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Social Determinants and Compliance with COVID-19 Measures among Schoolchildren in Bilbao, Spain: A Cross-Sectional Study

Determinantes sociales y cumplimiento de medidas contra la covid-19 en escolares de Bilbao (España): estudio transversal

Determinantes sociais e cumprimento das medidas contra a covid-19 em escolares de Bilbao, Espanha: estudo transversal

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ABSTRACT

Introduction: The COVID-19 pandemic led to the implementation of prevention, containment, and infection control measures in all settings, including educational ones. Although evidence exists on the influence of social determinants on infection transmission in educational centers, there is limited literature on the degree of compliance with these measures. **Objective**: To analyze the relationship between social determinants and the level of compliance with anti-COVID-19 measures among students, identifying differential patterns according to sociodemographic and educational context characteristics. **Methods**: This was a descriptive, cross-sectional observational study conducted through a questionnaire addressed to teachers in educational centers in Bilbao, between November 2021 and January 2022. The sample consisted of 997 teachers. A descriptive and bivariate analysis was

performed between sociodemographic variables and those related to COVID-19. **Results**: High compliance with anti-COVID-19 measures was observed among schoolchildren, with the greatest adherence seen in mask use ($p < 0.0001$) and hand hygiene ($p < 0.0001$). Statistically significant differences were found across educational stages ($p < 0.0001$), type of educational center ($p = 0.001$), and districts ($p = 0.006$). Districts with lower purchasing power, public schools, and preschool and secondary education stages showed lower adherence to anti-COVID-19 measures. **Conclusions**: In line with other research, it is evident that higher purchasing power is associated with greater compliance with anti-COVID-19 measures. Social determinants of health are shown to influence adherence to anti-COVID-19 measures in educational settings.

Keywords
social determinants of health; school health services; COVID-19; communicable disease control; public health surveillance.

RESUMEN
Introducción: La pandemia por la covid-19 supuso la implementación de medidas de prevención, contención y control de la infección en todos los ámbitos, incluido el educativo. Aunque existe evidencia sobre la influencia de los determinantes sociales en la transmisión de la infección en centros educativos, hay escasa literatura sobre el grado de cumplimiento de estas medidas. **Objetivo**: Analizar la relación entre los determinantes sociales y el nivel de cumplimiento de las medidas anti-covid-19 entre el alumnado, identificando patrones diferenciales según características sociodemográficas y del entorno educativo. **Métodos**: Estudio observacional, descriptivo y transversal, a través de un cuestionario dirigido a docentes de los centros educativos de Bilbao (España), entre noviembre de 2021 y enero de 2022. La muestra estuvo conformada por 997 docentes. Se realizó un análisis descriptivo y bivariado entre las variables sociodemográficas y las variables relacionadas con la covid-19. **Resultados**: Se evidenció un elevado cumplimiento de las medidas anti-covid-19 entre los escolares, de las cuales el uso de mascarilla ($p < 0,0001$) y la higiene de manos ($p < 0,0001$) fueron las medidas de mayor adherencia. Se encontraron diferencias estadísticamente significativas entre etapas educativas ($p < 0,0001$), tipo de centro educativo ($p = 0,001$) y distritos ($p = 0,006$). Los distritos con menor poder adquisitivo, los centros públicos y las etapas de infantil y secundaria son las que menor adherencia tuvieron a las medidas anti-covid-19. **Conclusiones**: en consonancia con otras investigaciones, se pone de manifiesto que, a mayor poder adquisitivo, mayor cumplimiento de las medidas anti-covid-19. Se demuestra que los determinantes sociales en salud influyen en el cumplimiento de las medidas anti-covid-19 en el ámbito educativo.

Palabras clave
determinantes sociales de la salud; servicios de salud escolar; covid-19; control de enfermedades transmisibles; vigilancia en salud pública.

RESUMO
Introdução: A pandemia da covid-19 levou à implementação de medidas de prevenção, contenção e controle da infecção em todos os âmbitos, inclusive o educacional. Embora exista evidência sobre a influência dos determinantes sociais na transmissão da infecção em centros educativos, há pouca literatura sobre o grau de cumprimento dessas medidas. **Objetivo**: Analisar a relação entre os determinantes sociais e o nível de cumprimento das medidas anti-covid-19 entre os escolares, identificando padrões diferenciais de acordo com as características sociodemográficas e do contexto educacional. **Métodos**: Estudo observacional descritivo e transversal, realizado por meio de um questionário dirigido a docentes de centros educativos de Bilbao, entre novembro de 2021 e janeiro de 2022. A amostra foi composta por 997 professores. Foi realizada uma análise descritiva e bivariada entre as variáveis sociodemográficas e as variáveis relacionadas à covid-19. **Resultados**: Observou-se elevado cumprimento das medidas anti-covid-19 entre os escolares, sendo as medidas de maior adesão o uso de máscara ($p < 0,0001$) e a higiene das mãos ($p < 0,0001$). Foram encontradas diferenças estatisticamente significativas entre as etapas educacionais ($p < 0,0001$), tipo de centro educativo ($p = 0,001$) e distritos ($p = 0,006$). Os distritos com menor poder aquisitivo, os centros públicos e as etapas de educação infantil e secundária foram os que apresentaram menor adesão às medidas anti-covid-19. **Conclusões**: Em consonância com outras pesquisas, observou-se que quanto maior o poder aquisitivo, maior o cumprimento das medidas anti-covid-19. Demonstra-se que os determinantes sociais em saúde influenciam o cumprimento das medidas anti-covid-19 no âmbito educacional.

Palavras-chave
determinantes sociais da saúde; serviços de saúde escolar; covid-19; controle de doenças transmissíveis; vigilância em saúde pública.

Introduction

On December 31, 2019, China reported a cluster of 27 cases of pneumonia of unknown etiology. By January 7, 2020, the country's authorities identified the causative agent as a new type of coronavirus, which was named SARS-CoV-2. The virus spread rapidly, and on March 11, 2020, the World Health Organization declared the COVID-19 situation a pandemic (1-3).

Three days later, on March 14, 2020, Spain declared a state of emergency through Royal Decree 463/2020 to manage the health crisis caused by COVID-19, which included the suspension of in-person educational activities nationwide (4). In May 2020, a partial reopening of educational institutions began, accompanied by a package of preventive and hygiene measures against COVID-19 (5). In September 2020, the Ministry of Health published a report with preventive instructions, hygiene protocols, and health promotion guidelines to resume in-person education at all educational levels for the 2020-2021 academic year (6). This report emphasized the need for students to return to in-person education in a safe, healthy, and sustainable manner, after analyzing the impact of school closures on students' health and well-being, as well as the progression of the pandemic. However, it did not address the potential impact that this package of measures might have on students' compliance based on social determinants of health.

There is substantial scientific evidence linking social determinants of health or health inequities to exposure to SARS-CoV-2 in terms of morbidity and mortality (7-13), even in pediatric populations (10,14). However, the concept of epidemiological vulnerability not only refers to the risk of contracting the infection, delays in diagnosing COVID-19, or difficulties in identifying close contacts, but also includes the population's difficulty in following prevention, control, and containment measures for the infection itself (15). The World Health Organization has recognized the challenges in adhering to COVID-19 measures in vulnerable populations, such as individuals experiencing homelessness, those living in overcrowded conditions, poor housing, marginalized neighborhoods, immigrants, refugees, individuals with disabilities, people residing in closed facilities, those in poverty, and the digital divide (16).

The school population is not exempt from belonging to these vulnerable groups, and therefore, it is reasonable to assume that students may face difficulties in complying with COVID-19 measures, even during their educational activities. A prospective cohort study conducted in Belgium by Callies et al. (17) showed that with lower implementation of preventive and control measures in schools, there was a higher prevalence of antibodies against SARS-CoV-2 among students and teaching staff, suggesting greater virus transmission.

Against this backdrop, the primary objective of the study was to analyze the influence of social determinants of health on compliance with SARS-CoV-2 prevention, control, and containment measures in schoolchildren in the city of Bilbao, as perceived by the teaching staff of educational institutions.

Materials and Methods

Design

Observational, descriptive, and cross-sectional study with an analytical approach.

Population and Study Setting

The study population consisted of 4050 teachers from early childhood education, primary, secondary, and high school levels from public, subsidized private, and private educational institutions located in the city of Bilbao (Basque Country, Spain), across 87 schools. The participants and source of information were the teachers, as they are the individuals best acquainted with the dynamics and social situation of students both individually and collectively, as well as being the key observers of compliance with COVID-19 measures throughout the educational day.

Sample, Sampling, and Sample Size

The entire study population was accessed. The sample size was estimated with a 95% confidence level, a population of 4050 teachers, and a 5% margin of error. Based on this, it was estimated that 352 valid responses were necessary.

Inclusion and Exclusion Criteria

The inclusion criteria were: educational institutions providing early childhood education, primary, secondary, and high school education located in the city of Bilbao, whether public, private subsidized, or private.

Exclusion criteria included: nurseries, vocational training centers, universities, official language schools, Basque language teaching centers (euskaltegis), and academies, irrespective of ownership.

Data Collection Instrument

The instrument used for data collection was an online, self-administered survey designed specifically for this study. It was not validated, as no validated questionnaires were available in our region for this purpose. The ad hoc questionnaire collected information on compliance with COVID-19 measures.

Survey Administration, Data Collection, and Time Frame

The questionnaire was administered between November 5, 2021, and January 5, 2022. To select the sample, the questionnaire was sent via email to the management team of each educational institution, who were then responsible for forwarding the questionnaire link to the teaching staff for completion. Data related to secondary variables or axes of inequality were collected from the Basque Institute of Statistics (18).

Data Analysis

Descriptive analysis was performed, with qualitative variables expressed as frequencies and percentages, and quantitative variables expressed as means and standard deviations if normally distributed, or as medians and interquartile ranges if non-normally distributed. Additionally, bivariate analysis was conducted between sociodemographic variables and both primary and secondary variables. The chi-square test (χ^2), Fisher's test, Student's t-test, or the Mann-Whitney U test were used. Data were analyzed using SPSS software, version 21.0. The statistical significance level was set at α or Type I error of 5% ($p < 0.05$).

Ethical Considerations

The study adhered to the basic ethical principles for clinical research, in accordance with the good clinical practice standards outlined in the Declaration of Helsinki (Fortaleza 2013) and the Oviedo Convention (1997). The handling, communication, and transfer of data complied with the provisions of the General Data Protection Regulation (GDPR) EU 2016/679 of the European Parliament and the Council of the European Union, dated April 27, 2016, which came into effect on May 25, 2018, and its incorporation into Spanish law through Organic Law 3/2018, of December 5, on the protection of personal data and the guarantee of digital rights. No personal data that could identify participants was collected, ensuring the confidentiality of the participants at all times (19,20).

Each participating teacher in the study freely and voluntarily signed the informed consent form online, after being provided with the study information sheet in advance. The study was reviewed and received a favorable opinion from the Research Ethics Committee of the Integrated Health Organization (OSI) Bilbao-Basurto (code: 104.21 CEICHUB) and was authorized by the Nursing Directorate of OSI Bilbao-Basurto for its execution and development.

Results

Description of Sociodemographic Variables: Axes of Inequality

The city of Bilbao has a population of 340,455 inhabitants, of which 10.1% are immigrants. Of the total population, 15.7% are under the age

of 20. The municipality has a total area of 4059 hectares and is divided into 8 districts and 40 neighborhoods. It has a population density of 8387.7 inhabitants/km^2, with an unemployment rate of 13.7%. Table 1 describes the demographic characteristics of the city of Bilbao by district.

Table 1.
Sociodemographic Variables Description (Axes of Inequality) of the City of Bilbao (Spain)

Districts	Population (n [%])	Population Density (inh./km²)	Family Income (€)	Emergency Social Aid (n [%])	Immigrant Population (n [%])	Family Households (n [%])
Deusto	48 146 (14,1)	9706,9	39 418	500 (9,1)	4031 (11,7)	23 124 (14,0)
Uribarri	35 515 (10,4)	8476,1	40 574	485 (8,8)	3797 (11,0)	17 741 (10,7)
Otxarkoaga - Txurdinaga	24 809 (73)	6361,3	33 247	755 (13,7)	1811 (5,2)	11 154 (6,7)
Begoña	39 951 (11,7)	22 444,4	36 549	767 (14,0)	3768 (10,9)	19 673 (11,9)
Ibaiondo	61 017 (17,9)	6323,0	35 871	1730 (31,5)	8012 (23,2)	29 466 (17,8)
Abando	50 481 (14,8)	23 589,3	74 677	203 (3,7)	3328 (9,6)	25 775 (15,6)
Rekalde	48 042 (14,1)	6892,7	32 089	601 (10,9)	6844 (19,8)	22 620 (13,7)
Basurto-Zorroza	32 494 (9,5)	4583,1	35 585	451 (8,2)	2917 (8,5)	15 891 (9,6)
Total	**340 455 (100)**	**8387,7**	**45 095**	**5492 (100)**	**34508 (100)**	**165 444 (100)**

Source: Based on data from the Basque Institute of Statistics.

The districts with the highest population are those occupying the central areas of the city (Ibaiondo, Abando, Deusto, and Rekalde), while the districts with the lowest population are the more peripheral ones (Otxarkoaga-Txurdinaga and Basurto-Zorroza). Similarly, the districts with the highest density are Abando and Begoña, while the districts with the lowest density are Basurto-Zorroza, Ibaiondo, Otxarkoaga-Txurdinaga, and Rekalde. Data on family income show significant differences between districts: Abando has the highest income, and Rekalde and Otxarkoaga-Txurdinaga have the lowest. On the other hand, Ibaiondo is the district with the highest percentage of immigrants, the highest percentage of emergency social aid, and the highest number of family households (Table 1).

Description of Secondary Sociodemographic Variables: Educational

The response rate was 24.7% among the total number of teachers in Bilbao, yielding 997 valid responses. Of the 87 educational institutions that met the inclusion criteria, representation was obtained from 81 of them (93.1%), with 47 (58.0%) being public, 30 (37.0%) subsidized private, and 4 (4.9%) private. By district, the number of participating schools was as follows: Deusto, 9 (11.1%); Uribarri, 10 (12.4%); Otxarkoaga-Txurdinaga, 14 (17.3%); Begoña, 7 (8.6%); Ibaiondo, 12 (14.8%); Abando, 15 (18.5%); Rekalde, 10 (12.4%); and Basurto-Zorroza, 4 (4.9%).

Regarding the 997 teachers who participated, significant differences were found based on the type of school ($p < 0.0001$), with 476 (47.7%) belonging to public schools, 510 (51.2%) to subsidized private schools, and 11 (1.1%) to private schools. By district, the number of teachers was as follows: Deusto, 139 (13.9%); Uribarri, 112 (11.2%); Otxarkoaga-Txurdinaga, 127 (12.7%); Begoña, 111 (11.1%); Ibaiondo, 156 (15.6%); Abando, 205 (20.6%); Rekalde, 110 (11.0%); and Basurto-Zorroza, 37 (3.7%).

By educational level, 118 teachers (11.8%) were from early childhood education, 396 (39.7%) from primary education, 330 (33.1%) from secondary education, and 153 (15.3%) from high school. Statistically significant differences were also found between districts and educational levels ($p < 0.0001$).

Compliance with Anti-COVID-19 Measures

In general, a high percentage of positive responses regarding the compliance with anti-COVID-19 measures was observed, and statistically significant differences were found according to the educational level ($p < 0.0001$). Primary and high school teachers reported a higher percentage of compliance by almost all or all students (87.9% and 86.3%, respectively). In contrast, the early childhood education stage

showed the lowest compliance rate, with only 68.7%.

Additionally, differences were found based on the type of educational institution (p = 0.001): private schools reported the highest degree of compliance by all or almost all students (100%), followed by subsidized private schools (88.1%) and public schools (77.7%). Similarly, differences were found by district (p = 0.006): Basurto-Zorroza and Otxarkoaga-Txurdinaga reported the lowest compliance by all or almost all students (64.8% and 78%, respectively) (Table 2).

Table 2.
General Compliance with COVID-19 Prevention and Control Measures

General compliance with anti-COVID-19 measures (n = 997)										
Responses	Districts, n (%)								Total (n [%])	P - Value
	Deusto (n = 139)	Uribarri (n = 112)	Otxarkoaga-Txurdinaga (n = 127)	Begoña (n = 111)	Ibaiondo (n = 156)	Abando (n = 205)	Rekalde (n = 110)	Basurto-Zorroza (n = 37)		
1. In general, does your student body comply with the prevention, control, and containment measures for the SARS-CoV-2 pandemic (mask use, hand hygiene, and social distancing)?										
All	26 (18,7)	38 (33,9)	24 (18,9)	21 (18,9)	27 (17,3)	63 (30,7)	24 (21,8)	7 (18,9)	**230 (23,1)**	**0,006**
Almost all	93 (66,9)	63 (56,3)	75 (59,1)	71 (64,0)	98 (62,8)	116 (56,6)	67 (60,9)	17 (45,9)	**600 (60,2)**	
Some	10 (7,2)	8 (7,1)	22 (17,3)	15 (13,5)	26 (16,7)	21 (10,2)	11 (10,0)	8 (21,6)	**121 (12,1)**	
Almost none	6 (4,3)	2 (1,8)	3 (2,4)	3 (2,7)	4 (2,6)	2 (1,0)	5 (4,5)	3 (8,1)	**28 (2,8)**	
None	4 (2,9)	1 (0,9)	3 (2,4)	1 (0,9)	1 (0,6)	3 (1,5)	3 (2,7)	2 (5,4)	**18 (1,8)**	

La figura 1 muestra los resultados en cuanto al grado de cumplimiento de cada medida (mascarillas, higiene de manos, distancias y ventilación) en función de la etapa educativa, tipo de centro educativo y distrito.

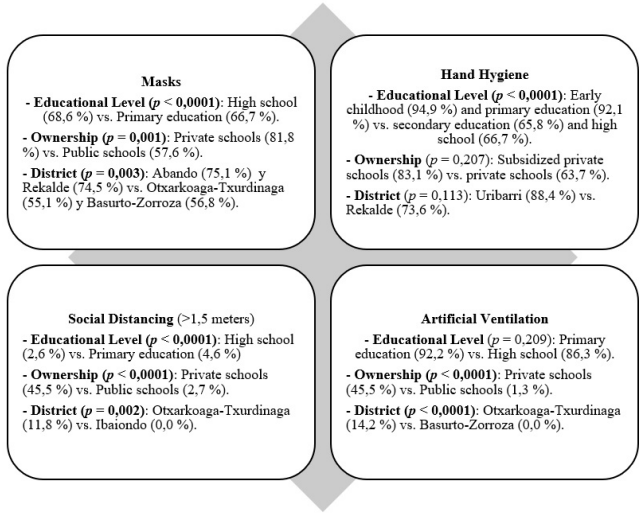

Figure 1.
Greater versus lesser compliance with different anti-COVID-19 measures according to educational level, type of educational institution, and district

Use of Masks

The use of masks was reported in 91% of students in educational institutions. The remaining 9%, who did not wear masks, were all in the early childhood education stage, where the use of masks was not standardized as mandatory.

Among the educational stages that used masks, correct usage was identified in a higher percentage of "almost all" students across all stages, with higher rates as the age increased: primary education (66.7%), secondary education (68.2%), and high school (68.6%), with statistically significant differences (p < 0.0001). Additionally, differences were found between correct mask use and the type of educational institution (p = 0.001), with "almost all" cases using them correctly in public schools (57.6%), subsidized private schools (63.5%), and private schools (81.8%). Similarly, differences were found between correct mask use and the district (p = 0.003), although correct mask use was lower in the districts of Otxarkoaga-Txurdinaga and Basurto-Zorroza (Table 3).

Table 3.
Compliance with COVID-19 Prevention and Control Measures: Use of Masks (n = 997)

Responses	Districts (n [%])								Total (n [%])	*p* - Value
	Deusto (n = 139)	Uribarri (n = 112)	Otxarkoaga-Txurdinaga (n = 127)	Begoña (n = 111)	Ibaiondo (n = 156)	Abando (n = 205)	Rekalde (n = 110)	Basurto-Zorroza (n = 37)		
2. What type of mask is most used by your students?										
Do not use	16 (11,5)	15 (13,4)	6 (4,7)	8 (7,2)	12 (7,7)	22 (10,7)	6 (5,5)	5 (13,5)	**90 (9,0)**	
Mesh	4 (2,9)	0 (0)	0 (0)	1 (0,9)	0 (0)	0 (0)	2 (1,8)	0 (0)	**7 (0,7)**	
Hygienic	46 (33,1)	50 (44,6)	35 (27,6)	30 (27,0)	74 (47,4)	58 (28,3)	41 (37,3)	17 (45,9)	**351 (35,2)**	**<0,0001**
Surgical	73 (52,5)	44 (39,3)	84 (66,1)	71 (64)	70 (44,9)	122 (59,5)	60 (54,5)	15 (40,5)	**539 (54,1)**	
FFP2	0 (0)	3 (2,7)	2 (1,6)	1 (0,9)	0 (0)	3 (1,5)	1 (0,9)	0 (0)	**10 (1,0)**	
3. Have you observed that your students use damaged masks (worn out, stained, etc.)?										
All	1 (0,7)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	1 (0,5)	0 (0,0)	0 (0,0)	**2 (0,2)**	
Almost all	7 (5)	2 (1,8)	6 (4,7)	4 (3,6)	2 (1,3)	4 (2)	4 (3,6)	0 (0)	**29 (2,9)**	
Some	70 (50,4)	62 (55,4)	68 (53,5)	54 (48,6)	70 (44,9)	78 (38)	69 (62,7)	20 (54,1)	**491 (49,2)**	**0,036**
Almost none	43 (30,9)	29 (25,9)	40 (31,5)	42 (37,8)	59 (37,8)	90 (43,9)	30 (27,3)	12 (32,4)	**345 (34,6)**	
None	18 (12,9)	19 (17,0)	13 (10,2)	11 (9,9)	25 (16,0)	32 (15,6)	7 (6,4)	5 (13,5)	**130 (13)**	
4. Does your student body use masks correctly in the classroom?										
All	5 (3,6)	10 (8,9)	10 (7,9)	8 (7,2)	8 (5,1)	17 (8,3)	12 (10,9)	2 (5,4)	**72 (7,2)**	
Almost all	86 (61,9)	69 (61,6)	60 (47,2)	72 (64,9)	94 (60,3)	137 (66,8)	70 (63,6)	19 (51,4)	**607 (60,9)**	**0,003**
Some	26 (18,7)	16 (14,3)	41 (32,3)	24 (21,6)	40 (25,6)	30 (14,6)	20 (18,2)	11 (29,7)	**208 (20,9)**	
Almost none	9 (6,5)	4 (3,6)	12 (9,4)	2 (1,8)	8 (5,1)	7 (3,4)	4 (3,6)	2 (5,4)	**48 (4,8)**	
None	13 (9,4)	13 (11,6)	4 (3,1)	5 (4,5)	6 (3,8)	14 (6,8)	4 (3,6)	3 (8,1)	**62 (6,2)**	
5. Do you need to remind your students to wear the mask correctly in the classroom?										
Always	15 (10,8)	3 (2,7)	17 (13,4)	6 (5,4)	10 (6,4)	14 (6,8)	12 (10,9)	3 (8,1)	**80 (8,0)**	
Frequently	42 (30,2)	25 (22,3)	49 (38,6)	36 (32,4)	60 (38,5)	49 (23,9)	33 (30,0)	13 (35,1)	**307 (30,8)**	
Occasionally	43 (30,9)	49 (43,8)	28 (22,0)	36 (32,4)	50 (32,1)	68 (33,2)	41 (37,3)	9 (24,3)	**324 (32,5)**	**0,004**
Rarely	25 (18,0)	19 (17,0)	24 (18,9)	27 (24,3)	25 (16,0)	56 (27,3)	18 (16,4)	9 (24,3)	**203 (20,4)**	
Never	14 (10,1)	16 (14,3)	9 (7,1)	6 (5,4)	11 (7,1)	18 (8,8)	6 (5,5)	3 (8,1)	**83 (8,3)**	
6. Does your student body change their mask daily within the educational center?										
All	6 (4,3)	1 (0,9)	14 (11,0)	13 (11,7)	9 (5,8)	20 (9,8)	6 (5,5)	1 (2,7)	**70 (7,0)**	
Almost all	22 (15,8)	13 (11,6)	19 (15,0)	13 (11,7)	18 (11,5)	31 (15,1)	24 (21,8)	8 (21,6)	**148 (14,8)**	
Some	39 (28,1)	40 (35,7)	38 (29,9)	40 (36,0)	47 (30,1)	52 (25,4)	21 (19,1)	6 (16,2)	**283 (28,4)**	**0,012**
Almost none	36 (25,9)	30 (26,8)	38 (29,9)	30 (27,0)	47 (30,1)	56 (27,3)	37 (33,6)	14 (37,8)	**288 (28,9)**	
None	36 (25,9)	28 (25,0)	18 (14,2)	15 (13,5)	35 (22,4)	46 (22,4)	22 (20,0)	8 (21,6)	**208 (20,9)**	
7. Do parents or other relatives who pick up students at the educational center wear masks?										
All	94 (67,6)	67 (59,8)	67 (52,7)	74 (66,7)	93 (59,6)	147 (71,7)	59 (53,6)	18 (48,6)	**619 (62,1)**	
Almost all	33 (23,7)	25 (22,3)	37 (29,1)	30 (27,0)	33 (21,2)	38 (18,5)	37 (33,6)	15 (40,5)	**248 (24,9)**	**0,009**
Some	11 (7,9)	17 (15,2)	15 (11,8)	6 (5,4)	23 (14,7)	17 (8,3)	12 (10,9)	2 (5,4)	**103 (10,3)**	
Almost none	1 (0,7)	3 (2,7)	6 (4,7)	1 (0,9)	5 (3,2)	2 (1,0)	1 (0,9)	1 (2,7)	**20 (2,0)**	
None	0 (0,0)	0 (0,0)	2 (1,6)	0 (0,0)	2 (1,3)	1 (0,5)	1 (0,9)	1 (2,7)	**7 (0,7)**	
8. Does your student body wear masks in outdoor spaces (playground)?										
All	68 (48,9)	72 (64,3)	44 (34,6)	66 (59,5)	76 (48,7)	107 (52,2)	50 (45,5)	20 (54,1)	**503 (50,5)**	
Almost all	36 (25,9)	15 (13,4)	43 (33,9)	24 (21,6)	38 (24,4)	43 (21,0)	28 (25,5)	7 (18,9)	**234 (23,5)**	**0,003**
Some	15 (10,8)	8 (7,1)	21 (16,5)	11 (9,9)	25 (16,0)	23 (11,2)	20 (18,2)	5 (13,5)	**128 (12,8)**	
Almost none	4 (2,9)	4 (3,6)	12 (9,4)	3 (2,7)	7 (4,5)	13 (6,3)	5 (4,5)	0 (0,0)	**48 (4,8)**	
None	16 (11,5)	13 (11,6)	7 (5,5)	7 (6,3)	10 (6,4)	19 (9,3)	7 (6,4)	5 (13,5)	**84 (8,4)**	
9. Does your student body bring a spare mask to the educational center?										
All	16 (11,5)	12 (10,7)	15 (11,8)	8 (7,2)	8 (5,1)	29 (14,1)	8 (7,3)	4 (10,8)	**100 (10,0)**	
Almost all	39 (28,1)	39 (34,8)	40 (31,5)	38 (34,2)	44 (28,2)	71 (34,6)	30 (27,3)	9 (24,03)	**310 (31,1)**	
Some	45 (32,4)	39 (34,8)	54 (42,5)	35 (31,5)	67 (42,9)	47 (22,9)	42 (38,2)	13 (35,1)	**342 (34,3)**	**0,040**
Almost none	23 (16,5)	11 (9,8)	13 (10,2)	21 (18,9)	23 (14,7)	39 (19,0)	19 (17,3)	5 (13,5)	**154 (15,4)**	
None	16 (11,5)	11 (9,8)	5 (3,9)	9 (8,1)	14 (9,0)	19 (9,3)	11 (10,0)	6 (16,2)	**91 (9,1)**	
10. Are there difficulties in obtaining or providing spare masks to your students at the educational center?										
Always	0 (0,0)	3 (2,7)	1 (0,8)	3 (2,7)	2 (1,3)	6 (2,9)	1 (0,9)	1 (2,7)	**17 (1,7)**	
Frequently	5 (3,6)	0 (0,0)	8 (6,3)	3 (2,7)	5 (3,2)	3 (1,5)	1 (0,9)	0 (0,0)	**25 (2,5)**	
Occasionally	9 (6,5)	7 (6,3)	15 (11,8)	6 (5,4)	13 (8,3)	11 (5,4)	6 (5,5)	3 (8,1)	**70 (7,0)**	
Rarely	20 (14,4)	20 (17,9)	24 (18,9)	26 (23,4)	26 (16,7)	36 (17,6)	14 (12,7)	8 (21,6)	**174 (17,5)**	0,146
Never	105 (75,5)	82 (73,2)	79 (62,2)	73 (65,8)	110 (70,5)	149 (72,7)	88 (80,0)	25 (67,6)	**711 (71,3)**	

Regarding calls for attention by the teaching staff for students to wear masks correctly, significant differences were found by educational level ($p < 0.0001$): most frequent in secondary education (35.2%) and occasionally in primary education (37.6%) and high school (37.9%). Similarly, there were differences in this variable by type of educational institution ($p = 0.002$), with calls for attention being frequent in public schools (35.3%), occasionally in subsidized private schools (35.5%), and rarely in private schools (45.5%). Lastly, differences by district were found ($p = 0.004$), with Otxarkoaga-Txurdinaga being the district where these calls for attention occurred most frequently.

Regarding mask use outdoors during the school day and educational level, differences were found ($p < 0.0001$): widespread use among "all" students in primary education, with 69.7%; in secondary education, 51.5%, and in high school, 30.1%. The same differences were observed concerning the type of educational institution ($p < 0.0001$), where private schools had the highest percentage of "almost all" or "all" students wearing masks outdoors (91%), followed by subsidized private schools (77.4%) and public schools (69.7%). Finally, statistically significant differences were also found by district ($p = 0.003$), with central districts showing mask use by almost all or all students, such as Begoña (81%) compared to Otxarkoaga-Txurdinaga (68.5%).

When exploring whether students bring a spare mask to school, differences were found by educational stage ($p < 0.0001$): in primary education, "almost all" (43.4%) brought a spare mask, while "some" brought them in secondary education (40.3%) and high school (47.1%). Similarly, there were differences by type of educational institution ($p < 0.0001$), with 31.5% of "almost all" or "all" students bringing a spare mask in public schools, 49.8% in subsidized private schools, and 54.6% in private schools. Additionally, differences were found between spare mask use and district ($p = 0.040$), with Abando being the district where the highest percentage of students brought a spare mask.

Hand Hygiene

Regarding the hand hygiene variable, significant differences were found ($p < 0.0001$) in the correct performance of hand hygiene by educational stage: it was higher in early childhood education (94.9%) and primary education (92.1%) compared to secondary education (65.8%) and high school (66.7%). No significant differences were found regarding the type of educational institution or district.

Additionally, the regular use of alcohol-based hand sanitizers in the classroom was explored, and statistically significant differences were observed by educational stage ($p < 0.0001$): in early childhood education, the use was frequent or always at 74.6%; in primary education, at 94.4%; in secondary education, at 88.5%; and in high school, at 85.6%. Differences were also found between the use of alcohol-based hand sanitizers in the classroom and the type of educational institution ($p < 0.0001$), with 83.5% of classrooms in public schools, 93.7% in subsidized private schools, and 91% in private schools using it frequently or always.

When exploring the availability of alcohol-based hand sanitizers in common areas by type of educational institution, no significant differences were found ($p = 0.743$). The availability of these dispensers was greater than 90% in public, subsidized private, and private schools. Similarly, differences in the availability of these dispensers by district were reported ($p = 0.003$), with lower availability in the districts of Otxarkoaga-Txurdinaga, Basurto-Zorroza, and Rekalde, where teachers reported fewer alcohol-based hand sanitizers in common areas of their educational institutions (Table 4).

Table 4.
Compliance with COVID-19 Prevention and Control Measures: Hand Hygiene (n = 997)

Responses	Districts (n [%])								Total (n [%])	*p*-Value
	Deusto (n = 139)	Uribarri (n = 112)	Otxarkoaga-Txurdinaga (n = 127)	Begoña (n = 111)	Ibaiondo (n = 156)	Abando (n = 205)	Rekalde (n = 110)	Basurto-Zorroza (n = 37)		
11. Is alcohol-based hand sanitizer regularly used for hand hygiene in your classroom?										
Always	113 (81,3)	81 (72,3)	94 (74,0)	67 (60,4)	100 (64,1)	138 (67,3)	72 (65,5)	25 (67,6)	**690 (69,2)**	**0,034**
Frequently	16 (11,5)	20 (17,9)	26 (20,5)	22 (19,8)	40 (25,6)	41 (20,0)	22 (20,0)	8 (21,6)	**195 (19,6)**	
Occasionally	6 (4,3)	5 (4,5)	4 (3,1)	11 (9,9)	12 (7,7)	17 (8,3)	11 (10,0)	1 (2,7)	**67 (6,7)**	
Rarely	2 (1,4)	2 (1,8)	2 (1,6)	6 (5,4)	3 (1,9)	3 (1,5)	5 (4,5)	2 (5,4)	**25 (2,5)**	
Never	2 (1,4)	4 (3,6)	1 (0,8)	5 (4,5)	1 (0,6)	6 (2,9)	0 (0,0)	1 (2,7)	**20 (2,0)**	
12. Are there alcohol-based hand sanitizer dispensers in the common areas of the educational institution?										
Yes	118 (84,9)	107 (95,5)	111 (87,4)	102 (91,9)	142 (91,0)	197 (96,1)	97 (88,2)	33 (89,2)	**907 (91,0)**	**0,003**
No	13 (9,4)	2 (1,8)	15 (11,8)	6 (5,4)	9 (5,8)	6 (2,9)	12 (10,9)	4 (10,8)	**67 (6,7)**	
Don't know	8 (5,8)	3 (2,7)	1 (0,8)	3 (2,7)	5 (3,2)	2 (1,0)	1 (0,9)	0 (0,0)	**23 (2,3)**	
13. Does your student body perform proper hand hygiene throughout the school day?										
All	49 (35,3)	56 (50,0)	41 (32,3)	36 (32,4)	52 (33,3)	67 (32,7)	43 (39,1)	14 (37,8)	**358 (35,9)**	0,113
Almost all	69 (49,6)	43 (38,4)	59 (46,5)	46 (41,4)	74 (47,4)	92 (44,9)	38 (34,5)	17 (45,9)	**438 (43,9)**	
Some	19 (13,7)	8 (7,1)	22 (17,3)	20 (18,0)	26 (16,7)	40 (19,5)	23 (20,9)	6 (16,2)	**164 (16,4)**	
Almost none	2 (1,4)	5 (4,5)	5 (3,9)	8 (7,2)	4 (2,6)	5 (2,4)	6 (5,5)	0 (0,0)	**35 (3,5)**	
None	0 (0,0)	0 (0,0)	0 (0,0)	1 (0,9)	0 (0,0)	1 (0,5)	0 (0,0)	0 (0,0)	**2 (0,2)**	

Interpersonal Distance

Regarding the distance between students within the classroom, statistically significant differences were found by educational stage ($p < 0.0001$). In this regard, 83.1% of early childhood education classrooms reported that the distance between students was less than 0.5 meters, while in primary education, secondary education, and high school, the most frequent response was a distance between 0.5 and 1 meter, with 45.5%, 49.7%, and 41.8%, respectively. Similarly, there were differences between student distances in the classroom and the type of educational institution ($p < 0.0001$). Public schools reported a higher rate of responses indicating distances between students of 0.5 and 1 meter (42.6%), followed by subsidized private schools (41.8%), while private schools reported distances between 1.5 and 2 meters as the most frequent between their students (45.5%). Finally, differences were found between the distance between students in the classroom and districts ($p = 0.002$), with the Otxarkoaga-Txurdinaga district having the highest proportion of students maintaining the recommended distance of at least 1.5 meters (Table 5).

Classroom Ventilation

Natural ventilation was present across all educational levels, regardless of the type of educational institution, with no significant

differences found (p = 0.792 and p = 0.198, respectively). In line with this, there were also no statistically significant differences between natural ventilation and district (p = 0.254) (Table 5).

Artificial ventilation was absent across all educational levels, although differences were found based on the type of educational institution (p < 0.0001). It was more frequently present in private schools (45.5%), followed by subsidized private schools (9.8%) and public schools (1.3%). Additionally, differences were found for the presence of artificial ventilation by district (p < 0.0001), with Otxarkoaga-Txurdinaga (14.2%) having the highest presence and Basurto-Zorroza (0.0%) the lowest (Table 5). However, when analyzing the district of Otxarkoaga-Txurdinaga by its two neighborhoods, the presence of artificial ventilation was concentrated in Txurdinaga (100%) but absent in Otxarkoaga (0.0%).

Table 5.
Compliance with COVID-19 Prevention and Control Measures: Distances and Ventilation (n = 997)

Responses	Districts (n [%])								Total (n [%])	*p*-Value
	Deusto (n = 139)	Uribarri (n = 112)	Otxarkoaga-Txurdinaga (n = 127)	Begoña (n = 111)	Ibaiondo (n = 156)	Abando (n = 205)	Rekalde (n = 110)	Basurto-Zorroza (n = 37)		
14. What is the distance between students in the classroom?										
Less than 0.5 meters	43 (30,9)	33 (29,5)	26 (20,5)	27 (24,3)	42 (26,9)	57 (27,8)	38 (34,5)	11 (29,7)	**277 (27,8)**	**0,002**
Between 0.6 and 1 meter	59 (42,4)	37 (33,0)	53 (41,7)	42 (41,0)	64 (41,0)	99 (48,3)	47 (42,7)	16 (43,2)	**417 (41,8)**	
Between 1 and 1.5 meters	32 (23,0)	36 (32,1)	33 (26,0)	35 (31,5)	50 (32,1)	46 (22,4)	23 (20,9)	9 (24,3)	**264 (26,5)**	
Between 1.5 and 2 meters	4 (2,9)	6 (5,4)	14 (11,0)	7 (6,3)	0 (0,0)	3 (1,5)	2 (1,8)	1 (2,7)	**37 (3,7)**	
More than 2 meters	1 (0,7)	0 (0,0)	1 (0,8)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	**2 (0,2)**	
15. Is there artificial ventilation in the classroom by district?										
Yes	134 (96,4)	1111 (99,1)	124 (97,6)	111 (100,0)	154 (98,7)	203 (99,0)	110 (100,0)	37 (100,0)	**984 (98,7)**	0,254
No	5 (3,6)	1 (0,9)	2 (1,6)	0 (0,0)	2 (1,3)	2 (1,0)	0 (0,0)	0 (0,0)	**12 (1,2)**	
Don't know	0 (0,0)	0 (0,0)	1 (0,8)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	**1 (0,1)**	
16. Is there artificial ventilation in your classroom (mechanical ventilation or air renewal systems)?										
Yes	15 (10,8)	2 (1,8)	18 (14,2)	3 (2,7)	16 (10,3)	5 (2,4)	2 (1,8)	0 (0,0)	**61 (6,1)**	**<0,0001**
No	118 (84,9)	108 (96,4)	104 (81,9)	104 (93,7)	136 (87,2)	186 (90,7)	102 (92,7)	37 (100,0)	**895 (89,8)**	
Don't know	6 (4,3)	2 (1,8)	5 (3,9)	4 (3,6)	4 (2,6)	14 (6,8)	6 (5,5)	0 (0,0)	**41 (4,1)**	

Discussion

This study highlights a high level of compliance with COVID-19 prevention and control measures by students, which supports the findings of other studies (21-23). This could explain the results of studies in our area indicating that the most frequent exposure/transmission setting was the family/home environment rather than the educational setting (24-26). Moreover, differences in compliance with anti-COVID-19 measures were found to be related to axes of inequality, such as age, district, or type of educational institution. In this way, public schools and lower-income districts reported lower levels of compliance, which aligns with the study by Lee et al. (27), which showed that individuals from lower educational or socioeconomic levels were more likely to fail to comply with COVID-19 prevention, control, and containment measures.

Social inequalities in health influenced the correct use of masks by students. Higher mask usage was found as the educational stage increased, in private schools, and in socioeconomically advantaged districts. The proportion of students in our study who used masks correctly in the classroom is very similar to the figures found in other studies, around two-thirds of students (28).

Regarding hand hygiene, correct hand hygiene was most frequently reported in early childhood and primary education, which may be explained by the greater supervision or monitoring by teachers in these stages. In line with this, the more frequent regular use of alcohol-based hand sanitizers in primary education compared to other educational stages can be explained. Similarly, districts again emerged as axes of inequality regarding the presence of alcohol-based hand sanitizers in common areas of educational institutions, with lower availability in districts with greater social health inequalities. This can be justified by the additional cost involved in implementing this measure in schools with fewer resources, as evidenced in the study by Lorenc et al. (29).

Regarding the distance between students in the classroom, it can be observed that, in general, in all educational stages, the recommendation of maintaining at least 1.5 meters of distance, as mandated by health authorities, was not met. This finding is supported by the results of the study by Lorenc et al. (29), which showed that students, teachers, and parents reported the impossibility of applying this measure due to the number of students and lack of space in the classrooms. On the other hand, within

the ownership of the schools, private schools reported achieving this recommendation at a higher percentage, which could be explained by the lower overcrowding in the classrooms of such institutions—a topic that could be further explored in future research.

In terms of artificial ventilation, although the Otxarkoaga-Txurdinaga district has the highest presence of artificial ventilation (14.2%), it is entirely concentrated in the Txurdinaga neighborhood (100%). This can be explained by the lack of homogeneity between the two neighborhoods, where, for example, the income in Txurdinaga is double that in Otxarkoaga, leaving the latter as one of the poorest and most unequal neighborhoods in Bilbao (30,31). Similarly, purchasing power allows for more artificial ventilation in classrooms, which was present in half of the classrooms in private schools and only in one out of every ten classrooms in public schools. The study by Jones et al. (32) was one of the first to consider ventilation as a factor in preventing and controlling COVID-19 infection. However, research conducted in classrooms of two Swiss schools by Banholzaer et al. (33) demonstrated that mask use is more effective than artificial ventilation, as it reduces aerosol and viral particle concentrations by 69% compared to 39%, respectively.

Limitations

Among the limitations of this study are the use of a non-validated questionnaire and the data collection at the beginning of the school year (during the first term), which led us to assume that teachers with temporary employment contracts might be unaware of the sociodemographic factors of their students.

Conclusiones

The limitations of this study include the use of a non-validated questionnaire and data collection at the beginning of the school year (during the first term), which led us to assume that teachers with temporary contracts might be unaware of the sociodemographic factors of their students. Strengths include the representativeness of the educational institutions and the sample size obtained, which lends external validity to the results of this study.

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Notes

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