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Research Article

Regular Sports Participation, Physical Activity, and Effective Communication Skills among University Students: A Cross-Sectional Study

Kaan KARATAŞ [1] **Melihcan GÜNAY** [2] ***Murat KASAP** [2]

[1] Bartın University, Faculty of Sport Sciences; Kkaan4786@gmail.com; Bartın/Türkiye
[2] Bartın University, Faculty of Sport Sciences; haltercimelih7@gmail.com; Bartın/Türkiye
[2] Bartın University, Faculty of Sport Sciences; Bartın/Türkiye
* *Corresponding author: Murat Kasap; mkasap@bartin.edu.tr*

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Abstract: This cross-sectional study examined physical activity, sitting time, and self-reported regular sports participation in relation to five communication dimensions among 431 university students in Türkiye. Participants completed the International Physical Activity Questionnaire–Short Form and the Effective Communication Skills Scale. Following verification of reverse scoring, subscales were analysed separately using Welch comparisons, correlations, and multivariable regressions with HC3 robust inference and Holm adjustments. Physical activity was weakly negatively associated with active-participative listening (Pearson $r = -.160$, Holm-adjusted $p = .003$; Spearman $\rho = -.156$, Holm-adjusted $p = .005$). Unadjusted sports group comparisons were not significant after adjustment. Self-recognition/self-disclosure differed by age, with higher scores among participants aged ≥30 than those aged 18–20 or 21–23. Its adjusted sport coefficient was positive but sensitive to activity-data processing. Models explained 2.7%–8.8% of variance. I-message use showed very low internal consistency ($\alpha = .259$), substantially limiting interpretation. Sitting-time correlations were not significant after adjustment. Findings do not establish a general communication advantage among self-reported sport participants or a causal activity effect. Future studies should measure participation context and establish adequate outcome reliability.

Keywords: Physical activity, communication skills, university students, sports participation, sedentary behaviour.

1. Introduction

This study examines whether university students' physical activity, sitting time, and self-perceived regular sports participation are associated with distinct communication skills. University life involves negotiating new relationships, expressing personal needs, understanding others, and cooperating across academic and social settings. These tasks make communication a relevant outcome in studies of student development. Emerging adulthood provides a developmental context for such questions, although university populations also include older students whose experiences may differ (Arnett, 2000). Communication is multidimensional: attentive listening, empathy, constructive language, and self-disclosure should not be assumed to respond identically to the same experience (Buluş et al., 2017).

Physical activity has established health benefits, but its relationship with communication requires separate investigation (World Health Organization, 2020). A metabolic equivalent of task (MET) expresses activity intensity relative to resting energy expenditure. The International Physical Activity Questionnaire–Short Form (IPAQ-SF) combines intensity, reported duration, and frequency into MET-minutes per week (Craig et al., 2003). This quantity describes activity volume rather than the quality of social interaction during activity. Walking alone and exercising with a group can contribute to the same weekly total while providing different opportunities to listen, negotiate, give feedback, or disclose feelings.

Evidence from Türkiye illustrates the importance of distinguishing the exposure and outcome being studied. Öztürk et al. (2011) reported higher communication scores among university-team athletes than among students not doing sport. Their comparison concerned membership of university teams and used a different communication instrument. Gökçe and Keçeci (2020) examined communication and social appearance anxiety among adults participating in physical activity in different settings. More recently, Kaşali et al. (2026) investigated communication dimensions among medical students and reported differences related to educational and sport-related characteristics. These studies motivate investigation of communication in activity settings, but their measures and populations do not make their findings directly interchangeable with an IPAQ total or a single self-assessment of regular sport participation.

Recent Turkish findings also suggest that communication differences depend on the population and dimension assessed. In 300 university students, Tunç and Uğur (2024) found no significant communication difference by regular sports participation. Çetin and İmamoğlu (2023), studying 395 sport-sciences students, reported small differences favouring women in selected communication dimensions but no differences across departments or class years. Among sport-centre participants, communication scores differed by age and education but not sex (Tapşın & Karagün, 2024). Yavuz et al. (2025) examined communication and self-confidence in 368 underwater-sport athletes and reported an association between these constructs. Together, these studies support attention to demographic and sporting context, while their different measures and participant groups limit direct comparison.

International studies have also examined social and psychological processes that might accompany activity. In a survey of 847 college students, Ni and Chen (2025) found positive associations between physical activity and interpersonal competence and considered self-control and prosocial emotional management as potential intervening variables. Zhao and Zhang (2026) examined exercise, peer relationships, self-efficacy, and social-emotional competence among 517 students. Wang et al. (2025) approached the relationship from the other direction, examining interpersonal relationships, social support, and motivation in relation to activity. Such cross-sectional models suggest hypotheses about social context; they do not establish temporal ordering or show that energy expenditure itself improves communication.

Social relationships may be both a context for activity and an outcome associated with participation. Shu et al. (2024) linked activity with perceived social support and modelled social–emotional competence as an intermediary among 408 students. Zhao et al. (2024) reported associations with relationship quality, support, and loneliness in 784 students. A two-wave study of 412 students found reciprocal prospective associations between social support and activity over two months (Zhou et al., 2024). Li and Meng (2023) further distinguished communication with close and acquaintance networks when examining physical activity. These studies indicate that social resources and interaction patterns deserve separate measurement rather than being inferred from weekly activity volume.

The broader sport literature reinforces this distinction. Eather et al. (2023) reviewed 29 adult studies and found generally favourable mental-health and social outcomes, with team sport often showing additional advantages; variation in study quality and exposure definitions limited causal interpretation. At the student level, Fu and Jiang (2026) reported a positive exercise–interpersonal-skills association and examined social anxiety and peer relationships as potential intermediaries. Xiang et al. (2024) instead studied subjective exercise experience, self-efficacy, interpersonal relationships, and anxiety among freshmen. Their exposure concerned the experience of exercise rather than its MET-based volume. Thus, evidence on social benefits of participation cannot automatically be translated into predictions for each specific communication skill.

These distinctions leave a practical measurement question. A student who describes their sport participation as regular may be physically active without sustained group interaction, while a student who answers no may accumulate substantial walking or other activity. Similarly, sitting can occur during solitary study or collaborative work. Treating sport, overall activity, and sitting as interchangeable markers of interpersonal exposure would therefore obscure the constructs actually measured. Assessing them together against separate communication dimensions can identify whether a pattern is broad, dimension-specific, or dependent on statistical adjustment. This is useful for university programmes that might otherwise infer communication benefits from attendance or activity volume alone.

Accordingly, this study examined associations of weekly activity volume and daily sitting time with five communication dimensions; differences by sex, recorded age group, self-reported regular sports participation, and IPAQ category; and associations after these demographic and behavioural variables were considered simultaneously. The aim was to describe the magnitude and consistency of associations in a university sample, without treating them

as causal effects. The analyses also evaluated internal consistency and sensitivity to data processing because communication scores and self-reported activity require explicit measurement checks before substantive conclusions can be drawn.

2. Materials and Methods

2.1. Research Model

A cross-sectional survey used convenience sampling to recruit undergraduate students from universities in Türkiye during 2025 through institutional communication channels and voluntary announcements. Eligibility required age ≥18 years, undergraduate enrolment, and informed consent. The sample comprised 431 participants, all of whom were included in the analyses. Study variables were complete, and no statistical imputation was used. The sample was not a probability sample of Turkish university students, and institution-specific representation cannot be established from the analytical file.

2.2. Research Group

Sample-size planning used G*Power for multiple regression with eight predictors, a medium effect size ($f^2 = .15$), $\alpha = .05$, and power = .80, yielding a minimum of 109 participants (Faul et al., 2009). The final sample exceeded this requirement. That calculation concerned an overall model of medium effect size; it does not establish adequate power for every small association, older age subgroup, or multiplicity-adjusted comparison in the present analyses.

2.3. Data Collection Tools

2.3.1. Physical activity and sitting time

The IPAQ-SF assessed vigorous activity, moderate activity, walking, and sitting over the preceding seven days (Craig et al., 2003; Öztürk, 2005). Recorded activity hours were converted to minutes; for example, 0.5 hours represented 30 minutes. Zero denoted no activity. Following IPAQ processing guidance, daily duration for each activity type was capped at 180 minutes before multiplying by frequency and the relevant MET value: 8.0 for vigorous activity, 4.0 for moderate activity, and 3.3 for walking (IPAQ Research Committee, 2005). Components were summed as MET-minutes per week. Sitting remained a separate hours-per-day variable. No logarithmic transformation or statistical outlier deletion was applied.

The duration cap affected at least one value for 73 participants: 12 vigorous, 23 moderate, and 52 walking durations. No participant exceeded the 960-minute sum-of-daily-activity-durations exclusion threshold, and no positive activity duration was shorter than 10 minutes. The final dataset had complete study variables and no contradictory zero-day/positive-duration combinations. Two source-verified responses reported 1.5 activity days. These were retained without rounding in the principal analysis, explicitly departing from the standard whole-day interpretation, and analyses excluding those two participants were conducted as a sensitivity check.

High activity required ≥3 vigorous days with ≥1500 vigorous MET-minutes/week, or ≥7 summed activity days with ≥3000 total MET-minutes/week. Among remaining participants, moderate activity required ≥3 vigorous days of ≥20 minutes/day, ≥5 qualifying walking/moderate days of ≥30 minutes/day, or ≥5 summed activity days with ≥600 total MET-minutes/week. Others were classified as low. Summed days represent reported activity-type frequencies, not verified distinct calendar days (IPAQ Research Committee, 2005).

2.3.2. Effective communication skills

The 34-item Effective Communication Skills Scale (ECSS) was scored as five separate subscales: ego-supportive language (ESL; items 1–6), active-participative listening (APL; 7–14), self-recognition/self-disclosure (SRSD; 15–19), empathy (EMP; 20–27), and I-message use (IM; 28–34). Responses were assigned values from 1 to 5 in increasing order of appropriateness. Items 15, 16, 28, 32, and 33 were reverse scored exactly once using 6 minus the raw item score. Relevant item scores were then summed. Higher scores are intended to indicate greater use of the corresponding skill; no overall 34-item communication score was interpreted, consistent with the original framework (Buluş et al., 2017).

Internal consistency was recalculated after reverse scoring. Cronbach's α was .892 for ESL, .956 for APL, .686 for SRSD, .965 for EMP, and .259 for IM. The very low IM estimate substantially restricts interpretation of that subscale; its results are reported transparently as exploratory rather than treated as evidence of a well-measured communication trait. No

item was deleted and no scoring direction was changed to increase reliability. SRSD results also warrant caution because of its lower internal consistency relative to ESL, APL, and EMP.

2.4. Data Collection Process

Data were collected through an online questionnaire. Participants received information about the study, voluntary participation, and confidentiality and provided informed consent before completing demographic questions, the IPAQ-SF, and the communication scale. The research team checked incomplete or ambiguous entries against the original questionnaire records and supplied the final verified dataset for reanalysis. The analysis used only that version. Days and hours were distinguished using the questionnaire headings and the researchers' verification of ambiguous entries. This source-based verification was completed before statistical scoring and was not model-based imputation.

Sex, age group, department or faculty field, and self-reported regular sports participation were recorded. Age was collected directly as 18–20, 21–23, 24–26, 27–29, or ≥30 years. Exact age was unavailable; continuous ages were neither reconstructed from midpoints nor inferred for the open-ended group. Four indicator variables represented age in regression. Faculty information was retained as reported categories, including other/unspecified and multiple selections; students selecting more than one field were not reassigned to a single faculty.

Regular sports participation was assessed by the yes/no item (whether the participant regularly participates in sport). No minimum days per week, minutes per session, or training history was specified. The term "self-reported regular sports participation" is therefore used throughout. The survey did not establish team versus individual sport, number of co-participants, competitive level, amateur or professional athlete status, or verified sporting background. IPAQ frequency and duration describe recent activity, not these missing sport-specific characteristics. No response consequently cannot be equated with physical inactivity.

2.5. Statistical Analysis

Analyses were performed in Python 3.12.14 using NumPy 2.5.3, SciPy 1.18.1, pandas 3.0.5, and stats models 0.15.0. Continuous variables are summarised as mean and standard deviation, median and interquartile range (IQR; Q3 minus Q1), and observed range; categorical variables are counts and percentages. Welch t tests compared sex and sport groups, and Welch ANOVA compared age groups and IPAQ categories. Thus, equal variances were not assumed for the principal group comparisons. Two-group mean differences, 95% confidence intervals, and Hedges g were calculated. For multi-group comparisons, descriptive η^2 was the between-group sum of squares divided by total sum of squares, not an effect size derived from the Welch statistic. Games–Howell comparisons followed a multiplicity-adjusted significant age result. Mann–Whitney U and Kruskal–Wallis tests assessed sensitivity to the parametric approach.

Pearson correlations quantified linear associations of activity and sitting with each subscale. Confidence intervals used Fisher's transformation. Spearman correlations provided sensitivity analyses for skewness and the influence of the ordering of observations. Separate ordinary least-squares regressions included sex, four age indicators, self-reported sport participation, activity per 1000 MET-minutes/week, and sitting hours/day. Reference categories were female, age 18–20, and no self-reported regular sport. Coefficients are unstandardised differences conditional on the other included variables, not causal effects.

HC3 heteroscedasticity-robust standard errors were used for the principal regression inference; conventional OLS model tests are also reported for comparison. Coefficient tests and intervals used a t distribution with 422 residual degrees of freedom, and robust overall model tests used an F distribution. Residual checks included Shapiro–Wilk tests, Breusch–Pagan tests, a robust second-order RESET specification test, variance inflation factors (VIFs), and Cook's distances. Observations exceeding Cook's $D > 4/n$ were flagged for diagnostic attention, not automatically deleted. Regression coefficients and HC3 standard errors were independently checked using matrix calculations.

All tests were two-sided. Holm adjustment was applied within each five-subscale family: separately for each group comparison, each exposure and correlation method, the five overall regression models, and each predictor's five coefficients. Reported confidence intervals are pointwise and are not multiplicity-adjusted. Games–Howell p values account for the age-pair comparison family. These procedures control errors within the stated families, not across every analysis in the study. Nominal and adjusted p values are distinguished, and an adjusted p below .05 was used to identify findings within each family. Because numerous related questions were examined, the analyses are interpreted as exploratory.

Sensitivity analyses evaluated correlations and regression models excluding the two participants reporting fractional days (n = 429) and, separately, using activity durations without the 180-minute cap (n = 431). These checks evaluated dependence on processing choices; they did not replace the primary capped-duration analysis. Findings were assessed using effect magnitude, uncertainty, measurement quality, and agreement between methods rather than isolated thresholds. No equivalence or non-inferiority testing was performed, so a non-significant comparison does not establish that groups are equivalent.

2.6. Ethical Approval

The study was conducted in accordance with the Declaration of Helsinki and received ethical approval from the Bartın University Social and Human Sciences Ethics Committee (Protocol No. 2025-SBB-0099, dated June 19, 2025). Participation was voluntary, and informed consent was obtained from all participants prior to questionnaire completion. Author and institutional information was retained in the manuscript for transparency.

3. Results

3.1. Participant and Variable Characteristics

The sample comprised 280 women (65.0%) and 151 men (35.0%); 146 participants (33.9%) reported regular sports participation. Age 18–20 was the largest category (49.2%). Fifty-nine participants (13.7%) reported sport sciences as their field. Other/unspecified was selected by 128 participants, and eight selected multiple fields. Faculty categories and all other participant characteristics are provided in Table 1; the recorded categories cannot establish athlete status or detailed training background.

Table 1. Participant characteristics

Characteristic	Category	n	%
Sex	Women	280	65.0
	Men	151	35.0
Age in years	18–20	212	49.2
	21–23	147	34.1
	24–26	24	5.6
	27–29	11	2.6
	≥30	37	8.6
Self-reported regular sport	Yes	146	33.9
	No	285	66.1
IPAQ category	Low	59	13.7
	Moderate	164	38.1
	High	208	48.3
	Other/unspecified	128	29.7
Faculty/field	Sport sciences	59	13.7
	Engineering/architecture	52	12.1
	Health sciences	51	11.8
	Science/arts	39	9.0
	Education	37	8.6
	Economics/administrative or political sciences	31	7.2
	Fine arts/design	14	3.2
	Multiple selections	8	1.9
	Communication	6	1.4
	Theology/Islamic sciences	4	0.9
	Law	2	0.5

Note. N = 431. Faculty categories reproduce the recorded fields; other/unspecified does not identify a particular faculty. Percentages may not sum to 100 because of rounding. IPAQ = International Physical Activity Questionnaire.

Mean physical activity was 3754.12 ± 3069.34 MET-minutes/week, with a median of 3030 and IQR of 3708. Low, moderate, and high IPAQ categories included 59, 164, and 208 participants, respectively. Mean sitting time was 7.25 ±

3.34 hours/day. Subscale distributions and reliability estimates are shown in Table 2. IM had an observed range of 13–35 but very low internal consistency; a plausible numerical score range should therefore not be mistaken for satisfactory measurement quality.

Table 2. Descriptive Statistics and Subscale Reliability

Variable	M ± SD	Median (IQR)	Range	α
Ego-supportive language	22.72 ± 5.21	24 (6)	6–30	.892
Active-participative listening	32.33 ± 7.23	33 (9)	8–40	.956
Self-recognition/self-disclosure	17.06 ± 4.24	17 (5)	5–25	.686
Empathy	31.00 ± 7.25	32 (8)	8–40	.965
I-message use	24.10 ± 3.62	23 (5)	13–35	.259
Activity (MET-min/week)	3754.12 ± 3069.34	3030 (3708)	0–17838	—
Sitting (hours/day)	7.25 ± 3.34	7 (3)	0–21	—

Note. N = 431 for every variable. IQR = Q3 − Q1. Activity durations are capped at 180 minutes per activity type per day. α = Cronbach's alpha after reverse scoring.

3.2. Group Comparisons

Welch comparisons are summarised in Table 3. Women scored higher on IM than men (mean difference = 1.81, 95% CI [1.13, 2.49], g = 0.514; Holm p < .001), but this result concerns the poorly reliable subscale. The APL sex difference reached nominal significance (p = .017) but not Welch–Holm significance (p = .069). Its Mann–Whitney sensitivity result was significant after Holm adjustment (p = .028), indicating dependence on the comparison method rather than a uniformly supported sex difference.

No unadjusted sport-group comparison was significant after Holm adjustment. For SRSD, the mean difference between sport yes and no was 0.65 points (95% CI [−0.17, 1.48], g = 0.154; nominal p = .119, Holm p = .475). The nominal IM sport difference (p = .045) did not survive adjustment (p = .227). These comparisons provide no consistent evidence of a general communication advantage in the self-reported regular-sport group; they do not establish equivalence between groups.

Table 3. Sex and Sport Group Comparisons

Group / score	First group M ± SD	Second group M ± SD	Difference [95% CI]	Welch t (df)	p / Holm p
Sex / ESL	23.03 ± 4.98	22.15 ± 5.60	0.88 [−0.19, 1.95]	1.62 (277.99)	.106 / .317
Sex / APL	32.95 ± 7.04	31.18 ± 7.45	1.77 [0.32, 3.22]	2.40 (292.76)	.017 / .069
Sex / SRSD	17.24 ± 4.26	16.73 ± 4.20	0.51 [−0.33, 1.35]	1.20 (310.92)	.232 / .320
Sex / EMP	31.36 ± 7.17	30.32 ± 7.38	1.04 [−0.41, 2.49]	1.41 (299.73)	.160 / .320
Sex / IM	24.74 ± 3.65	22.93 ± 3.27	1.81 [1.13, 2.49]	5.26 (336.91)	<.001 / <.001
Sport / ESL	22.55 ± 5.74	22.80 ± 4.93	−0.25 [−1.35, 0.85]	−0.45 (256.31)	.656 / 1.000
Sport / APL	32.46 ± 7.64	32.26 ± 7.02	0.20 [−1.29, 1.69]	0.26 (271.59)	.792 / 1.000
Sport / SRSD	17.49 ± 3.98	16.84 ± 4.36	0.65 [−0.17, 1.48]	1.56 (316.85)	.119 / .475
Sport / EMP	31.19 ± 7.72	30.90 ± 7.01	0.29 [−1.21, 1.79]	0.38 (268.88)	.704 / 1.000
Sport / IM	23.62 ± 3.61	24.35 ± 3.61	−0.74 [−1.46, −0.01]	−2.01 (292.58)	.045 / .227

Note. First minus second group: women (n = 280) minus men (n = 151), or sport yes (n = 146) minus no (n = 285). Confidence intervals are pointwise. Holm adjustment is separate within each comparison's five outcomes. ESL = ego-supportive language; APL = active-participative listening; SRSD = self-recognition/self-disclosure; EMP = empathy; IM = I-message use. IM has very low reliability (α = .259).

SRSD differed by age, Welch F(4, 49.87) = 4.861, nominal p = .002, Holm p = .011, descriptive η^2 = .037 (Table 4). Kruskal–Wallis analysis also supported an age difference after adjustment (p = .020). Games–Howell comparisons showed higher scores for participants aged ≥30 than those aged 18–20 (difference = 2.71, 95% CI [0.88, 4.54], p < .001) and 21–23 (difference = 2.41, 95% CI [0.53, 4.28], p = .006). Other age pairs were not significant. No other subscale showed a significant Welch–Holm age difference.

None of the IPAQ-category Welch comparisons remained significant after Holm adjustment. The adjusted APL p value was .0504 and was therefore not classified as significant. IM was significant in the Kruskal–Wallis sensitivity analysis (Holm p = .045) but not the principal Welch analysis (p = .0592). This disagreement and the very low IM reliability preclude a firm interpretation of an activity-category difference.

Table 4. Age and Activity Category Comparisons

Comparison	Welch F	df1, df2	p	Holm p	η^2
Age / ESL	0.878	4, 48.99	.484	.9680	.008
Age / APL	0.492	4, 49.38	.742	.9680	.005
Age / SRSD	4.861	4, 49.87	.002	.0109	.037
Age / EMP	1.625	4, 49.30	.183	.7064	.015
Age / IM	1.651	4, 48.56	.177	.7064	.021
IPAQ / ESL	0.968	2, 166.75	.382	.7637	.005
IPAQ / APL	4.728	2, 165.12	.010	.0504	.021
IPAQ / SRSD	0.435	2, 160.43	.648	.7637	.002
IPAQ / EMP	2.159	2, 167.94	.119	.3559	.009
IPAQ / IM	4.322	2, 165.56	.015	.0592	.020

Note. N = 431. Holm adjustment is separate for age and IPAQ families. η^2 is descriptive between-group SS/total SS, not derived from Welch F. The APL IPAQ adjusted value .0504 exceeds .05. ESL = ego-supportive language; APL = active-participative listening; SRSD = self-recognition/self-disclosure; EMP = empathy; IM = I-message use. IM has very low reliability (α = .259).

3.3. Correlations

Activity showed small negative Pearson correlations with ESL, APL, EMP, and IM after Holm adjustment (Table 5). Among subscales with strong internal consistency, APL had the clearest agreement between linear and rank-based analyses: r = −.160, 95% CI [−.251, −.067], Holm p = .003; Spearman ϱ = −.156, Holm p = .005. ESL and EMP correlations did not remain significant in their Spearman–Holm analyses. IM was significant by both correlation methods, but its measurement limitation remains. No sitting-time correlation with a communication subscale was significant after Holm adjustment. These small associations do not identify whether activity preceded communication differences.

Table 5. Correlations With Activity and Sitting

Exposure / score	Pearson r [95% CI]	p	Holm p	Spearman ϱ	p	Holm p
Activity / ESL	−.130 [−.222, −.036]	.007	.020	−.107	.027	.079
Activity / APL	−.160 [−.251, −.067]	<.001	.003	−.156	.001	.005
Activity / SRSD	−.071 [−.164, .024]	.141	.141	−.107	.026	.079
Activity / EMP	−.120 [−.212, −.026]	.012	.025	−.072	.137	.137
Activity / IM	−.181 [−.271, −.088]	<.001	<.001	−.174	<.001	.001
Sitting / ESL	.040 [−.055, .134]	.411	1.000	.076	.117	.351
Sitting / APL	.071 [−.024, .164]	.141	.565	.105	.029	.144
Sitting / SRSD	−.004 [−.098, .091]	.941	1.000	.027	.575	1.000
Sitting / EMP	.084 [−.010, .177]	.081	.406	.096	.047	.187
Sitting / IM	.007 [−.088, .101]	.891	1.000	.026	.594	1.000
Activity / ESL	−.130 [−.222, −.036]	.007	.020	−.107	.027	.079
Activity / APL	−.160 [−.251, −.067]	<.001	.003	−.156	.001	.005
Activity / SRSD	−.071 [−.164, .024]	.141	.141	−.107	.026	.079
Activity / EMP	−.120 [−.212, −.026]	.012	.025	−.072	.137	.137
Activity / IM	−.181 [−.271, −.088]	<.001	<.001	−.174	<.001	.001
Sitting / ESL	.040 [−.055, .134]	.411	1.000	.076	.117	.351
Sitting / APL	.071 [−.024, .164]	.141	.565	.105	.029	.144
Sitting / SRSD	−.004 [−.098, .091]	.941	1.000	.027	.575	1.000
Sitting / EMP	.084 [−.010, .177]	.081	.406	.096	.047	.187
Sitting / IM	.007 [−.088, .101]	.891	1.000	.026	.594	1.000

Note. N = 431. Pearson intervals use Fisher's transformation and are pointwise. Holm families are defined separately for each exposure and each method. ESL = ego-supportive language; APL = active-participative listening; SRSD = self-recognition/self-disclosure; EMP = empathy; IM = I-message use. IM has very low reliability (α = .259).

3.4. Multivariable Models and Diagnostics

Models explained 2.7%–8.8% of subscale variance (Table 6). With HC3 inference and Holm adjustment across the five models, SRSD (p = .002) and IM (p < .001) remained significant. APL had a nominal robust model p of .045 but an

adjusted p of .136. The IM model's significance does not resolve its poor outcome reliability. Full coefficient estimates and pointwise confidence intervals are reported in Table 7 to make the conditional comparisons transparent.

Table 6. Dimension-Specific Regression Model Summaries

Outcome	R^2	Adjusted R^2	OLS p	HC3 F	HC3 p	HC3 Holm p
ESL	.027	.009	.165	1.254	.266	.266
APL	.048	.030	.007	1.998	.045	.136
SRSD	.058	.040	.001	3.598	<.001	.002
EMP	.040	.022	.027	1.877	.062	.136
IM	.088	.071	<.001	4.883	<.001	<.001

Note. N = 431; model df = 8, 422. Predictors: sex, four age indicators, sport participation, activity, and sitting. HC3 = heteroscedasticity-consistent inference, type 3. Holm adjustment covers the five robust model tests. ESL = ego-supportive language; APL = active-participative listening; SRSD = self-recognition/self-disclosure; EMP = empathy; IM = I-message use. IM has very low reliability (α = .259).

In the SRSD model, participants aged ≥30 scored 2.73 points higher than those aged 18–20 (95% CI [1.39, 4.07]; predictor-family Holm p < .001). Self-reported regular sport was associated with a 1.28-point higher SRSD score (95% CI [0.38, 2.18]; Holm p = .028). The APL activity coefficient was −0.402 per 1000 MET-minutes/week (95% CI [−0.704, −0.100]; Holm p = .046), although the overall APL model did not survive model-family adjustment. The IM male coefficient was negative (B = −1.61, 95% CI [−2.32, −0.91]; Holm p < .001), subject to its reliability limitation. Other coefficients did not survive their corresponding predictor-family adjustments.

Residual normality tests were significant in all five models. Breusch–Pagan tests indicated heteroscedasticity for APL, EMP, and IM (p = .024, .003, and .021), supporting the use of HC3 inference. Robust RESET tests did not identify significant second-order specification terms. VIFs ranged from 1.040 to 1.324. Maximum Cook's distances ranged from 0.056 to 0.095; the numbers exceeding 4/n were 36, 28, 17, 26, and 26 for ESL, APL, SRSD, EMP, and IM. These observations were retained. Robust standard errors address a specific variance assumption, not measurement error, all possible nonlinearity, or omitted confounding.

Table 7. Full Multivariable Coefficient Estimates

Outcome / predictor	B	HC3 SE	95% CI	p	Holm p
ESL / Intercept	22.986	0.869	[21.278, 24.695]	<.001	—
ESL / Male vs female	−0.622	0.568	[−1.739, 0.495]	.274	.530
ESL / Age 21–23 vs 18–20	0.779	0.545	[−0.292, 1.849]	.154	.676
ESL / Age 24–26 vs 18–20	−0.141	1.177	[−2.455, 2.172]	.904	1.000
ESL / Age 27–29 vs 18–20	0.630	2.137	[−3.570, 4.831]	.768	.768
ESL / Age ≥30 vs 18–20	0.779	1.036	[−1.257, 2.816]	.452	1.000
ESL / Sport yes vs no	0.677	0.646	[−0.592, 1.946]	.295	.590
ESL / Activity per 1000 MET-min/week	−0.214	0.106	[−0.423, −0.005]	.044	.133
ESL / Sitting per hour/day	0.025	0.086	[−0.143, 0.194]	.767	1.000
APL / Intercept	32.764	1.273	[30.262, 35.267]	<.001	—
APL / Male vs female	−1.516	0.754	[−2.999, −0.033]	.045	.181
APL / Age 21–23 vs 18–20	0.079	0.741	[−1.378, 1.536]	.915	1.000
APL / Age 24–26 vs 18–20	0.344	1.710	[−3.018, 3.706]	.841	1.000
APL / Age 27–29 vs 18–20	2.243	2.388	[−2.450, 6.936]	.348	.696
APL / Age ≥30 vs 18–20	0.601	1.460	[−2.269, 3.471]	.681	1.000
APL / Sport yes vs no	1.906	0.848	[0.240, 3.572]	.025	.100
APL / Activity per 1000 MET-min/week	−0.402	0.154	[−0.704, −0.100]	.009	.046
APL / Sitting per hour/day	0.111	0.124	[−0.132, 0.354]	.371	1.000
SRSD / Intercept	16.934	0.627	[15.702, 18.165]	<.001	—
SRSD / Male vs female	−0.670	0.445	[−1.544, 0.204]	.133	.398
SRSD / Age 21–23 vs 18–20	0.305	0.453	[−0.586, 1.196]	.501	1.000
SRSD / Age 24–26 vs 18–20	0.607	0.963	[−1.285, 2.500]	.528	1.000
SRSD / Age 27–29 vs 18–20	2.435	1.473	[−0.461, 5.331]	.099	.397

Tablo 7. (Continue)

Outcome / predictor	B	HC3 SE	95% CI	p	Holm p
SRSD / Age ≥30 vs 18–20	2.730	0.682	[1.389, 4.070]	<.001	<.001
SRSD / Sport yes vs no	1.276	0.458	[0.376, 2.176]	.006	.028
SRSD / Activity per 1000 MET-min/week	−0.122	0.081	[−0.281, 0.036]	.131	.133
SRSD / Sitting per hour/day	−0.006	0.064	[−0.132, 0.119]	.919	1.000
EMP / Intercept	30.132	1.212	[27.750, 32.514]	<.001	—
EMP / Male vs female	−0.855	0.767	[−2.362, 0.651]	.265	.530
EMP / Age 21–23 vs 18–20	1.073	0.732	[−0.365, 2.511]	.143	.676
EMP / Age 24–26 vs 18–20	0.849	1.909	[−2.904, 4.602]	.657	1.000
EMP / Age 27–29 vs 18–20	4.342	2.270	[−0.120, 8.804]	.056	.282
EMP / Age ≥30 vs 18–20	0.918	1.390	[−1.814, 3.650]	.509	1.000
EMP / Sport yes vs no	1.646	0.865	[−0.054, 3.346]	.058	.173
EMP / Activity per 1000 MET-min/week	−0.289	0.153	[−0.589, 0.011]	.059	.133
EMP / Sitting per hour/day	0.151	0.116	[−0.076, 0.378]	.193	.965
IM / Intercept	25.099	0.535	[24.048, 26.150]	<.001	—
IM / Male vs female	−1.613	0.360	[−2.321, −0.905]	<.001	<.001
IM / Age 21–23 vs 18–20	0.540	0.361	[−0.169, 1.249]	.135	.676
IM / Age 24–26 vs 18–20	0.303	0.811	[−1.291, 1.897]	.709	1.000
IM / Age 27–29 vs 18–20	2.333	1.805	[−1.216, 5.882]	.197	.591
IM / Age ≥30 vs 18–20	0.988	0.663	[−0.315, 2.290]	.137	.547
IM / Sport yes vs no	0.113	0.410	[−0.694, 0.919]	.784	.784
IM / Activity per 1000 MET-min/week	−0.137	0.056	[−0.246, −0.027]	.015	.058
IM / Sitting per hour/day	−0.041	0.052	[−0.143, 0.061]	.427	1.000

Note. N = 431. B is unstandardised; confidence intervals use HC3 SE and t(422) and are not multiplicity-adjusted. Each predictor's five outcome coefficients form a separate Holm family. Intercepts are not interpreted substantively. IM estimates are exploratory owing to very low reliability. ESL = ego-supportive language; APL = active-participative listening; SRSD = self-recognition/self-disclosure; EMP = empathy; IM = I-message use. IM has very low reliability (α = .259).

3.5. Sensitivity Analyses and Overall Pattern

Excluding the two fractional-day responses did not change the significance pattern of the overall models or the activity and sport coefficients after Holm adjustment (Table 8). Without the 180-minute cap, however, the APL Pearson correlation no longer survived adjustment (p = .052), while its Spearman association did (p = .010). The adjusted SRSD sport coefficient also no longer survived adjustment (p = .061), and the APL activity coefficient was not significant (p = .338). Thus, some associations depended on activity-data processing and should not be described as stable independent effects.

Table 8. Sensitivity of Models and Activity and Sport Coefficients

Analysis / outcome	n	R^2	Model Holm p	Activity Holm p	Sport Holm p
Exclude fractional days / ESL	429	.027	.269	.129	.603
No duration cap / ESL	431	.020	.414	.464	.966
Exclude fractional days / APL	429	.048	.141	.043	.109
No duration cap / APL	431	.036	.326	.338	.297
Exclude fractional days / SRSD	429	.057	.002	.129	.030
No duration cap / SRSD	431	.055	.004	.569	.061
Exclude fractional days / EMP	429	.040	.141	.129	.178
No duration cap / EMP	431	.032	.326	.569	.384
Exclude fractional days / IM	429	.089	<.001	.057	.798
No duration cap / IM	431	.086	<.001	.125	.966

Note. Each model retains the same covariate set. The primary analysis retains all 431 participants and applies the 180-minute cap. The two variants are separate sensitivity analyses. Adjustment families match those in the principal analysis. ESL = ego-supportive language; APL = active-participative listening; SRSD = self-recognition/self-disclosure; EMP = empathy; IM = I-message use. IM has very low reliability (α = .259).

Overall, students reporting regular sport did not have uniformly higher communication scores in unadjusted comparisons. Adjustment identified a positive SRSD sport coefficient, but this finding was sensitive to activity processing. The small inverse activity–APL association and the SRSD age difference were the most interpretable dimension-specific patterns, with the former remaining sensitive to the choice of correlation method when uncapped durations were used. Sitting showed no multiplicity-adjusted correlation, and IM results were constrained by poor reliability. These findings support evaluating specific communication outcomes and participation context rather than using sport status or activity volume alone as a proxy for communication competence.

4. Discussion

This study found small, dimension-specific associations rather than a general communication advantage associated with self-reported regular sport or greater activity volume. The principal APL correlation was negative and small, SRSD differed across age groups, and a positive adjusted SRSD sport coefficient was sensitive to activity processing. The models explained little variance. The very low internal consistency of IM restricts interpretation of otherwise significant findings involving that dimension. These results require a narrower conclusion than either a general benefit of sport for communication or a claim that activity has no relationship with communication.

The negative activity–APL association contrasts with the positive activity–interpersonal competence relationship reported by Ni and Chen (2025). It also differs from the favourable exercise–social-emotional competence pattern examined by Zhao and Zhang (2026). Fu and Jiang (2026) also reported a positive association with interpersonal skills. The outcomes are related but not identical: APL concerns a specific communication dimension, whereas those studies investigated broader constructs and psychological pathways. The present analysis did not measure emotional regulation, peer relationship quality, or self-efficacy. Differences in exposure, measurement, and sample composition are therefore plausible explanations to investigate, not established explanations for the observed sign. The correlation's small magnitude and sensitivity to duration processing argue against interpreting it as evidence that physical activity impairs listening.

The unadjusted sport results do not reproduce the higher communication scores among university-team athletes reported by Öztürk et al. (2011). Conversely, it agrees with the absence of a regular-sport communication difference reported by Tunç and Uğur (2024). Our yes/no item captured perceived regularity, not team membership or competitive sport. This distinction matters: a student can answer yes because of solitary exercise, and a no respondent may still walk extensively or exercise irregularly. Kaşali et al. (2026) likewise examined a different population and sport-related characteristics among medical students, so their findings should not be reduced to an expectation of higher scores in every self-reported sport group. The current comparison cannot test whether structured team interaction has benefits that a broad yes/no indicator fails to capture.

The contrast with favourable social outcomes in the review by Eather et al. (2023) is therefore informative rather than necessarily contradictory. Team membership and sustained interaction provide exposures that the present binary sport item cannot distinguish. Likewise, the communication–self-confidence association among underwater-sport athletes (Yavuz et al., 2025) concerns differences within a specialised sporting population, not the effect of doing sport versus not doing sport. Our data cannot identify whether confidence, shared goals, or interaction during participation accounts for particular communication scores. These comparisons support collecting sport type and social context alongside activity frequency and duration.

The SRSD sport coefficient illustrates how a conditional comparison can differ from an unadjusted group contrast. Participants were compared at the same modelled sex, age group, activity volume, and sitting time, producing a larger positive coefficient than the direct mean difference. That does not imply that the adjustment recovered a causal sport effect. Activity could be a correlate, a confounder, or part of a pathway linking sport and communication; the cross-sectional data cannot distinguish these possibilities. Wang et al. (2025) examined social relationships and motivational pathways in relation to activity, further illustrating why direction should remain open. The reciprocal prospective activity–support associations reported by Zhou et al. (2024) also caution against assuming a single direction. The loss of adjusted significance with uncapped activity strengthens the case for treating the SRSD sport result as tentative.

Social support and emotional experience offer hypotheses for future work, but they do not explain the present coefficients without direct measurement. The models of Shu et al. (2024) and Zhao et al. (2024) concern perceived support, relationship quality, and loneliness; Xiang et al. (2024) examined exercise experience and anxiety. These

constructs differ from both APL and SRSD. Li and Meng (2023) found that communication-related social control was not associated with physical activity, illustrating that even plausible network pathways need empirical testing. Adding measures of relationship quality and exercise context could clarify whether the small associations observed here reflect interpersonal opportunities, selection into activity, or other shared influences.

Participants aged ≥30 had higher SRSD scores than the two youngest groups. The agreement of Welch and rank-based comparisons supports an age-related pattern in this sample, but age cannot be separated here from accumulated experience, educational trajectory, or unmeasured social circumstances. The older group contained 37 participants, while the 27–29 group contained only 11, so subgroup precision was uneven. Tapşın and Karagün (2024) also found age differences in communication among sport-centre participants, although their findings do not establish the same SRSD pattern. Exact ages were not collected, and treating the categories as a linear age trend would add an unsupported assumption. Developmental interpretations are compatible with the broader framework of changing interpersonal demands in adulthood (Arnett, 2000), but the present data do not demonstrate that ageing itself improves disclosure.

The sex findings also require dimension-specific interpretation. Çetin and İmamoğlu (2023) reported small female advantages in selected communication dimensions among sport-sciences students. In the present sample, the APL difference depended on the comparison method and the clearest adjusted sex difference involved IM, whose reliability was very low. These results do not support a general claim that one sex communicates more effectively. Differences in measurement, sample composition, and multiplicity procedures are relevant when comparing demographic patterns across studies.

Internal consistency varied substantially across the five ECSS dimensions (Buluş et al., 2017). IM items did not form an internally consistent score in this sample. The corrected item–total correlation for item 32 was negative, and removing any single IM item increased α to no more than .369. The subscale was analysed using its published item composition and scoring key. IM sex differences, correlations, and regression results are therefore reported for transparency and should not anchor the substantive conclusions. The lower SRSD α of .686 also limits confidence in precise individual-level interpretation.

No sitting-time correlation survived multiplicity adjustment. This is not evidence of equivalence, nor does it establish that all sedentary contexts are socially similar. Time spent seated in lectures, solitary study, conversation, and collaborative activities was not distinguished. The result consequently concerns total reported sitting duration, not the interpersonal quality of sedentary behaviour. Physical-activity and sedentary-behaviour recommendations remain relevant to health (World Health Organization, 2020), but the present findings do not establish that reducing total sitting necessarily improves communication.

Several limitations constrain inference. Convenience sampling and voluntary participation restrict generalisability and leave possible selection bias. All principal measures were self-reported, making recall, response style, and social desirability possible influences. Sport regularity had no shared frequency or duration threshold, and sport type, competitive status, history, and group interaction were unmeasured. Faculty was recorded broadly, with substantial other/unspecified responses; it cannot substitute for those missing characteristics. Institution-specific sample counts were unavailable. Checking responses against source records cannot eliminate recall error or misunderstanding of item wording. Retaining two fractional-day responses also departs from the standard IPAQ day format, although excluding them did not materially alter the reported significance patterns.

The cross-sectional design cannot establish temporal order or rule out unmeasured common causes, including personality, mental health, social support, and prior communication training. Low explained variance shows that the included variables offer limited information about individual scores. Multiple testing was addressed within explicitly defined families, but the many exploratory analyses still require independent confirmation. Some findings differed between Welch and rank-based tests or between capped and uncapped activity. Neither robust standard errors nor a large total sample resolves these measurement and design limitations. In particular, the IM reliability problem places a substantive limit on what can be inferred from that score even when a p value is small.

For universities, the practical implication is to assess communication needs directly in students who do and do not report regular sport. Activity programmes may provide opportunities for cooperation and feedback, but their communication outcomes should be measured rather than presumed from participation. Students who answer no should not be labelled physically inactive or communicatively disadvantaged on that basis. If listening or constructive self-expression is a programme objective, structured peer interaction and reflection can be tested alongside usual

activity provision. The present observational findings do not establish the effectiveness of such components; they identify a question for prospective evaluation.

Future studies should combine accelerometery with records of sport type, weekly exposure, team membership, and actual interpersonal contact. Repeated measurements could distinguish selection into activity from subsequent communication change, while comparison groups would improve evaluation of programmes. Communication assessment should include adequately reliable subscales and, where feasible, peer ratings or observed behaviour. Before IM is used as a principal outcome in a similar sample, the administered wording, response process, and factor structure require examination. More detailed recruitment records and larger older-age subgroups would also improve interpretation. These steps would move the question from activity volume alone towards the specific experiences and skills that an intervention is intended to change.

5. Conclusion

Among 431 university students, self-reported regular sports participation was not associated with a consistent advantage across communication dimensions in unadjusted comparisons. Activity volume showed a small inverse association with active-participative listening; self-recognition/self-disclosure differed by age and had a positive but processing-sensitive, adjusted sport coefficient. Sitting-time correlations were not significant after multiplicity adjustment. Models explained little variance, and I-message use had very low reliability. Communication support should therefore be guided by assessed needs among both sport participants and non-participants, while physical activity continues to be promoted for its established health benefits. Prospective research should measure activity context and use reliable communication outcomes before drawing causal or programme-level conclusions.

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