorders, or cognitive conditions were considered as exclusion criteria according to the medical record [7,30].

2.4. HV Deformity Degrees

A specialized podiatrist carried out the HV deformity degree diagnosis by the Manchester Scale [28]. This tool might be considered as a non-invasive technique in order to measure the HV deformity degree using a standardized photograph set, divided into I degree (no HV), II degree (mild HV), III degree (moderate HV), and IV degree (severe HV). This scale showed an excellent inter-examiner repeatability ($\kappa = 0.86$) [29]. Also, excellent inter-examiner reliability and validity were shown for the HV angle between photographic measures and radiographs. Intraclass correlation coefficients (ICCs > 0.96) and the Pearson's correlation coefficient ($r = 0.96$) were categorized as excellent. Despite this method was recommended in order to avoid the cost and radiation exposure secondary to radiographs, foot radiographs might be considered as the current standard in clinical practice, and thus HV angle clinical measurements have been recommended if it is not possible or necessary to perform radiographs [29].

2.5. Demographic Data

Demographic data comprised age (years), sex (female or male), body mass index (kg/cm^2) [31], height (cm), weight (kg), and pain chronicity, measured as duration in months with painful HV [7,30].

2.6. Outcome Measurements

Kinesiophobia total score was considered as the main outcome measurement and evaluated with the Spanish validated version of the Tampa Scale of Kinesiophobia–11 items (TSK-11) [21,22]. Secondary outcome measures were activity avoidance and harm domains scores of kinesiophobia, as well as fear of movement or kinesiophobia levels categorized by the TSK-11 score [21,22], and the pain intensity score measured by the numeric rating scale (NRS) [32,33]. According to these scales, both tools were self-reported by the study's subjects.

2.6.1. TSK-11

The Spanish validated version of the TSK-11 was self-reported by all study's subjects in order to detail kinesiophobia symptoms total scores, activity avoidance and harm domains scores of kinesiophobia, and levels fear of movement or kinesiophobia [21,22]. Kinesiophobia was considered as an adaptive response to the threat, which might consequently generate maladaptive or avoidance behaviors with an increase of fear and/or pain as well as activities limitation and/or fear of movement [34–36]. Future disability of a musculoskeletal condition might be predicted by fear or movement or kinesiophobia [34]. This scale was composed of total kinesiophobia symptoms score and two domains, including activity avoidance and harm under kinesiophobia. This scale was scored using 4 points Likert-type scale, indicating higher scores as an increase of fear of pain, movement, or damage. In addition, TSK-11 total scores were categorized into kinesiophobia levels of fear of movement, including no fear of movement (0–17 points), slight fear of movement (18–24 points), moderate fear of movement (25–31 points), severe fear of movement (32–38 points), and maximum fear of movement (39–44 points) [21,22]. Adequate psychometric properties were reported for this scale, showing an internal consistency with Cronbach's α of 0.78, test-retest with ICC of 0.82, standard error of measurement with SEM of 3.16, responsiveness of −1.19, minimum clinical important difference with MCID of 4.80, and minimum detectable change with MDC of 5.60 [21,22,37–39].

2.6.2. NRS

Pain intensity was measured by the NRS. This tool showed 11 points ranged from 0 (no pain) to 10 (highest pain intensity) points. Subjects were asked to mark the subjective pain intensity of the painful HV (Hallux valgus) by a finger on the scale composed of a graphic representation with 11 spaces. This scale was stated as a valid and reliable scale to evaluate subjective pain intensity in adults and older adults [32,33]. High convergent validity (0.79–0.95) was shown with respect to the VAS (Visual Analogue Scale) [40]. The MDC and MCID were set at 2 points for lower limb musculoskeletal conditions [41–43].

2.7. Statistical Analysis

The software version 24th of the Statistical Package for Social Sciences (from IBM Corp; Armonk, NY, USA) was utilized to carry out all data analyses by an α error of 0.05, a p-value < 0.05 as statistically significant, and a 95% confidence interval (CI).

First, quantitative data analyses were performed by the Shapiro–Wilk test to determine normality distributions. Second, all data were described by the mean ± standard deviation (SD). Third, one-way analysis of variance completed with Bonferroni's correction post hoc analyses was used to assess between-group differences for parametric data. Fourth, Kruskal–Wallis test completed with Bonferroni's correction post hoc analyses were used to assess between-groups differences for non-parametric data. For outcome measurements, effect size was calculated by Eta-squared (η^2) coefficients for comparisons among all groups, as well as Cohen's d coefficients for comparisons between paired groups and categorized into very small effect size ($d < 0.20$), small effect size (d = 0.20–0.49), medium effect size (d = 0.50–0.79), and large effect size ($d > 0.8$) [44,45]. Finally, categorical data were described as frequency (n) and percentage (%). In addition, Chi-square tests were applied to assess differences among all groups.

Furthermore, multivariate predictive analyses were performed by means of two linear regression models. Both models were carried out by the stepwise selection method; as well as R^2 coefficients were determined to show the quality of adjustment [46]. The 1st linear regression model included demographic data, pain intensity (NRS), chronicity, and HV deformity degree as independent variables, as well as kinesiophobia total score (TSK-11) as the dependent variable. The 2nd linear regression model included demographic data, kinesiophobia total score, levels of fear of movement of kinesiophobia, activity avoidance, and harm domains of kinesiophobia (TSK-11), and HV deformity degree as independent variables, as well as pain intensity (NRS) as the dependent variable. F probability pre-established parameters ranged from $p_{in} = 0.05$ to $p_{out} = 0.10$, and p-values < 0.05 for statistical significance with a 95% CI were considered for these analyses.

3. Results

3.1. Demographic Data

Statistically significant differences ($p < 0.05$) were shown for demographic data, except for weight ($p = 0.608$), showing that a higher HV deformity degree was associated with greater age, height, body mass index (BMI), and chronicity, as well as female sex (Table 1).

Table 1. Demographic data among different HV deformity degrees.

Sociodemographic Characteristics		No HV Degree-I (n = 25)	Mild HV Degree-II (n = 25)	Moderate HV Degree-III (n = 25)	Severe HV Degree-IV (n = 25)	*p*-Value
Age (years)		37.52 ± 15.19	37.16 ± 19.53	59.24 ± 18.35	68.40 ± 14.60	<0.001 †
Weight (kg)		75.80 ± 16.12	70.80 ± 15.03	72.92 ± 10.57	73.08 ± 13.03	0.608 †
Height (m)		1.70 ± 0.07	1.69 ± 0.08	1.64 ± 0.05	1.61 ± 0.08	<0.001 *
BMI (kg/cm^2)		26.01 ± 4.52	24.34 ± 3.32	26.87 ± 3.49	27.92 ± 3.65	0.003 †
Chronicity (months)		0	15.37 ± 37.13	88.32 ± 55.62	190.08 ± 160.20	<0.001 †
Sex	male	12 (48%)	13 (52%)	7 (28%)	4 (16%)	0.025 ‡
	female	13 (52%)	12 (48%)	18 (72%)	21 (84%)	

Abbreviations: BMI: body mass index; CI: confidence interval; HV: hallux valgus; SD: standard deviation. * Mean ± SD and one-way analysis of variance (ANOVA) were used. † Mean ± SD and the Kruskal–Wallis test were used. ‡ Frequency, percentage (%), and the Chi-squared test (χ^2) were utilized. In all analyses, $p < 0.05$ (with a 95% CI) was considered statistically significant.

3.2. Kinesiophobia Total Score

Statistically significant differences ($p < 0.001$; $\eta^2 = 0.203$) were shown for between-groups comparison of kinesiophobia total scores among HV deformity degrees by the one-way ANOVA test. Post hoc comparisons showed statistically significant differences with a large effect size ($p < 0.05$; $d = 0.85$–1.44), showing higher kinesiophobia symptoms for III-moderate and IV-severe HV deformity degrees with respect to I-no HV deformity degree, as well as for IV-severe HV deformity degree versus II-mild HV deformity degree. The rest of the post hoc comparisons did not show statistically significant differences ($p < 0.05$) (Table 2).

Table 2. Comparisons of outcome measurement scores among different HV deformity degrees.

Outcome Measurements	**No HV Degree-I (n = 25)**	**Mild HV Degree-II (n = 25)**	**Moderate HV Degree-III (n = 25)**	**Severe HV Degree-IV (n = 25)**	***p*-Value (η^2)**	**Bonferroni *p*-Value (*d*) (1) I vs. II (2) I vs. III (3) I vs. IV (4) II vs. III (5) II vs. IV (6) III vs. IV**
Kinesiophobia total score (TSK-11)	19.64 ± 4.81	21.60 ± 6.07	23.64 ± 4.56	26.36 ± 4.49	<0.001* (η^2 = 0.203)	(1) (*d* = 0.35) (2) (*d* = 0.85) (3) <0.001 (*d* = 1.44) (4) 0.928 (*d* = 0.38) (5) (*d* = 0.89) (6) 0.353 (*d* = 0.60)
Activity avoidance score (TSK-11)	12.84 ± 3.11	13.76 ± 4.56	15.44 ± 3.96	17.24 ± 3.41	<0.001 † (η^2 = 0.168)	(1) (*d* = 0.23) (2) 0.127 (*d* = 0.87) (3) (*d* = 1.34) (4) 0.392 (*d* = 0.39) (5) (*d* = 0.86) (6) 0.851 (*d* = 0.48)
Harm score (TSK-11)	6.80 ± 2.29	7.84 ± 2.19	8.20 ± 2.16	9.12 ± 2.02	0.002 † (η^2 = 0.132)	(1) 0.599 (*d* = 0.46) (2) 0.205 (*d* = 0.62) (3) (*d* = 1.07) (4) (*d* = 0.16) (5) 0.177 (*d* = 0.60) (6) 0.530 (*d* = 0.43)
Pain intensity (NRS)	0	1.12 ± 1.26	6.40 ± 1.87	7.36 ± 1.55	<0.001 † (η^2 = 0.850)	(1) 0.420 (*d* = N/A) (2) <0.001 (*d* = N/A) (3) <0.001 (*d* = N/A) (4) <0.001(*d* = 3.31) (5) <0.001 (*d* = 4.41) (6) 1.000 (*d* = 0.55)

Abbreviations: CI, confidence interval; d, Cohen d coefficient; HV, hallux valgus; η^2, Eta-squared coefficient; N/A, not applicable; NRS, numeric rating scale; SD, standard deviation; TSK-11, Tampa Scale of Kinesiophobia–11 items. * Mean ± SD and one-way analysis of variance (ANOVA) completed with Bonferroni's correction were used. † Mean ± SD and Kruskal—allis test completed with Bonferroni's correction were used. In all analyses, $p < 0.05$ (with a 95% CI) was considered statistically significant.

3.3. Activity Avoidance Score (TSK-11)

Statistically significant differences ($p < 0.001$; $\eta^2 = 0.168$) were shown for between-groups comparison for the activity avoidance domain of kinesiophobia among HV deformity degrees by the Kruskal–Wallis test. Post hoc comparisons showed statistically significant differences with a large effect size ($p < 0.01$; $d = 0.86$–1.34), showing higher activity avoidance kinesiophobia symptoms for IV-severe HV deformity degree with respect to I-no HV and II-mild HV deformity degrees. The rest of the post hoc comparisons did not show statistically significant differences ($p < 0.05$) (Table 2).

3.4. Harm Score (TSK-11)

Statistically significant differences ($p = 0.002$; $\eta^2 = 0.132$) were shown for between-groups comparison for the harm domain of kinesiophobia among HV deformity degrees by the Kruskal–Wallis test. Post hoc comparisons showed statistically significant differences with a large effect size ($p = 0.001$; $d = 1.07$), showing higher harm kinesiophobia symptoms for IV-severe HV deformity degree with respect to I-no HV deformity degree. The rest of the post hoc comparisons did not show statistically significant differences ($p < 0.05$) (Table 2).

3.5. Pain Intensity (NRS)

Statistically significant differences ($p < 0.001$; $\eta^2 = 0.850$) were shown for between-groups comparison for the pain intensity among HV deformity degrees by the Kruskal–Wallis test. Post hoc comparisons showed statistically significant differences with a large effect size ($p < 0.001$; $d = 3.31$–4.41), showing higher pain intensity for III-moderate and IV-severe HV deformity degree with respect to I-no HV and II-mild HV deformity degree. The rest of the post hoc comparisons did not show statistically significant differences ($p < 0.05$) (Table 2).

3.6. Kinesiophobia Levels of Fear of Movement (TSK-11)

Statistically significant differences ($p = 0.007$; $\chi^2 = 22.556$) were shown for between-groups comparison for the kinesiophobia levels of fear of movement among HV deformity degrees by the Chi-squared test, showing higher kinesiophobia levels with greater HV deformity degree, especially for moderate kinesiophobia level (Figure 1).

3.7. Prediction Models

Kinesiophobia total score (TSK-11) showed one statistically significant prediction model ($R^2 = 0.300$) based on age (R2 = 0.271; β = +0.101; F[1,98] = 35.978; P < 0.001) and HV deformity degrees (R2 = 0.029; β = +1.050; F[1,97] = 4.033; P = 0.047), predicting higher kinesiophobia total scores based on greater age and HV deformity degree. Therefore, this prediction model excluded the rest of independent variables (P > 0.05) as the kinesiophobia total score (dependent variable) was not predicted by sex, height, weight, BMI, chronicity, and pain intensity (independent variables) according to the pre-established parameters for F probability (Table 3).

Table 3. Linear regression model for the kinesiophobia total score multivariate among HV deformity degrees.

Parameter	Model	R^2 Change	Model R^2
Kinesiophobia total score (TSK-11)	15.136		
	+0.101 * Age (years)	0.271 ‡	
	+0.050 * HV deformity degrees	0.029 †	0.300

Abbreviations: HV, hallux valgus; TSK-11, Tampa Scale of Kinesiophobia–11 items. * Multiplay: HV deformity degrees (I degree (no HV) = 1; II degree (mild HV) = 2; III degree (moderate HV) = 3; IV degree (severe HV) = 4). † *p*-value < 0.05 for a 95% confidence interval was shown, ‡ *p*-value < 0.001 for a 95% confidence interval was shown.

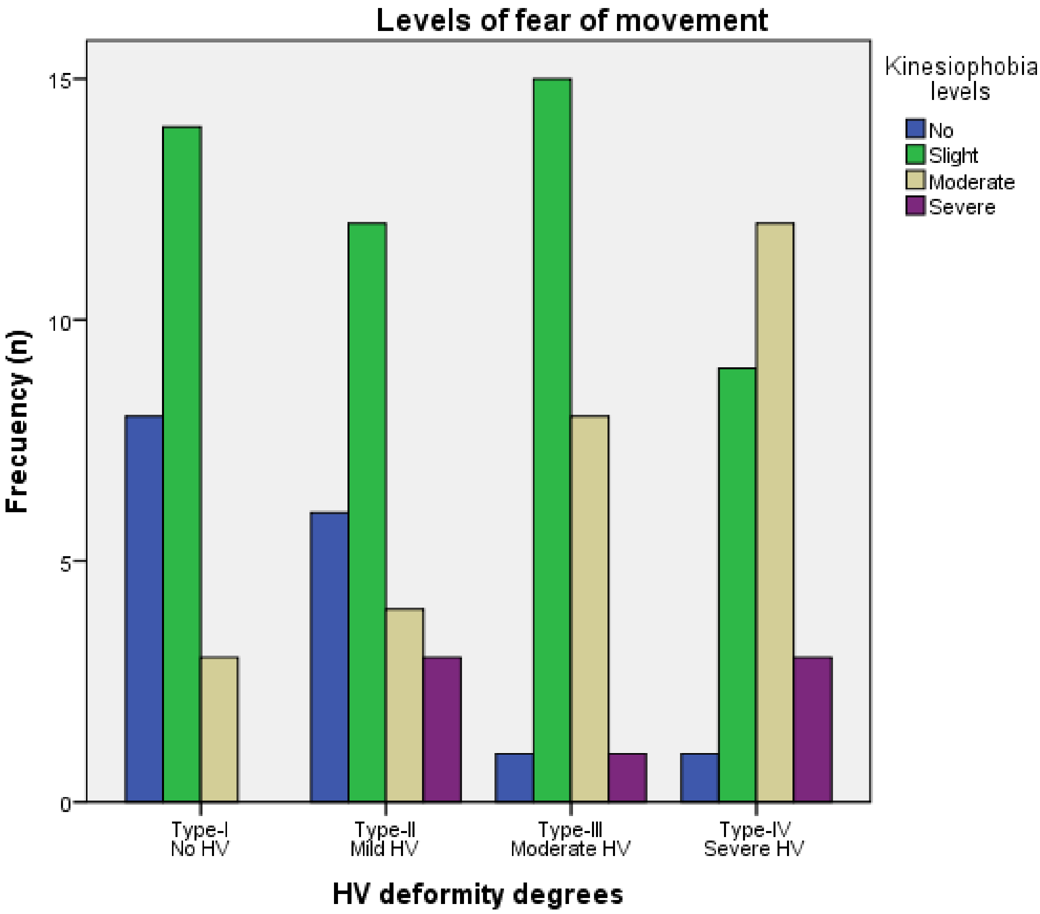

Figure 1. Bar graph showing the kinesiophobia levels of fear of movement (TSK-11), such as no fear (0–17 points), slight (18–24 points), moderate (25–31 points), severe (32–8 points), and maximum (39–4 points) kinesiophobia levels among different HV deformity degrees. Abbreviations: HV, hallux valgus; TSK-11, Tampa Scale of Kinesiophobia–11 items.

Pain intensity (NRS) showed one statistically significant prediction model (R^2 = 0.815) based on HV deformity degrees (R^2 = 0.776; β = +0.276; F[1,98] = 339.076; P < 0.001) and age (R2 = 0.040; β = +1.050; F[1,97] = 20.782; P < 0.001), predicting higher pain intensity based on greater HV deformity degree and age. Therefore, this prediction model excluded the rest of independent variables (P > 0.05) as the pain intensity (dependent variable) was not predicted by sex, height, weight, BMI, kinesiophobia total scores, kinesiophobia activity avoidance and harm domain scores, and kinesiophobia levels of fear of movement (TSK-11) according to the pre-established parameters for F probability (Table 4).

Table 4. Linear regression model for the pain intensity multivariate among HV deformity degrees.

Parameter	Model	R^2 Change	Model R^2
Pain intensity (NRS)	–3.993 +2.276 * HV deformity degrees +0.040 * Age (years)	0.776 ‡ 0.040 ‡	0.815

Abbreviations: HV: hallux valgus; NRS: numeric rating scale. * Multiplay: HV deformity degrees (I degree (no HV) = 1; II degree (mild HV) = 2; III degree (moderate HV) = 3; IV degree (severe HV) = 4). ‡ *p*-value < 0.001 for a 95% confidence interval was shown.

4. Discussion

Despite higher HV deformity degree has been previously associated with psychological disorders [4,5,47], this study might be considered as the first cross-sectional study detailing greater kinesiophobia symptoms, total scores as activity avoidance and harm domains scores, as well as pain intensity associated with higher HV degree deformity, especially for severe and/or moderate HV deformity degrees with respect to non-presence of HV and/or mild HV deformity degrees. Indeed, moderate kinesiophobia level deformity showed a clear increase according to greater HV deformity degrees. Thus, pain and fear of movement under HV condition might be linked to III and IV deformity degrees compared to I and II deformity degrees according to prior studies associating greater HV deformity with worse quality of life related to foot health, higher depression, as well as foot posture, pressure patterns, and function alterations [4–7,23,24]. Our findings were in line with prior research studies detailing kinesiophobia and pain in different musculoskeletal conditions, such as patellofemoral pain [20], temporomandibular conditions [48], chronic fatigue syndrome and/or fibromyalgia [49], whiplash-associated conditions and/or low back pain [50], chronic mechanical neck pain [51], or migraine [52].

In addition, our study showed that age and the HV deformity degree were shown as predictors for kinesiophobia symptoms and pain intensity. These findings were in accordance with prior studies reporting that psychological disorders were linked to musculoskeletal conditions, increasing this association with greater age distribution [8–13]. In addition, greater instability was shown in older adults under musculoskeletal disorders [14–16]. Finally, higher HV deformity was associated with worse physical and psychological factors [4–7,23,24].

4.1. Future Studies

Future studies should propose interventions in order to reduce kinesiophobia and pain intensity in patients with HV, such as myofascial pain interventions [53,54], neural mobilization techniques [55], or surgical procedures [47]. In addition, other outcome measurements should be evaluated in order to determine the influence of HV mechanical soft tissue properties on pain and kinesiophobia, such as myofascial trigger points evaluation [56], sonoelastography [57], pressure pain threshold [58], or thermography [59]. Finally and most importantly, an x-ray should be included in future studies as the gold stand, as well as ultrasound imaging could be used in advance to decline other possible pathologies [29].

4.2. Limitations

The following limitations could be acknowledged in this study. Firstly, socio-economic, civil, or working status should be considered for future studies. In spite of the pain intensity of HV was measured by the NRS [32,33], pain location, distribution, or type (neurological or musculoskeletal) were not collected. Second, despite the presented prediction models determined the influence of demographic data on our findings, future studies should detail the influence of age ranges on kinesiophobia and pain intensity according to our multivariate regression analyses. Thirdly, pregnant women could influence the psychological status and should be considered in future research studies [60]. Finally, despite exclusion criteria were considered according to the medical record, imaging examination was not performed (i.e., ultrasound and/or x-ray) to rollout other underlying pathologies (i.e., Morton neuroma, stress fracture, metatarsal bursitis, and others), which should be included in future studies. In addition, foot x-ray might provide additional information about the other metatarsal angles, sesamoid displacement, or underlying pathologies [29].

5. Conclusions

Greater kinesiophobia symptoms and levels and pain were associated with higher HV deformity degrees, especially severe and/or moderate HV with respect to no and/or mild HV. The kinesiophobia and pain intensity were predicted by greater HV deformity degree and age.

Author Contributions: Conceptualization, R.B.-d.-B.-V., M.E.L.-I., D.L.-L., C.C.-L., and V.M.-P.; Data curation, P.P.-L. and C.C.-L.; Formal analysis, R.B.-d.-B.-V., M.E.L.-I., D.R.-S., and C.C.-L.; Investigation, P.P.-L. and V.M.-P.; Methodology, P.P.-L., R.B.-d.-B.-V., M.E.L.-I., D.L.-L., D.R.-S., C.R.-M., C.C.-L., and V.M.-P.; Supervision, D.L.-L. and

C.R.-M.; Writing—original draft, D.L.-L. and C.C.-L.; Writing—review and editing, P.P.-L., R.B.-d.-B.-V., M.E.L.-I., D.R.-S., C.R.-M., C.C.-L., and V.M.-P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Menz, H.B.; Jordan, K.P.; Roddy, E.; Croft, P.R. Characteristics of primary care consultations for musculoskeletal foot and ankle problems in the UK. *Rheumatology* **2010**, *49*, 1391–1398. [CrossRef]
2. Nix, S.; Smith, M.; Vicenzino, B. Prevalence of hallux valgus in the general population: A systematic review and meta-analysis. *J. Foot Ankle Res.* **2010**, *3*, 21. [CrossRef] [PubMed]
3. Hecht, P.J.; Lin, T.J. Hallux valgus. *Med. Clin. N. Am.* **2014**, *98*, 227–232. [CrossRef] [PubMed]
4. López, D.L.; González, L.C.; Iglesias, M.E.L.; Canosa, J.L.S.; Sanz, D.R.; Lobo, C.C.; de Bengoa Vallejo, R.B. Quality of Life Impact Related to Foot Health in a Sample of Older People with Hallux Valgus. *Aging Dis.* **2016**, *7*, 45. [CrossRef]
5. López, D.L.; Fernández, J.M.V.; Iglesias, M.E.L.; Castro, C.Á.; Lobo, C.C.; Galván, J.R.; de Bengoa Vallejo, R.B. Influence of depression in a sample of people with hallux valgus. *Int. J. Ment. Health Nurs.* **2016**, *25*, 574–578. [CrossRef] [PubMed]
6. Palomo-López, P.; Becerro-de-Bengoa-Vallejo, R.; Losa-Iglesias, M.E.; Rodríguez-Sanz, D.; Calvo-Lobo, C.; López-López, D. Impact of Hallux Valgus related of quality of life in Women. *Int. Wound J.* **2017**, *14*. [CrossRef] [PubMed]
7. Lobo, C.C.; Marin, A.G.; Sanz, D.R.; Lopez, D.L.; Lopez, P.P.; Morales, C.R.; Corbalan, I.S. Ultrasound evaluation of intrinsic plantar muscles and fascia in hallux valgus: A case-control study. *Medicine* **2016**, *95*, e5243. [CrossRef]
8. Calvo-Lobo, C.; Fernández, J.M.V.; Becerro-de-Bengoa-Vallejo, R.; Losa-Iglesias, M.E.; Rodríguez-Sanz, D.; López, P.P.; López, D.L. Relationship of depression in participants with nonspecific acute or subacute low back pain and no-pain by age distribution. *J. Pain Res.* **2017**, *10*, 129–135. [CrossRef]
9. Lobo, C.C.; Morales, C.R.; Sanz, D.R.; Corbalán, I.S.; Romero, E.A.S.; Carnero, J.F.; López, D.L. Comparison of hand grip strength and upper limb pressure pain threshold between older adults with or without non-specific shoulder pain. *PeerJ* **2017**, *5*, e2995. [CrossRef]
10. Palomo-López, P.; Becerro-de-Bengoa-Vallejo, R.; Losa-Iglesias, M.E.; Rodríguez-Sanz, D.; Calvo-Lobo, C.; López-López, D. Footwear used by older people and a history of hyperkeratotic lesions on the foot. *Medicine* **2017**, *96*, e6623. [CrossRef]
11. López-López, D.; Vilar-Fernández, J.M.; Calvo-Lobo, C.; Losa-Iglesias, M.E.; Rodriguez-Sanz, D.; Becerro-De-Bengoa-Vallejo, R. Evaluation of depression in subacute low back pain: A case control study. *Pain Physician* **2017**, *20*, E499–E505. [CrossRef] [PubMed]
12. Rodríguez-Sanz, D.; Tovaruela-Carrión, N.; López-López, D.; Palomo-López, P.; Romero-Morales, C.; Navarro-Flores, E.; Calvo-Lobo, C. Foot disorders in the elderly: A mini-review. *Dis. Mon.* **2017**, *64*, 64–91. [CrossRef] [PubMed]
13. Palomo López, P.; Rodríguez-Sanz, D.; Becerro de Bengoa Vallejo, R.; Losa-Iglesias, M.E.; Guerrero Martín, J.; Calvo Lobo, C.; Lopez Lopez, D. Clinical aspects of foot health and their influence on quality of life among breast cancer survivors: A case–control study. *Cancer Manag. Res.* **2017**, *9*, 545–551. [CrossRef] [PubMed]
14. Kazemi, K.; Arab, A.M.; Abdollahi, I.; López-López, D.; Calvo-Lobo, C. Electromiography comparison of distal and proximal lower limb muscle activity patterns during external perturbation in subjects with and without functional ankle instability. *Hum. Mov. Sci.* **2017**, *55*, 211–220. [CrossRef]
15. Romero Morales, C.; Calvo Lobo, C.; Rodríguez Sanz, D.; Sanz Corbalán, I.; Ruiz Ruiz, B.; López López, D. The concurrent validity and reliability of the Leg Motion system for measuring ankle dorsiflexion range of motion in older adults. *PeerJ* **2017**, *5*, e2820. [CrossRef]
16. Velázquez-Saornil, J.; Ruíz-Ruíz, B.; Rodríguez-Sanz, D.; Romero-Morales, C.; López-López, D.; Calvo-Lobo, C. Efficacy of quadriceps vastus medialis dry needling in a rehabilitation protocol after surgical reconstruction of complete anterior cruciate ligament rupture. *Medicine* **2017**, *96*, e6726. [CrossRef]

17. Oosterhoff, J.H.F.; Bexkens, R.; Vranceanu, A.-M.; Oh, L.S. Do Injured Adolescent Athletes and Their Parents Agree on the Athletes' Level of Psychologic and Physical Functioning? *Clin. Orthop. Relat. Res.* **2018**, *476*, 767–775. [CrossRef]
18. Goubert, L.; Crombez, G.; Van Damme, S. The role of neuroticism, pain catastrophizing and pain-related fear in vigilance to pain: A structural equations approach. *Pain* **2004**, *107*, 234–241. [CrossRef]
19. Hoch, J.M.; Houston, M.N.; Baez, S.E.; Hoch, M.C. Fear-Avoidance Beliefs and Health-Related Quality of Life in Post-ACL Reconstruction and Healthy Athletes: A Case-Control Study. *J. Sport Rehabil.* **2019**, 1–5. [CrossRef]
20. Priore, L.B.; Azevedo, F.M.; Pazzinatto, M.F.; Ferreira, A.S.; Hart, H.F.; Barton, C.; de Oliveira Silva, D. Influence of kinesiophobia and pain catastrophism on objective function in women with patellofemoral pain. *Phys. Ther. Sport* **2019**, *35*, 116–121. [CrossRef]
21. Gómez-Pérez, L.; López-Martínez, A.E.; Ruiz-Párraga, G.T. Psychometric Properties of the Spanish Version of the Tampa Scale for Kinesiophobia (TSK). *J. Pain* **2011**, *12*, 425–435. [CrossRef] [PubMed]
22. Woby, S.R.; Roach, N.K.; Urmston, M.; Watson, P.J. Psychometric properties of the TSK-11: A shortened version of the Tampa Scale for Kinesiophobia. *Pain* **2005**, *117*, 137–144. [CrossRef] [PubMed]
23. Hagedorn, T.J.; Dufour, A.B.; Riskowski, J.L.; Hillstrom, H.J.; Menz, H.B.; Casey, V.A.; Hannan, M.T. Foot disorders, foot posture, and foot function: The Framingham foot study. *PLoS ONE* **2013**, *8*, e74364. [CrossRef] [PubMed]
24. Galica, A.M.; Hagedorn, T.J.; Dufour, A.B.; Riskowski, J.L.; Hillstrom, H.J.; Casey, V.A.; Hannan, M.T. Hallux valgus and plantar pressure loading: The Framingham foot study. *J. Foot Ankle Res.* **2013**, *6*, 42. [CrossRef] [PubMed]
25. Menz, H.B.; Roddy, E.; Marshall, M.; Thomas, M.J.; Rathod, T.; Myers, H.; Thomas, E.; Peat, G.M. Demographic and clinical factors associated with radiographic severity of first metatarsophalangeal joint osteoarthritis: Cross-sectional findings from the Clinical Assessment Study of the Foot. *Osteoarthr. Cartil.* **2015**, *23*, 77–82. [CrossRef]
26. Vandenbroucke, J.P.; von Elm, E.; Altman, D.G.; Gøtzsche, P.C.; Mulrow, C.D.; Pocock, S.J.; Poole, C.; Schlesselman, J.J.; Egger, M.; STROBE Initiative. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and elaboration. *Int. J. Surg.* **2014**, *12*, 1500–1524. [CrossRef]
27. World Medical Association. World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. *J. Am. Coll. Dent.* **2014**, *81*, 14–18.
28. Menz, H.B.; Fotoohabadi, M.R.; Wee, E.; Spink, M.J. Validity of self-assessment of hallux valgus using the Manchester scale. *BMC Musculoskelet. Disord.* **2010**, *11*, 215. [CrossRef]
29. Nix, S.; Russell, T.; Vicenzino, B.; Smith, M. Validity and reliability of hallux valgus angle measured on digital photographs. *J. Orthop. Sports Phys. Ther.* **2012**, *42*, 642–648. [CrossRef]
30. Lobo, C.C.; Morales, C.R.; Sanz, D.R.; Corbalán, I.S.; Marín, A.G.; López, D.L. Ultrasonography Comparison of Peroneus Muscle Cross-sectional Area in Subjects With or Without Lateral Ankle Sprains. *J. Manip. Physiol. Ther.* **2016**, *39*, 635–644. [CrossRef]
31. Garrow, J.S. Quetelet index as indicator of obesity. *Lancet* **1986**, *1*, 1219. [CrossRef]
32. Williamson, A.; Hoggart, B. Pain: A review of three commonly used pain rating scales. *J. Clin. Nurs.* **2005**, *14*, 798–804. [CrossRef] [PubMed]
33. Taylor, L.J.; Harris, J.; Epps, C.D.; Herr, K. Psychometric evaluation of selected pain intensity scales for use with cognitively impaired and cognitively intact older adults. *Rehabil. Nurs.* **2005**, *30*, 55–61. [CrossRef] [PubMed]
34. Swinkels-Meewisse, I.E.J.; Roelofs, J.; Schouten, E.G.W.; Verbeek, A.L.M.; Oostendorp, R.A.B.; Vlaeyen, J.W.S. Fear of movement/(re)injury predicting chronic disabling low back pain: A prospective inception cohort study. *Spine* **2006**, *31*, 658–664. [CrossRef]
35. Ferrer-Peña, R.; Moreno-López, M.; Calvo-Lobo, C.; López-de-Uralde-Villanueva, I.; Fernández-Carnero, J. Relationship of Dynamic Balance Impairment with Pain-Related and Psychosocial Measures in Primary Care Patients with Chronic Greater Trochanteric Pain Syndrome. *Pain Med.* **2019**, *20*, 810–817. [CrossRef]
36. Costa, L.d.C.M.; Maher, C.G.; McAuley, J.H.; Hancock, M.J.; Smeets, R.J.E.M. Self-efficacy is more important than fear of movement in mediating the relationship between pain and disability in chronic low back pain. *Eur. J. Pain* **2011**, *15*, 213–219. [CrossRef]

37. Chmielewski, T.L.; Zeppieri, G.; Lentz, T.A.; Tillman, S.M.; Moser, M.W.; Indelicato, P.A.; George, S.Z. Longitudinal changes in psychosocial factors and their association with knee pain and function after anterior cruciate ligament reconstruction. *Phys. Ther.* **2011**, *91*, 1355–1366. [CrossRef]
38. George, S.Z.; Valencia, C.; Beneciuk, J.M. A psychometric investigation of fear-avoidance model measures in patients with chronic low back pain. *J. Orthop. Sports Phys. Ther.* **2010**, *40*, 197–205. [CrossRef]
39. Hapidou, E.G.; O'Brien, M.A.; Pierrynowski, M.R.; de Las Heras, E.; Patel, M.; Patla, T. Fear and Avoidance of Movement in People with Chronic Pain: Psychometric Properties of the 11-Item Tampa Scale for Kinesiophobia (TSK-11). *Physiother. Can.* **2012**, *64*, 235–241. [CrossRef]
40. Kahl, C.; Cleland, J.A. Visual analogue scale, numeric pain rating scale and the McGill pain Questionnaire: An overview of psychometric properties. *Phys. Ther. Rev.* **2005**, *10*, 123–128. [CrossRef]
41. Katz, N.P.; Paillard, F.C.; Ekman, E. Determining the clinical importance of treatment benefits for interventions for painful orthopedic conditions. *J. Orthop. Surg. Res.* **2015**, *10*. [CrossRef] [PubMed]
42. Salaffi, F.; Stancati, A.; Silvestri, C.A.; Ciapetti, A.; Grassi, W. Minimal clinically important changes in chronic musculoskeletal pain intensity measured on a numerical rating scale. *Eur. J. Pain* **2004**, *8*, 283–291. [CrossRef] [PubMed]
43. Devji, T.; Guyatt, G.H.; Lytvyn, L.; Brignardello-Petersen, R.; Foroutan, F.; Sadeghirad, B.; Buchbinder, R.; Poolman, R.W.; Harris, I.A.; Carrasco-Labra, A.; et al. Application of minimal important differences in degenerative knee disease outcomes: A systematic review and case study to inform BMJ Rapid Recommendations. *BMJ Open* **2017**, *7*, e015587. [CrossRef] [PubMed]
44. Kelley, K.; Preacher, K.J. On Effect Size. *Psychol. Methods* **2012**, *17*, 137–152. [CrossRef]
45. Lakens, D. Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for *t*-tests and ANOVAs. *Front. Psychol.* **2013**, *4*. [CrossRef]
46. Austin, P.C.; Steyerberg, E.W. The number of subjects per variable required in linear regression analyses. *J. Clin. Epidemiol.* **2015**, *68*, 627–636. [CrossRef]
47. Shakked, R.; McDonald, E.; Sutton, R.; Lynch, M.K.; Nicholson, K.; Raikin, S.M. Influence of Depressive Symptoms on Hallux Valgus Surgical Outcomes. *Foot Ankle Int.* **2018**, *39*, 795–800. [CrossRef]
48. Gil-Martínez, A.; Grande-Alonso, M.; López-de-Uralde-Villanueva, I.; López-López, A.; Fernández-Carnero, J.; La Touche, R. Chronic Temporomandibular Disorders: Disability, pain intensity and fear of movement. *J. Headache Pain* **2016**, *17*, 103. [CrossRef]
49. Malfliet, A.; Van Oosterwijck, J.; Meeus, M.; Cagnie, B.; Danneels, L.; Dolphens, M.; Buyl, R.; Nijs, J. Kinesiophobia and maladaptive coping strategies prevent improvements in pain catastrophizing following pain neuroscience education in fibromyalgia/chronic fatigue syndrome: An explorative study. *Physiother. Theory Pract.* **2017**, *33*, 653–660. [CrossRef]
50. Reis, F.; Guimarães, F.; Nogueira, L.C.; Meziat-Filho, N.; Sanchez, T.A.; Wideman, T. Association between pain drawing and psychological factors in musculoskeletal chronic pain: A systematic review. *Physiother. Theory Pract.* **2019**, *35*, 533–542. [CrossRef]
51. Saavedra-Hernández, M.; Castro-Sánchez, A.M.; Cuesta-Vargas, A.I.; Cleland, J.A.; Fernández-de-las-Peñas, C.; Arroyo-Morales, M. The contribution of previous episodes of pain, pain intensity, physical impairment, and pain-related fear to disability in patients with chronic mechanical neck pain. *Am. J. Phys. Med. Rehabil.* **2012**, *91*, 1070–1076. [CrossRef]
52. Benatto, M.T.; Bevilaqua-Grossi, D.; Carvalho, G.F.; Bragatto, M.M.; Pinheiro, C.F.; Lodovichi, S.S.; Dach, F.; Fernandez-de-Las-Penas, C.; Florencio, L.L. Kinesiophobia is associated with migraine. *Pain Med.* **2019**, *20*, 846–851. [CrossRef] [PubMed]
53. Calvo-Lobo, C.; Pacheco-da-Costa, S.; Hita-Herranz, E. Efficacy of Deep Dry Needling on Latent Myofascial Trigger Points in Older Adults With Nonspecific Shoulder Pain: A Randomized, Controlled Clinical Trial Pilot Study. *J. Geriatr. Phys. Ther.* **2017**, *40*, 63–73. [CrossRef] [PubMed]
54. Segura-Pérez, M.; Hernández-Criado, M.T.; Calvo-Lobo, C.; Vega-Piris, L.; Fernández-Martín, R.; Rodríguez-Sanz, D. A Multimodal Approach for Myofascial Pain Syndrome: A Prospective Study. *J. Manip. Physiol. Ther.* **2017**, *40*, 397–403. [CrossRef] [PubMed]
55. Rodríguez-Sanz, D.; Calvo-Lobo, C.; Unda-Solano, F.; Sanz-Corbalán, I.; Romero-Morales, C.; López-López, D. Cervical Lateral Glide Neural Mobilization Is Effective in Treating Cervicobrachial Pain: A Randomized Waiting List Controlled Clinical Trial. *Pain Med.* **2017**, *18*, 2492–2503. [CrossRef]

56. Sanz, D.R.; Lobo, C.C.; López, D.L.; Morales, C.R.; Marín, C.S.; Corbalán, I.S. Interrater Reliability in the Clinical Evaluation of Myofascial Trigger Points in Three Ankle Muscles. *J. Manip. Physiol. Ther.* **2016**, *39*, 623–634. [CrossRef]
57. Calvo-Lobo, C.; Diez-Vega, I.; Martínez-Pascual, B.; Fernández-Martínez, S.; de la Cueva-Reguera, M.; Garrosa-Martín, G.; Rodríguez-Sanz, D. Tensiomyography, sonoelastography, and mechanosensitivity differences between active, latent, and control low back myofascial trigger points: A cross-sectional study. *Medicine* **2017**, *96*, e6287. [CrossRef]
58. Romero-Morales, C.; Jaén-Crespo, G.; Rodríguez-Sanz, D.; Sanz-Corbalán, I.; López-López, D.; Calvo-Lobo, C. Comparison of Pressure Pain Thresholds in Upper Trapezius and Temporalis Muscles Trigger Points Between Tension Type Headache and Healthy Participants: A Case–Control Study. *J. Manip. Physiol. Ther.* **2017**, *40*, 609–614. [CrossRef]
59. Rodríguez-Sanz, D.; Losa-Iglesias, M.E.; López-López, D.; Calvo-Lobo, C.; Palomo-López, P.; Becerro-de-Bengoa-Vallejo, R. Infrared thermography applied to lower limb muscles in elite soccer players with functional ankle equinus and non-equinus condition. *PeerJ* **2017**, *5*, e3388. [CrossRef]
60. López-López, D.; Rodríguez-Vila, I.; Losa-Iglesias, M.E.; Rodríguez-Sanz, D.; Calvo-Lobo, C.; Romero-Morales, C.; Becerro-De-Bengoa-Vallejo, R. Impact of the quality of life related to foot health in a sample of pregnant women: A case control study. *Medicine* **2017**, *96*, e6433. [CrossRef]