Baseline

Baseline report on the KPI Helmet use among Cyclists and PTWs

January 2023

Baseline

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Any comments or feedback regarding this report should be sent to Baseline@vias.be.

Version history

Version	Date	Changes
1.0	April 30, 2020	First draft version using data collected in 2021.
2.0	September 16, 2022	Draft version of report, including data for 9 countries.
2.1	October 4, 2022	Draft version of report, including data for 10 countries, KEG's comments addressed.
2.2	October 17, 2022	Draft version of report, including data for 10 countries, comments from MS addressed.
2.3	December 1, 2022	Updated draft version of report.
2.4	December 21, 2022	Final Draft version of report
2.5	January 20, 2023	Final version of report

Contents

Executive summary

The aim of the BASELINE project is to assist participating Member States' authorities in the collection and harmonized reporting of Key Performance Indicators (KPIs) and to contribute to building the capacity of Member States which have not yet collected and calculated the relevant data for the KPIs. The outcomes of this project will be used to set future European targets and goals based on the KPIs. This document is the report providing information on the KPI Helmet use among cyclists and powered two-wheelers (PTWs), which is defined as the percentage of riders of powered two wheelers and bicycles wearing a protective helmet.

Out of the 18 EU Member States participating in the Baseline project, 12 countries provided KPI data on helmet use among cyclists and 13 countries provided KPI data on helmet use among PTW riders, based on common methodological guidelines developed within the project.

Helmet use rates for PTW riders and passengers are very high for almost all countries (above 90%), while the respective KPIs for cyclists are significantly lower, varying from 17,9% to 52,6%. It is noted that in all countries helmet use for PTWs is mandatory, while helmet use for cyclists is not mandatory by law, except some countries (e.g. helmet use is mandatory for children, on rural roads, for e-bikes).

Additionally, for cyclists the helmet use rates are higher on rural roads compared to urban roads for all countries. On the other hand, for PTWs, the prevalence of helmet use is almost the same on motorways and rural roads for almost all countries, while KPIs on urban roads are lower than those observed on the other types of roads in a few countries. Regarding the two different time periods examined, the helmet use among cyclists is higher during weekends compared to weekdays for all countries, while for the respective indicators for PTWs, no significant difference was observed depending on the day of the week. KPIs for cyclists by gender and age group were also provided by a few countries. The results showed that there is a difference in the helmet use by gender and age group, with more males and children using a protective helmet when cycling.

Figure 1. Helmet use among cyclist and PTW riders by road type

**Note: Countries with deviations in the methodology are shown with light colours*

All countries collected data and provided indicators as close to the methodological specifications of the project as possible. The performance of countries concerning the helmet use among cyclists and PTWs is successfully recorded and a first picture is depicted at European level. However, the comparative assessment of the results among the countries should be made with caution, taking into account any different methodological approaches or deviations from the minimum requirements suggested in the Baseline project that have been followed in some cases.

1 Introduction

1.1 Context

The Communication of the European Commission "Europe on the Move – Sustainable Mobility for Europe: safe, connected and clean" of the 13th of May 2018 confirmed the EU's long-term goal of moving close to zero fatalities in road transport by 2050 and added that the same should be achieved for serious injuries. It also proposed new interim targets of reducing the number of road deaths by 50% between 2020 and 2030 as well as reducing the number of serious injuries by 50% in the same period. To measure progress, the most basic – and important – indicators are of course the result indicators on deaths and serious injuries.

In order to gain a better understanding of the different issues that influence overall safety performance, the Commission has elaborated, in cooperation with Member State experts, a first set of key performance indicators (KPIs). The list of the KPIs is given in ***Table 1***. The minimum requirements for these KPIs are described in the *Commission Staff Working Document SWD (2019) 283*, further referred to as 'SWD'.

Table 1. List of European KPIs for road safety

KPI area	KPI definition
Speed	Percentage of vehicles travelling within the speed limit
Safety belt	Percentage of vehicle occupants using the safety belt or child restraint system correctly
Protective equipment	Percentage of riders of PTWs and bicycles wearing a protective helmet
Alcohol	Percentage of drivers driving within the legal limit for blood alcohol content (BAC)
Distraction	Percentage of drivers not using a handheld mobile device
Vehicle Safety	Percentage of passenger cars with a Euro NCAP safety rating equal or above a threshold
Infrastructure	Percentage of distance driven over roads with a rating above an agreed threshold
Post-crash care	Time elapsed between the emergency call following a collision resulting in personal injury and the arrival at the scene of the collision of the emergency services

Funding has been made available by the European Commission to support Member States in the data collection and analysis for these KPIs. Eighteen Member States participate in a common project, called "Baseline". The aim of the Baseline project, funded partially by the European Commission, is to assist participating Member States' authorities in the collection and harmonized reporting of these KPIs and to contribute to building the capacity of Member States which have not yet collected and calculated the relevant data for the KPIs. The outcomes of this project will be used to set future European targets and goals based on the KPIs.

1.2 Participation in Baseline

The following EU Member States participated in the Baseline project: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Finland, Germany, Greece, Ireland, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Poland, Portugal, Spain, Sweden. Some data regarding KPIs of EU Member States that were not participating in Baseline are also included in the deliverables.

1.3 Final deliverables of the Baseline project

The final public outcomes and deliverables of the Baseline project are:

- Eight specific reports, each on one KPI
- A website on which all public information is accessible
- A final report including the key results of the project and recommendations for next steps.

This document is the report providing information on the ***KPI Helmet use among cyclists and powered two-wheelers (PTWs)***. This KPI has been defined as:

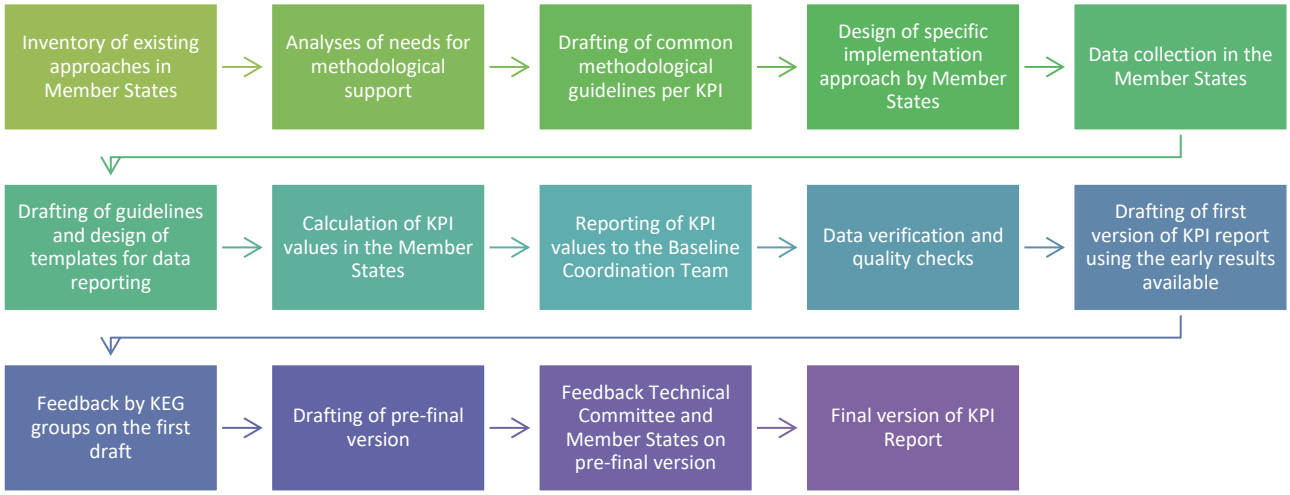
"Percentage of riders of powered two wheelers and bicycles wearing a protective helmet"

2 Methodology

2.1 Overall process

The process followed for arriving at this report is summarized in the following scheme:

Figure 2. Process leading to this report



For each KPI, a "KPI Expert Group" (KEG) was established, which was responsible for the design of the methodological guidelines and for the review of a draft version of this report. The KEG for the helmet indicator consisted of the following persons:

- Nathalie Moreau, Vias Institute (Belgium)
- Ellen Boudry, Vias Institute (Belgium)
- Anna Zielinska, ITS (Poland)
- Sheila Ferrer López, DGT (Spain)
- Maria João Da Silva Barros, ANSR (Portugal)

The overall process was overseen by the Technical Committee, which focused in particular on issues that were important for several KPIs (e.g. structure and content of methodological guidelines, minimum samples, number of observations and locations, weighting of data, data reporting, etc.). The Technical Committee consisted of:

- Peter Silverans, Vias institute (Belgium) - Coordinator
- Wouter Van den Berghe, Vias institute (Belgium)
- Frits Bijleveld, SWOV (Netherlands)
- Sheila Ferrer López, DGT (Spain)
- Peter Larsson, Trafikverket (Sweden)
- Markus Schumacher, BASt (Germany)
- Veronika Valentova, CDV (Czech Republic)
- George Yannis, NTUA (Greece)

2.2 Support tools developed

For every KPI, methodological guidelines were developed, covering topics such as:

- definition of the KPI concerned, and possibly complementary or alternative KPIs
- methods to be used for data collection
- breakdowns requested of the KPI values (road category, vehicle type, day of week, …)
- minimum sample of observations/cases and observation locations
- methods for weighting and analysing the data
- nature and format of data to be reported

The methodological guidelines of the KPI on helmet use among cyclists and powered two-wheelers (PTWs) can be accessed from the Baseline website via this link: https://www.baseline.vias.be/storage/minisites/methodological-guidelines-kpi-helmet-use-of-cyclists-and-ptws-2.pdf. Many elements of the Methodological Guidelines have been integrated in this report, either within the main body of the text, or as part of the Annex.

In order to streamline and harmonize the data flow, data reporting guidelines and data reporting templates were developed. The data reporting templates (in Excel) were used by the Member States for reporting their KPI values to the Baseline Coordination Team. Below a part of the data file concerning the use of helmet by PTW riders is shown.

BASELINE - Helmet for PTWs

Road Type	Time period	Vehicle Type	Nr of Locations	Traffic Counts	Weight proportion	N-rider	Nused-rider	KPI-rider
motorways	weekday/daytime	Motorcycle	24	559	14,0%	480	480	100,0%
motorways	weekend/daytime	Motorcycle	7	37	4,0%	28	28	100,0%
motorways	(all periods)	**Motorcycle-Total**	24	597	18,0%	508	508	100,0%
rural roads	weekday/daytime	Motorcycle	36	1.765	43,7%	1.300	1.300	100,0%
rural roads	weekday/daytime	Moped	36	1.765	43,7%	188	186	99,2%
rural roads	**weekday/daytime-Total**	*(all PTWs)*	36	1.765	43,7%	1.488	1.486	100,0%
rural roads	weekend/daytime	Motorcycle	25	6.367	12,3%	5.007	5.006	100,0%
rural roads	weekend/daytime	Moped	25	6.367	12,3%	145	145	100,0%
rural roads	**weekend/daytime-Total**	*(all PTWs)*	25	6.367	12,3%	5.152	5.151	100,0%
rural roads	*(all periods)*	**Motorcycle-Total**	48	8.133	56,0%	6.307	6.306	100,0%
rural roads	*(all periods)*	**Moped-Total**	48	8.133	56,0%	333	331	99,3%
rural roads-Total	*(all periods)*	*(all PTWs)*	48	8.133	56,0%	6.640	6.637	100,0%
urban roads	weekday/daytime	Motorcycle	69	9.280	20,3%	6.118	6.107	99,8%
urban roads	weekday/daytime	Moped	69	9.280	20,3%	1.869	1.857	99,1%
urban roads	**weekday/daytime-Total**	*(all PTWs)*	69	9.280	20,3%	7.987	7.964	99,7%
urban roads	weekend/daytime	Motorcycle	22	540	5,7%	265	263	98,9%
urban roads	weekend/daytime	Moped	22	540	5,7%	170	167	97,4%
urban roads	**weekend/daytime-Total**	*(all PTWs)*	22	540	5,7%	435	430	98,5%
urban roads	*(all periods)*	**Motorcycle-Total**	74	9.820	26,0%	6.383	6.370	99,8%
urban roads	*(all periods)*	**Moped-Total**	74	9.820	26,0%	2.039	2.024	99,0%
urban roads-Total	*(all periods)*	*(all PTWs)*	74	9.820	26,0%	8.422	8.394	99,7%

2.3 Scope

The major protective systems for cyclists, moped riders and motorcyclists are safety helmets. Injuries to the head and neck are the main cause of death, severe injury and disability among users of motorcycles. Systematic reviews on the effectiveness of motorcycle and bicycle helmets on road safety outcomes have been published. Such a review on motorcycle helmets including 53 studies estimated that the use of a helmet decreases the risk and severity of injuries by about 72% and the likelihood of being killed by up to 39%, with the probability depending on the speed of the motorcycle involved (WHO, 2006). A more recent meta-analysis of the effects of bicycle helmets on injuries has shown that bicycle helmets reduce head injuries by 48%, serious head injuries by 60% and the total number of killed or seriously injured cyclists by 34% (Hoye, 2018).

Based on the Methodological guidelines for the KPI on helmet, data should be presented separately for PTW riders and for cyclists, thus, in this report results for the two KPI measurements will be presented separately: one on helmet use among PTW riders and the other on helmet use among cyclists. In order to obtain comparable results,

the definitions of the vehicle types included for the measurements are based on the UNECE Transport Glossary, as follows:

- Bicycle: A road vehicle which has two or more wheels and generally propelled by the muscular energy of the persons on that vehicle, in particular by means of a pedal system, lever or handle (e.g., bicycles, tricycles, quadricycles, and invalid carriages). Included are cycles with a supportive power unit (e.g., electric bikes).
- Moped: A two or three-wheeled road motor vehicle which is fitted with an engine having a cylinder capacity of less than 50cc and a maximum authorized design speed in accordance with national regulations. Where limitations concerning the engine displacement are not applicable, a restriction in terms of motor power may be in force. This relates to categories L1 and L2 of the UN Consolidated Resolution on the Construction of Vehicles (R.E.3).
- Motorcycle: A two or three-wheeled road motor vehicle not exceeding 400 kg of unladen weight. All such vehicles with a cylinder capacity of 50cc or over are included, as are those under 50cc which do not meet the definition of moped. This relates to categories L3, L4, L5, L6 and L7 of the UN Consolidated Resolution on the Construction of Vehicles (R.E.3).

2.4 Minimum and optional requirements for the KPI on Helmet use within Baseline

The minimum requirements for the KPI on Helmet use among cyclists and PTWs are given in ***Table 2***. The table also includes optional supplementary approaches. Baseline partner countries had the option of either just meet the minimum requirements or to extend (part of) their methodology and include other elements.

The KPI is presented as the percentage of riders wearing a helmet, separately for users of bikes and PTWs, and for riders and passengers. So overall there are 4 main KPIs for which a point estimate and a 95% confidence interval is to be calculated:

- riders of bicycles (including e-bikes)
- passengers of bicycles (including e-bikes)
- riders of PTWs (mopeds and motorcyclists)
- passengers of PTWs (mopeds and motorcyclists).

Optionally, for PTWs, it is recommended to make at least the distinction between "moped" and "motorcycle" and for bicycles, the distinction between "bicycle" (non-electric) and "electric bike / e-bike" is also suggested. Additionally, for cyclists, values for children and older people are recommended to be distinguished; in case national legislation requires children cyclists to wear helmets up to a certain age, this age category is suggested to be added.

Table 2. Minimum requirements and optional additions for the KPI Helmet use

	Minimum requirement	Optional additions
KPI definition	• Percentage of riders wearing a helmet (+ 95% CIs)	• types of bicycle/PTW • type of helmet • correct use of the helmet • use of other protective equipment • colour of the helmet • wearing of reflective clothing • private or a public/shared vehicle • professional/non-professional rider • gender • age category • wearing earphones (only for cyclists)
Sample size	• Min 2.000 observations / category • Min 500 observations / category / road type • Min 10 locations / road type; and 10 locations / time period • At least 2 locations for each stratification combination • Driver / Passenger • Age (if legally relevant)	

Locations	• Random selection • Representative of entire national road network • A minimum traffic flow of at least 10 vehicles passing per hour is required	• Stratification by Region
Vehicle types	• PTWs (mopeds and motorcycles) • Bicycles (including e-bikes)	• Types of bicycle: electric or not, city/sport bike, etc. • Types of PTW: moped, e-moped, motorcycles of certain types, etc.
Road types	• Motorways (only for motorcycles) • Rural roads (defined as roads outside built-up areas, but no motorways) • Urban roads (defined as roads inside built-up areas)	
Time periods	• Weekdays and weekend days • Daylight hours • End of spring or at the beginning of autumn. In principle, all months are allowed except December, January, July, and August.	• For countries facing difficulties in reaching the minimal number of observations, the measurement can be extended to summer months.

3 Results

3.1 Metadata

In this section, the metadata concerning the data collection, sample characteristics and KPIs delivered, as well as post-stratification weighting and national legislations concerning helmet use among PTWs and cyclists are presented.

As shown in Table 3, the helmet use is mandatory for all PTW (motorcycle and moped) riders and passengers in all Member States. On the contrary, helmet use among cyclists is not mandatory for all Member States. More precisely, in Belgium, Bulgaria, Germany, Poland and Portugal, the use of helmet is not mandatory or there is no law or regulation about helmet use among cyclists. Exceptions are made for children in Austria and Latvia (up to 12 y.o.), Czech Republic (up to 18 y.o.), Malta (up to 10 y.o.), Spain (up to 16 y.o.) and Sweden (up to 15 y.o.). Also, the use of helmet is mandatory for power assisted pedal cycles in Malta and for cyclists travelling on interurban roads in Spain, while in Czech Republic cyclists older than 18 y.o. are strongly recommended to use a protective helmet.

*Table 3.National Legislation on KPI Cycle and PTWs Helmet**

	Cycle	PTWs
Austria	Mandatory for children up to 12 years old.	Mandatory for all riders and passengers.
Belgium	Not mandatory.	Mandatory for all riders and passengers. Riders and passengers of speed pedelecs can choose between a moped/motorbike helmet or a bicycle helmet.
Bulgaria	Not mandatory.	Mandatory for all riders and passengers.
Cyprus	-	Mandatory for all riders and passengers.
Czech Republic	Children under the age of 18 years must wear a cycle helmet. For older cyclists than 18 years is strongly recommended to use cycle helmet.	Mandatory for all riders and passengers. They must also protect eyes with protective shield or glasses.
Germany	Not mandatory.	Mandatory for all riders and passengers.
Greece	-	Mandatory for all riders and passengers.
Ireland	Recommended but not mandatory.	Mandatory for all riders and passengers.
Latvia	Mandatory for children younger than 12 years old.	Mandatory for all riders and passengers.
Malta	Mandatory for power assisted pedal cycles and for children under 10 travelling pillion in a safety seat.	Mandatory for all riders and passengers.
Poland	Not mandatory.	Mandatory for all riders and passengers.
Portugal	Not mandatory.	Mandatory for all riders and passengers.

Spain	Minors under 16 years and also by those who ride on interurban roads are obliged to use the protective helmet.	Mandatory for all riders and passengers.
Sweden	The use of bicycle helmets is mandatory for children under the age of 15.	-
MS not participating in Baseline		
Italy	Not mandatory.	Mandatory for all riders and passengers.

All Member States conducted roadside observations for the data collection for both cyclists and PTWs (Table 4, Table 5). Most roadside observation surveys were carried out in 2021. Measurements were carried out about 2-3 months continuously for all countries, except for Czech Republic, Bulgaria, Germany, Poland and Spain, where data were collected in two seasons (e.g. about 1 month during the spring/summer and about 1 month during the autumn). Also, most countries collected data during spring and/or autumn, following Baseline guidelines, except Austria, where roadside observations took place during the summer.

Concerning the KPI data collection for cyclists (Table 4), a stratified random sampling of the observation locations was selected for Austria, Latvia, Malta, Poland, Portugal and Spain, a non-proportional stratified sample for Belgium and a simple random sampling of locations was selected for Bulgaria and Czech Republic. In Sweden, 190 locations in 21 cities for the observation of helmet use among cyclists on urban roads were selected. The locations are not strictly randomized, but they are chosen to represent the urban road environment, where cyclists are common. In Germany, 70 locations in 6 regions were selected according to regional dispersion over the country. Observations in Germany take place in the same regions and locations since the mid-1970s in order to assess developments over time.

As far as PTWs are concerned, a stratified random sampling of the observation locations was selected for all countries, except Belgium, Bulgaria, Czech Republic and Germany. Metadata concerning the sampling and survey period have not been provided for Ireland.

Table 4. Methodology on KPI Cycle Helmet

	Data collection method	Sampling of locations	Survey Period	Sampling Unit	Breakdowns
Austria	Roadside observations by researchers	Stratified random	01/06/2021 - 30/8/2021	Rider and Passenger	KPIs by road type; vehicle type and time period
Belgium	Roadside observations by researchers	Non-proportional stratified sample	05/03/2022-14/05/2022	Rider and Passenger	KPIs by road type; time period; age; gender
Bulgaria	Roadside observations by researchers	Simple random (some locations selected based on expert decision)	02/10/21-07/11/2021, 14/03/21-31/05/2022	Rider and Passenger	KPIs by road type; vehicle type and time period
Cyprus	Roadside observations by researchers	-	01/09/2022-13/10/2022	Rider	no KPIs - low total sample
Czech Republic	Roadside observations by researchers	Simple random	4/6/2021-29/6/2021, 4/9/2021-3/10/2021	Rider	KPIs by road type, time period, vehicle type, gender
Germany	Roadside observations by researchers	6 regions across the country; 70 different locations; regions are selected according to regional dispersion over the country and are the result of a project group, aiming to define regions according to criteria that allow representative and generalizable observations.	13/6/2021-30/6/2021, 1/9/2021-26/9/2021	Rider	KPI on urban roads and on weekdays
Greece	Roadside observations by researchers	-	28/03/2022-09/07/2022	Rider	no KPIs - low total sample
Ireland	Roadside observations by researchers	-	-	Rider and Passenger	KPI on urban roads by time period

Latvia	Roadside observations by researchers	Stratified random	09/09/21-02/11/2021	Rider and Passenger	KPIs by road type and time period
Malta	Roadside observations by researchers	Stratified random	11/01/22 - 15/05/22	Rider and Passenger	by road type, time period, road type x time period, age, gender, age x gender
Poland	Roadside observations by researchers	Stratified random	21/09/21-6/11/21 and 30/04/22-24/05/22	Rider and Passenger	KPIs by road type and time period
Portugal	Roadside observations by researchers	Stratified random	10/10/2021 - 03/12/2021	Vehicle	KPI on urban roads by vehicle type and time period
Spain	Roadside observations by researchers	Stratified random	19/10/21-23/11/21 & 04/12/21 to 6/12/21	Vehicle	KPIs by road type, time period, road type x time period, age, gender, age x gender
Sweden	Roadside observations by researchers	21 cities across the country; 160 different locations (locations not strictly randomized, but chosen to represent the urban road environment)	08/2020 - 09/2020	Rider	KPI on urban roads

Concerning cyclists, 14 countries provided data, but 12 countries have delivered KPIs (either national or for specific strata). For most countries, data were provided by road type and time period, with fewer countries providing data by vehicle type or gender. It is also noted that the sample stratification differs in some countries in comparison with the minimum strata proposed in the respective Baseline methodological requirements. More specifically, concerning the KPI on cycle helmet, the sampling framework of Austria includes observations during weekdays only for urban roads and during weekends only on rural roads (leisure areas). Additionally, helmet use data for cyclists were collected only on urban roads for Germany (only on weekdays), Ireland, Portugal and Sweden (both on weekdays and weekends).

Concerning PTWs, 13 countries provided data (Table 5). For most countries, data were provided by road type and time period for all PTWs (motorcyclists and moped riders). Data for Germany and Ireland have been collected only on urban roads during weekdays. Also, Germany, Austria, Poland and Portugal provided data by vehicle type, while data for Czech Republic refer only to motorcyclists.

Table 5. Methodology on KPI PTW Helmet

Country	Data collection method	Sampling of locations	Survey Period	Sampling Unit	Breakdowns
Austria	Roadside observations by researchers	Stratified random	01/06/2021 - 30/8/2021	Rider and Passenger	KPIs by road type; vehicle type and time period
Belgium	Roadside observations by researchers	Non-proportional stratified random	05/03/2022 - 28/05/2022	Rider and Passenger	KPIs by road type, vehicle type and time period
Bulgaria	Roadside observations by researchers	Simple random (some locations selected based on expert decision)	02/10/21 - 07/11/2021, 14/03/21 - 31/05/22	Rider and Passenger	KPIs by road type and time period
Cyprus	Roadside observations by researchers	Stratified random	01/09/2022-13/10/2022	Rider and Passenger	KPIs by road type and time period
Czech Republic	Roadside observations by researchers	Simple random	24/5/2021-27/6/2021, 4/9/2021-10/10/2021	Rider and Passenger	KPIs by road type and time period (motorcyclists only)
Germany	Roadside observations by researchers	6 regions across the country; 70 different locations; regions are selected according to regional dispersion over the country and are the result of a project group, aiming to define regions according to criteria that allow representative and generalizable observations.	13/6/2021-30/6/2021, 1/9/2021-26/9/2021	Rider and Passenger	KPI on urban roads and on weekdays, by vehicle type

Greece	Roadside observations by researchers	Stratified random	28/03/2022-09/07/2022	Rider and Passenger	KPIs by road type and time period
Ireland	Roadside observations by researchers	-	-	Rider and Passenger	KPI on urban roads by time period
Latvia	Roadside observations by researchers	Stratified random	09/09/21-15/11/2021	Rider and Passenger	KPIs by road type and time period
Malta	Roadside observations by researchers	Stratified random	11/01/22 - 15/05/22	Rider and Passenger	KPIs by road type and time period
Poland	Roadside observations by researchers	Stratified random	21/09/21-6/11/21 and 30/04/22-24/05/22	Rider and Passenger	KPIs by road type; vehicle type and time period
Portugal	Roadside observations by researchers	Stratified random	10/10/2021 - 05/12/2021	Vehicle	KPIs by road type; vehicle type and time period
Spain	Roadside observations by researchers	Stratified random	19/10/21-23/11/21 and 04/12/21 to 6/12/21	Vehicle	KPIs by road type and time period
Sweden	-	-	-	-	-

In Table 6, the number of selected locations per road type and the number of observation sessions by road type and time period (weekday/weekend) are shown for both cyclist and PTW data collection. The minimum requirement of 10 locations per road type is achieved in all countries. It is noted that no motorways exist in Latvia and Malta. Also, in Spain, 120 observation sessions took place at 30 locations on expressways.

Table 6. Observation sessions and locations

	Cyclists						PTWs							
	Number of locations		Number of sessions				Number of locations			Number of sessions				
	Rural	Urban	Rural	Urban	Weekday	Weekend	Motorway	Rural	Urban	Motorway	Rural	Urban	Weekday	Weekend
Austria	33	33	-	-	-	-	24	48	74	-	-	-	-	-
Belgium	15	41	29	82	54	57	21	17	62	40	31	108	111	68
Bulgaria	25	31	100	124	112	112	15	30	30	60	120	120	150	150
Cyprus	-	-	-	-	-	-	13	12	14	32	32	42	94	12
Czech Republic	10	10	10	10	20	20	10	10	10	10	10	10	30	30
Germany	-	70	-	n/a	n/a	-	-	-	70	-	-	n/a	n/a	-
Greece	-	-	-	-	-	-	14	35	44	14	35	44	72	21
Ireland	-	150	-	150	104	46	-	-	137	-	-	137	91	46
Latvia	13	57	35	145	113	67	-	17	48	-	56	134	101	89
Malta	22	17	30	30	30	30	-	16	15	-	28	31	30	29
Poland	28	22	41	29	42	28	22	29	25	31	43	31	65	40
Portugal	-	44	-	66	45	21	16	22	31	24	29	45	64	34
Spain[1]	25	65	100	260	240	240	10	25	65	40	100	260	260	260
Sweden	-	190	-	-	-	-	-	-	-	-	-	-	-	-
MS not participating in Baseline														
Italy	6	17	-	-	-	-	17	15	17	-	-	-	-	-

[1] *In Spain, 120 observation sessions took place at 30 locations on expressways*[1]

In Tables 7 and 8, the total samples of observed riders and passengers, as well as the respective samples by road type and time period, are presented for cyclists and PTWs. Based on the Baseline guidelines, a sample of at minimum 2.000 observations (riders and passengers) should be collected for each road user type, i.e. PTWs and cyclists, while the respective minimum number of required observations per road type is 500 riders and passengers. As shown in Table 7, the minimum samples of cyclist riders and passengers are reached for all countries, except Malta and Latvia for rural roads.

The total minimum sample of PTWs is not achieved for Belgium and Cyprus. Also, minimum samples of PTW riders and passengers by road type are achieved in all countries, except on motorways for Belgium, Czech Republic, Greece and Portugal and on rural roads for Belgium (Table 8). The deviations in the minimum requirements are shown with different colour in the respective tables.

Table 7. Sample Data on KPI Cycle Helmet

	Number of observations		Number of observations (riders and passengers)		Number of observations (riders)				Number of observations (passengers)			
	Riders	Passengers	Rural road	Urban road	Rural road	Urban road	Weekday	Weekend	Rural road	Urban road	Weekday	Weekend
Austria	27.407	360	13.820	13.947	13.591	13.816	13.816	13.591	229	131	131	229
Belgium	6.564	215	809	5.970	803	5.761	3.764	2.800	6	209	98	117
Bulgaria	6.410	31	1.224	5.217	1.223	5.187	2.747	3.663	1	30	11	20
Cyprus	-	-	-	-	-	-	-	-	-	-	-	-
Czech Republic	6.638	-	3.294	3.344	3.294	3.344	3.254	3.384	-	-	-	-
Germany	-	-	-	-	-	16.199	16.199	-	-	-	-	-
Greece	-	-	-	-	-	-	-	-	-	-	-	-
Ireland	-	-	-	11.889	-	11.849	6.058	5.791	-	40	17	23
Latvia	3.177	24	189	3.012	188	2.989	1.981	1.196	1	23	15	9
Malta	288	2	180	50	179	49	36	192	1	1	1	1
Poland	3.539	36	1.612	1.963	1.590	1.949	1.835	1.704	22	14	9	27
Portugal	2.004	11	-	2.015	-	2.004	1.363	641	-	11	6	5
Spain[1]	1.717	19	643	1.040	642	1.022	594	1.123	1	18	4	15
Sweden				38.067								
MS not participating in Baseline												
Italy	1.963	17	335	1.645	334	1.629	954	1.009	1	16	6	11

[1] *In Spain, 53 riders were also observed on expressways.*

[1] *Expressways are pubic roads that do not meet all the requirements of motorways, have separate carriageways for each direction and limited access to and from neighbouring properties, and do not have level crossings. Driving with animal-drawn vehicles, bicycles, mopeds and vehicles for people with reduced mobility or personal mobility vehicles (e-scooters) is prohibited. Cyclists over the age of 14 may ride on the shoulders of these roads, unless it is prohibited by signage for justified reasons of road safety.*

Table 8. Sample Data on KPI PTW Helmet

	Number of observations		Number of observations (riders and passengers)			Number of observations (riders)					Number of observations (passengers)				
	Riders	Passengers	Motorway	Rural	Urban	Motorway	Rural	Urban	Weekday	Weekend	Motorway	Rural	Urban	Weekday	Weekend
Austria	15.570	1.295	543	7.394	8.928	508	6.640	8.422	9.955	5.615	35	754	506	596	699
Belgium	1.183	80	339	210	714	312	196	675	715	468	27	14	39	33	47
Bulgaria	5.220	587	835	2.269	2.703	749	2.046	2.425	1.540	3.680	86	223	278	97	490
Cyprus	631	59	110	100	480	101	85	445	577	54	9	15	35	53	6
Czech Republic	2.006	249	93	1.132	1.030	85	1.007	914	1.313	693	8	125	116	132	117
Germany	-	-	-	-	5.881	-	-	5.616	5.616	-	-	-	265	265	-
Greece	3.464	615	209	910	2.960	185	755	2.524	2.697	767	24	155	436	480	135
Ireland	-	-	-	-	1.664	-	-	1.643	929	714	-	-	21	11	10
Latvia	2.010	235	-	902	1.343	-	803	1.207	599	1.411	-	99	136	32	203
Malta	1.366	132	-	821	677	-	747	619	473	893	-	74	58	31	101
Poland	3.554	188	1.184	1.336	1.222	1.110	1.282	1.162	1.998	1.556	74	54	60	73	115
Portugal	2.207	213	374	752	1.294	322	681	1.204	1.533	674	52	71	90	124	89
Spain[1]	3.504	466	84	602	2.403	76	528	2.152	1.818	1.686	8	74	251	164	302
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MS not participating in Baseline															
Italy	7.533	2.272	3.245	2.719	3.724	2.300	2.161	3.045	4.423	3.110	945	558	679	1.262	930

[1] *In Spain, 748 riders and 133 passengers were observed on expressways.*

Regarding the passengers of both bicycles and PTWs, in most countries, the collected samples are very low, especially for cyclists or PTWs on motorways or rural roads. Despite the fact that no minimum samples are required separately for passengers, the low samples affect the significance of the results and the comparability of the respective KPIs between drivers and passengers or among the countries. In the following chapters of the report, the indicators for passengers alongside with the 95% Confidence Intervals are shown for those countries and/or strata with a sample equal to or higher than 30 passengers. Also, only for those countries and/or strata, the respective KPIs for all riders (riders and passengers together) are shown. However, due to the different sample sizes of riders and passengers, results should be interpreted with caution, even for the same country.

In Table 9, weighting methodologies applied for the calculation of the KPIs per country are presented. Six countries, i.e. Bulgaria, Czech Republic, Greece, Malta, Portugal and Spain, applied the Baseline weight formula, as described in the respective guidelines (Silverans & Boets, 2021). In all these countries, two strata (road type and time period) were considered for the post-stratification weighting and the calculation of the KPIs at national level.

Austria and Latvia used traffic estimates for the weighting of data, which is also an acceptable method. Belgium used a weight based on traffic volume and session sampling weight based on traffic counts, while for the estimated traffic volume the combination of two proxies was used: the percentage of injured cyclists per stratum and kilometres driven by cyclists per stratum.

No weighting procedures were followed by Germany, Ireland, Poland and Sweden. However, it is noted that since all other requirements have been followed (large representative samples, high number of selected locations, etc.), the respective KPIs are presented in the following sections, highlighting though the differences in the methodologies followed.

Table 9.Post-stratification weighting on KPI Cycle and PTWs Helmet

	Cycle	PTWs
Austria	Weighting: 70% for urban & weekday; 30% for leisure & weekend (estimation, no statistics available). Analysis was done by counting for fulfilling KPI divided by number of observations, including the weight, ignoring the locations.	Weighting: by road type (see above) and time period (weekday 78%; weekend 22%). Analysis was done by counting for fulfilling KPI divided by number of observations, including the weight, ignoring the locations.
Belgium	As described by Baseline guidelines, a weight based on traffic volume and session sampling weight based on traffic counts. Traffic volume was defined by the combination of 2 proxy's: % injured cyclists per stratum (crash statistics) and kilometres driven by cyclists per stratum (mobility survey). Session sampling weight was based on traffic counts. A weight based on time share of the used time spans was also added. A weight based on road length was not included.	As described by Baseline guidelines, a weight based on traffic volume. Traffic volume was defined by the combination of 2 proxy's: % injured PTWs per stratum (crash statistics) and kilometres driven by PTWs per stratum (mobility survey)
Bulgaria	As described by Baseline guidelines. Strata sampling weight: road type.	As described by Baseline guidelines. Strata sampling weight: road type.
Cyprus	-	As described by Baseline guidelines. Traffic volume was not available. Strata sampling weight: road type x time period; session sampling weight based on traffic counts
Czech Republic	As described by Baseline guidelines. Weight proportion is based on ratio combination of national road network (km of rural roads, urban roads, cycle paths and pedestrian-cycle paths), total number of all cyclists during all observations (bikes, electric bikes), time period (weekdays/daytime, weekend/daytime) and total population in the Czech Republic (male/female/children).	As described by Baseline guidelines. Weight proportion is based on ratio combination of national road network (km of motorways, rural roads and urban roads) and time period (weekdays/daytime, weekend/daytime).
Germany	No weighting.	No weighting.
Greece	-	Data weighted based on the Baseline weight formula, including strata sampling weight (road type x time period) and session sampling weight (traffic counts).
Ireland	No weighting.	No weighting.
Latvia	There was no information or expert estimates available for traffic volume or mileage of cyclists on rural and urban roads. Considering the session timing and the number of cyclists spotted, the expert decision was made for the KPI calculations to apply 75% weighting factor for cycling in urban areas and 25% for cycling on rural roads.	Similar assumptions have been made for PTWs where weighting factors are also calculated from PTWs per hour observed.
Malta	As described by Baseline guidelines. Results were weighted based upon road lengths of the road types (urban and rural roads).	As described by Baseline guidelines. Results were weighted based upon road lengths of the road types (urban and rural roads).
Poland	No data on cyclist traffic volume at country level is available or estimates on the length of urban and rural roads. All bicycles during the session were observed. Thus no weighting procedure was applied.	No data on PTWs traffic volume at country level is available or estimates on the length of urban and rural roads. All PTWs during the sessions were observed, thus no weighting procedure was applied.
Portugal	As described by Baseline guidelines.	As described by Baseline guidelines.
Spain	The document "Considerations for sampling weights in Baseline" was thoroughly followed. Sampling weights were calculated according to section 2.2.2. "KPIs with several time period strata".	The document "Considerations for sampling weights in Baseline" was thoroughly followed. Sampling weights were calculated according to section 2.2.2. "KPIs with several time period strata".
Sweden	No weighting.	-

3.2 National KPIs on Helmet use among Cyclists and PTWs

In this section, the national KPIs on the Helmet use among Cyclists and PTWs are shown (Table 10). These KPIs concern the percentages of riders and passengers wearing a helmet at national level, including all road types and time periods (weekdays and weekends).

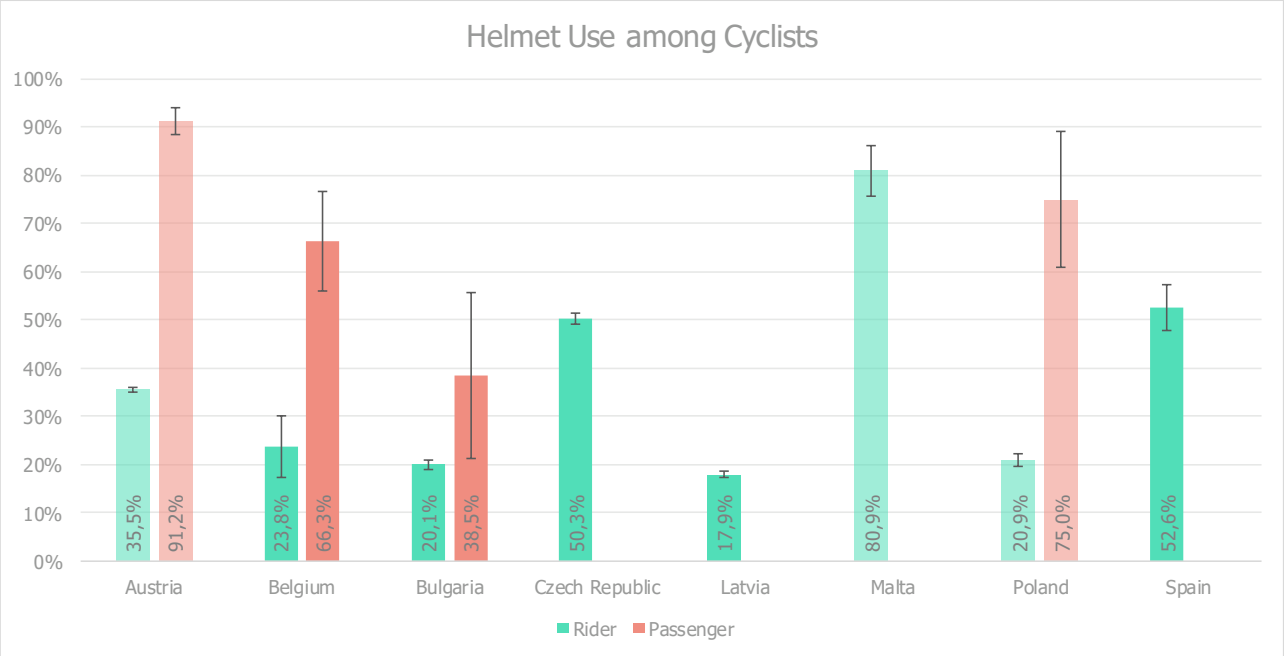
Concerning cyclists, so far available national data exist for Austria, Belgium, Bulgaria, Czech Republic, Latvia, Malta, Poland and Spain. Also the respective KPIs for Italy, which has not participated in the Baseline project, are shown. Data for Germany, Ireland, Portugal and Sweden are not included in this section, since they concern only urban roads. As also mentioned in the previous chapters, a different sampling framework has been considered in case of Austria (observations during weekdays only for urban roads and during weekends only on rural roads/leisure areas), while no weighting was applied on data of Poland and Italy. Thus, the KPIs of these countries are shown in Figure 3 with light colours. On the other hand, data for PTWs are available for Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Greece, Latvia, Malta, Poland, Portugal, Spain and Italy. The respective KPIs are shown in Figure 4, with light colours for the countries with deviations from the minimum requirements.

Table 10. National indicators per vehicle type, all roads and time periods combined

	PTWs			Bicycles		
	Rider	Passenger	All	Rider	Passenger [1]	All
Austria	99,9% (99,8%-100,0%)	100,0%	99,9% (99,8%-100,0%)	35,5% (34,9%-36,1%)	91,2% (88,3%-94,1%)	35,5% (34,9%-36,1%)
Belgium [3]	99,7% (98,8%-99,9%)	100,0%	99,7% (98,8%-99,9%)-	23,77% (18,4%-30,2%)	66,32% (54,3%-76,6%)	24,8% (19,3%-31,3%)
Bulgaria	96,0% (95,4%-96,5%)	92,8% (90,7%-94,9%)	95,9% (95,4%-96,4%)	20,8% (19,8%-21,8%)	38,9% (21,7%-56,0%)	20,8% (19,8%-21,8%)
Cyprus [3]	87,4% (84,8%-90,0%)	87,8% (79,5%-96,2%)	87,7% (85,3%-90,2%)	-	-	-
Czech Republic[4]	99,5% (99,1%-99,8%)	100,0%	99,5% (99,2%-99,8%)	50,3% (49,1%-51,5%)	-	-
Germany	-	-	-	-	-	-
Greece[4]	80,3% (79,0%-81,6%)	65,5% (61,8%-69,3%)	78,9% (77,6%-80,1%)	-	-	-
Ireland	-	-	-	-	-	-
Latvia	100,0%	99,5% (98,6%-100,0%)	100,0%	17,9% (16,6%-19,2%)	-	-
Malta	99,8% (99,6%-100,0%)	97,0% (94,1%-99,9%)	99,8% (99,6%-100,0%)	80,9% (75,8%-86,0%)	-	-
Poland [2]	99,5% (99,4%-99,7%)	100,0%	99,6% (99,4%-99,7%)	20,9% (19,5%-22,2%)	75,0% (60,9%-89,1%)	21,4% (20,1%-22,8%)
Portugal[4]	99,8% (99,4%-99,9%)	99,5% (96,9%-100%)	99,8% (99,4%-99,9%)	-	-	-
Spain	99,4% (99,0%-99,8%)	96,2% (93,0%-99,4%)	99,1% (98,6%-99,6%)	52,6% (47,8%-57,3%)	-	-
Sweden	-	-	-	-	-	-
MS not participating in Baseline						
Italy [2]	96,2% (95,7%-96,6%)	96,5% (95,6%-97,2%)	96,2% (95,9%-96,6%)	30,7% (28,7%-32,8%)	-	-

[1] Low samples for passengers of cycles in all MS./ [2] No weighting / [3]Minimum total sample size not achieved for riders and passengers of PTWs / [4] Minimum sample size for motorways not achieved for Czech Republic, Greece, Portugal

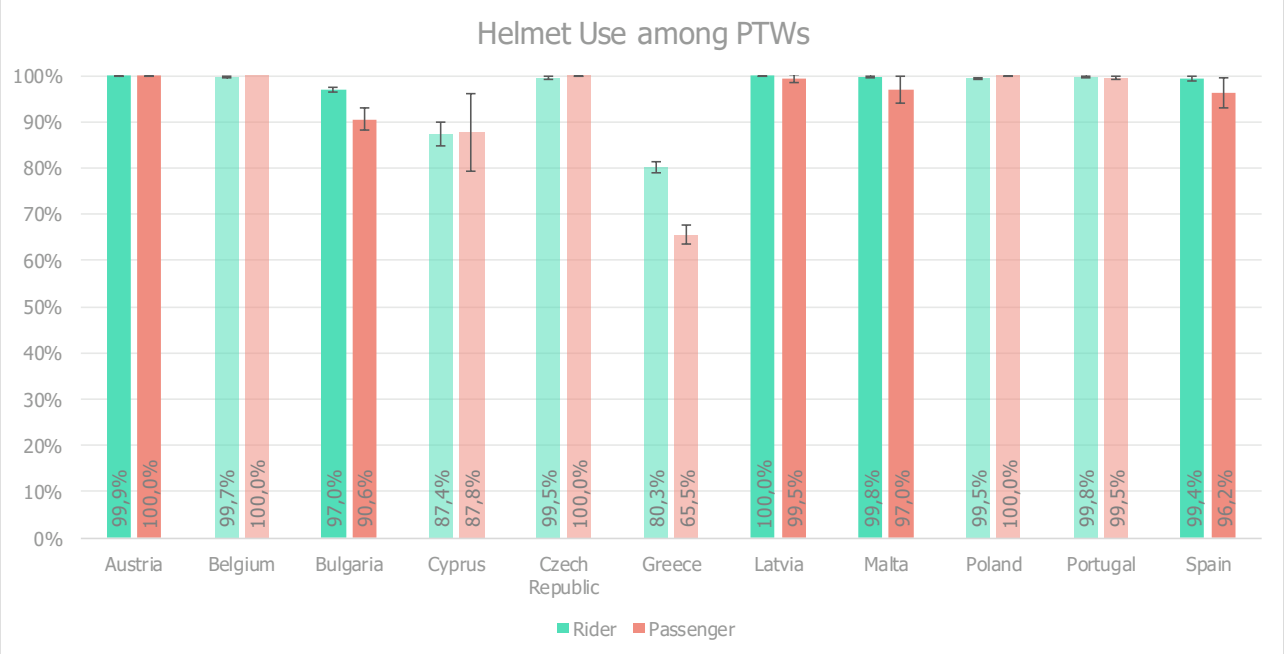
Figure 3. National indicator for Cyclist riders and passengers, all roads and time periods combined



**Note: Countries with deviations in the methodology are shown with light colours (sampling framework for Austria / min. sample not achieved for Malta / no weighting for Poland)*

Among cyclists, the highest use of helmet for riders is observed in Spain (52,6%) and Czech Republic (50,3%), followed by Austria (35,5%), while the lowest helmet use rate is observed in Latvia (17,9%) (Figure 3). It is noted that the helmet use for cyclists is mandatory under the age of 18 years in Czech Republic and is strongly recommended for cyclists older than 18 years old. Also, in Spain the use of helmet is mandatory for cyclists younger than 16 years old and for all cyclists circulating on interurban roads. It is also worth noting that Austria presents a high rate of helmet use for passengers of bicycles, which is may be attributed to the fact that about 95% of passengers observed in Austria are younger than 12 years old, who are obliged by the law to wear a helmet when cycling.

Figure 4. National indicators for PTW riders and passengers, all roads and time periods combined



**Note: Countries with deviations in the methodology are shown with light colours (no weighting for Poland / Minimum total sample size not achieved for Belgium and Cyprus / Minimum sample size for motorways not achieved for Czech Republic, Greece and Portugal)*

Regarding PTWs, in almost all countries the helmet use is very high for both riders and passengers, except Greece, where only 80,1% of riders and 63,5% of passengers use a helmet when riding a motorcycle or moped (Figure 4), followed by Cyprus. Also, in Bulgaria the use of helmet by PTW passengers is lower (90,6%) compared to the remaining countries.

3.3 Breakdown by Road type

The KPIs on helmet use among PTWs and cyclists are shown separately for each type of road in this section (Tables 11, 12 and 13).

Table 11. National indicators per vehicle type on urban roads, all periods included

	PTWs			Bicycles		
	Rider	Passenger	All	Rider	Passenger	All
Austria [1]	99,7% (99,6%-99,8%)	99,8% (99,4%-100,0%)	99,7% (99,6%-99,8%)	32,2% (31,4%-33,0%)	92,0% (87,4%-96,7%)	32,2% (31,4%-33,0%)
Belgium	99,6% (97,3%-99,9%)	100,0%	99,6% (97,4%-99,9%)	23,7% (17,6%-31,1%)	67,2% (55,0%-77,5%)	24,9% (18,7%-32,3%)
Bulgaria	94,7% (93,8%-95,6%)	91,4% (88,1%-94,7%)	94,7% (93,8%-95,6%)	17,0% (16,0%-18,0%)	32,6% (15,8%-49,4%)	16,9% (15,9%-17,9%)
Cyprus [2]	85,5% (82,2%-88,8%)	81,2% (68,2%-94,1%)	86,0% (82,9%-89,1%)	-	-	-
Czech Republic	99,2% (98,7%-99,8%)	100,0%	99,3% (98,8%-99,8%)	39,1% (37,4%-40,7%)	-	-
Germany	99,5% (99,3%-99,7%)	99,3 (98,2%-100,0%)	99,5% (99,3%-99,7%)	31,7% (31,0%-32,4%)	-	-
Greece	75,5% (73,8%-77,2%)	60,5% (55,9%-65,0%)	73,3% (71,7%-74,8%)	-	-	-
Ireland [3]	98,8% (98,3%-99,3%)	-	-	41,7% (40,8%-42,6%)	45,0% (41,2%-47,8%)	41,7% (40,8%-42,6%)
Latvia	100,0%	98,9% (97,1%-100,0%)	99,9% (99,8%-100,0%)	13,6% (12,4%-14,8%)	-	-
Malta	99,6% (99,1%-100,0%)	100,0%	99,6% (99,1%-100,0%)			
Poland [3]	99,1% (99,0%-99,3%)	100,0%	99,2% (99,0%-99,4%)	16,6% (15,0%-18,3%)	-	-
Portugal	99,4% (98,8%-99,8%)	98,6% (94,1%-99,8%)	99,4% (98,8%-99,7%)	47,7% (45,2%-50,2%)	-	-
Spain	99,3% (98,8%-99,8%)	97,1% (93,8%-100,0%)	99,1% (98,6%-99,7%)	33,0% (27,8%-38,2%)	-	-
Sweden	-	-	-	47,2% (46,7%-47,7%)	-	-
MS not participating in Baseline						
Italy [3]	92,6% (91,6%-93,5%)	91,8% (89,5%-93,6%)	92,4% (91,6%-93,3%)	23,5% (21,5%-25,6%)	-	-

[1] Only weekdays have been considered for cyclists on urban roads. / [2] Minimum sample size not achieved for PTWs. / [3] No weighting.

Table 12. National indicators per vehicle type on rural roads, all periods included

	PTWs			Bicycles		
	Rider	Passenger	All	Rider	Passenger	All
Austria[1]	100,0%	100,0%	100,0%	44,8% (44,0%-45,6%)	90,4% (86,6%-94,2%)	45,0% (44,0%-45,6%)
Belgium[2]	99,6% (98,2%-99,9%)	-	-	24,2% (16,7%-33,8%)	-	-
Bulgaria	99,7% (99,4%-99,9%)	98,6% (97,1%-100,0%)	99,5% (99,2%-99,8%)	32,9% (30,3%-35,5%)	-	-
Cyprus[2]	89,3% (82,7%-95,8%)	-	-	-	-	-
Czech Republic	99,6% (99,2%-100,0%)	100,0%	99,6% (99,3%-100,0%)	61,7% (60,0%-63,3%)	-	-
Germany	-	-	-	-	-	-
Greece	83,7% (81,1%-86,3%)	68,7% (61,4%-76,0%)	83,0% (80,5%-85,4%)	-	-	-
Ireland	-	-	-	-	-	-
Latvia	100,0%	100,0%	100,0%	35,1% (28,3%-41,9%)	-	-
Malta	100,0%	93,3% (87,7%-99,0%)	100,0%			
Poland [3]	99,5% (99,4%-99,7%)	100,0%	99,6% (99,4%-99,7%)	26,1% (23,9%-28,3%)	-	-
Portugal	100,0%	100,0%	100,0%	-	-	-
Spain	100,0%	94,2% (82,9%-100,0%)	99,5% (98,4%-100,0%)	89,8% (85,5%-94,1%)	-	-
Sweden	-	-	-	-	-	-
MS not participating in Baseline						
Italy [3]	98,9% (98,4%-99,3%)	98,8% (97,5%-99,5%)	98,9% (98,4%-99,3%)	65,9% (60,5%-70,9%)	-	-

[1] *Only weekends have been considered for cyclists on rural roads.* / [2] *Minimum sample size not achieved for PTWs.* / [3] *No weighting.*

Table 13. National indicators per vehicle type on motorways, all periods included

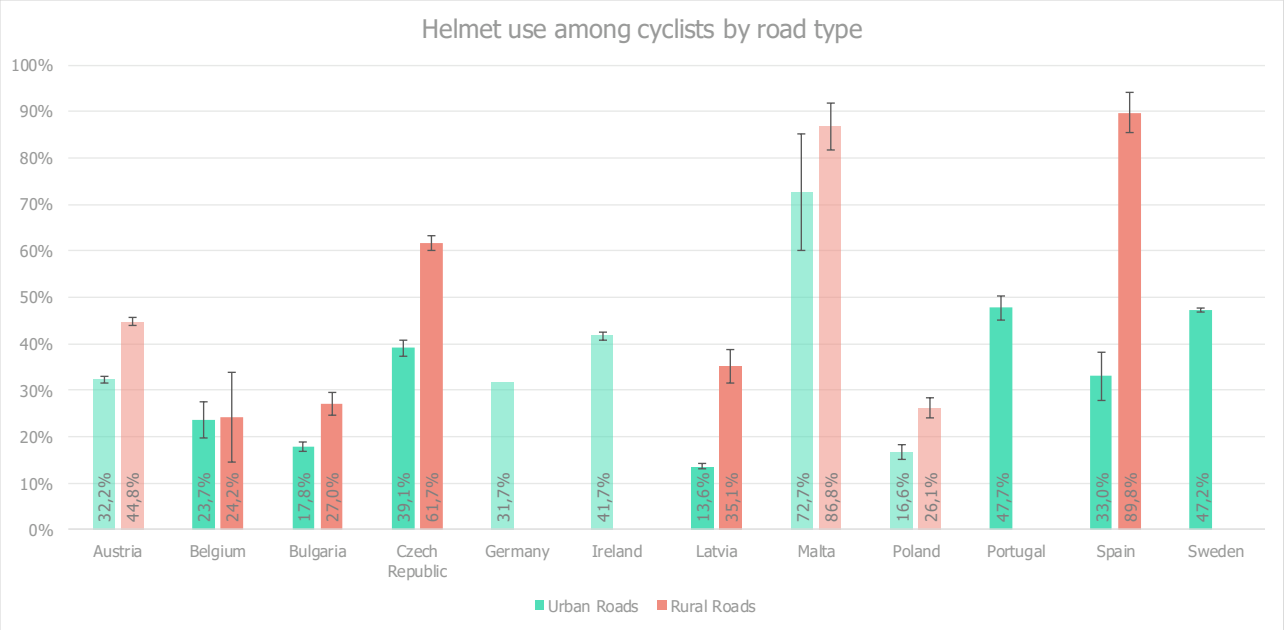
	PTWs (motorcycles only)		
	Rider	Passenger	All
Austria	100,0%	100,0%	100,0%
Belgium [1]	100,0%	-	-
Bulgaria	99,9% (99,7%-100,0%)	97,9% (95,0%-100,0%)	99,4% (98,8%-99,9%)
Cyprus [1]	95,7% (91,7%-99,6%)	-	-
Czech Republic [1]	100,0%	100,0%	100,0%
Germany [2]	-	-	-

	PTWs (motorcycles only)		
	Rider	Passenger	All
Greece [1]	94,9% (91,7%-98,0%)	-	-
Ireland	-	-	-
Latvia	-	-	-
Malta	-	-	-
Poland [2]	99,9% (99,7%-100,0%)	100,0%	99,9% (99,7%-100,0%)
Portugal [1]	100,0%	100,0%	100,0%
Spain [3]	100,0%	-	-
Sweden	-	-	-
MS not participating in Baseline			
Italy [2]	98,3% (97,6%-98,8%)	98,7% (97,8%-99,4%)	98,4% (97,9%-98,8%)

[1] *Minimum sample requirements are not achieved* / [2] *No weighting* / [3] *KPI on expressways in Spain is 100% for riders, 75,8% (59,9%-91,6%) for passengers and 98,2% (96,8%-99,6%) for all riders.*

As far as cyclists are concerned, data for 9 countries on urban and rural roads are provided, while for Germany, Ireland, Portugal and Sweden, data are available only for urban roads. In Figure 5, it is shown that the helmet use rates are higher on rural roads compared to urban roads for all countries. Among the countries applying a common methodology, the KPI values on rural roads vary from 24,2% in Belgium to 89,8% in Spain. On urban roads, the KPIs on helmet use vary from 13,6% in Latvia to 47,7% in Portugal.

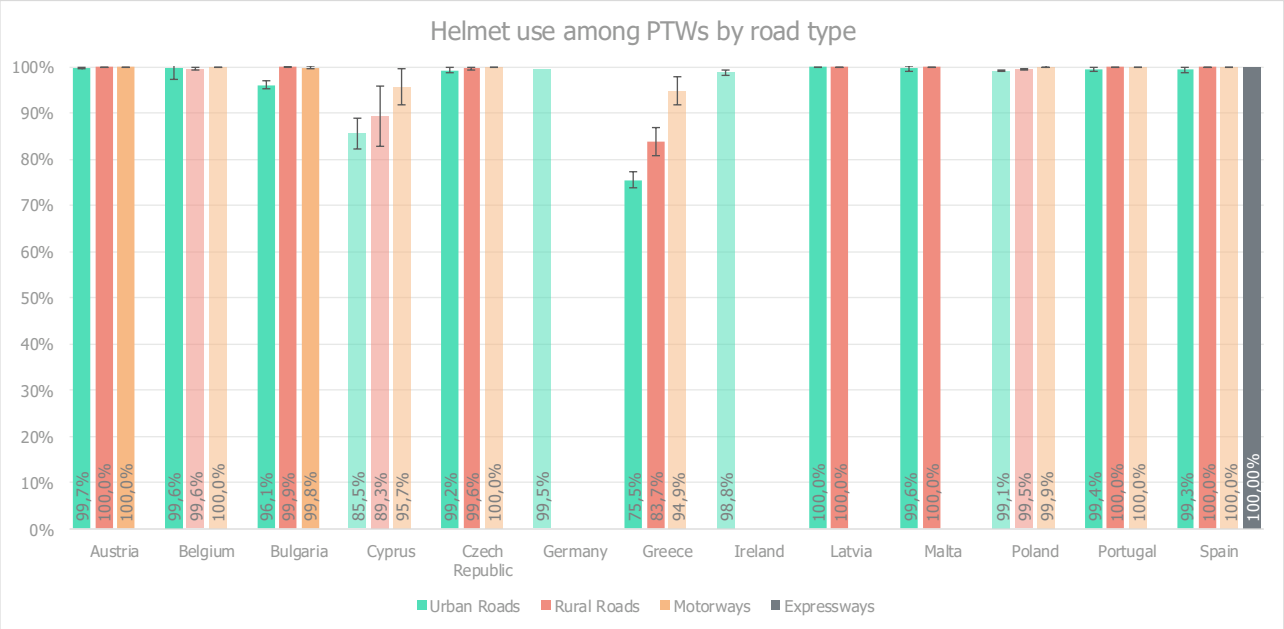
Figure 5. Helmet Use among Cyclist riders by country and road type (all periods included)



**Note: Countries with deviations in the methodology are shown with light colours (sampling framework for Austria/ no weighting for Germany, Ireland and Poland / min. sample not achieved for Malta)*

In Figure 6, the respective KPIs for PTW riders by road type are presented. It is noted that in Latvia and Malta, no motorways exist, thus, the respective KPIs are not available. The use of helmet for these user types are much higher than those of cyclists in all countries. Additionally, in most of the countries, the prevalence of helmet use is almost same on motorways and rural roads, except Greece. Also, in Bulgaria, Greece and Italy, KPIs on urban roads are lower than those observed on the other types of roads, with the highest difference being identified in Greece (only a 76% of drivers use helmet when travelling on urban roads).

Figure 6. Helmet Use among PTW riders by country and road type (all periods included)



**Note: Countries with deviations in the methodology are shown with light colours (Minimum sample requirements not achieved for motorways of Belgium, Cyprus, Czech Republic, Greece, Portugal / no weighting for Germany, Ireland and Poland)*

3.4 Breakdown by Time period

In this section, KPIs by time period (weekdays/weekends) are shown for both cyclists and PTWs (Tables 14 and 15).

Table 14. National indicators per vehicle type on weekdays, all roads included

	PTWs			Bicycles		
	Rider	Passenger	All	Rider	Passenger	All
Austria [1]	99,7% (99,8%-100,0%)	100,0%	99,9% (99,8%-100,0%)	32,2% (31,4%-33,0%)	92,0% (87,4%-96,7%)	32,2% (31,4%-33,0%)
Belgium [2]	99,6% (98,2%-99,9%)	100%	99,6% (98,3%-99,9%)	23,9% (17,7%-31,4%)	64,7% (50,5%-76,8%)	24,8% (18,6%-32,4%)
Bulgaria	95,6% (94,6%-96,6%)	90,4% (84,6%-96,3%)	95,7% (94,7%-96,7%)	19,6% (18,1%-21,1%)	-	-
Cyprus[2]	88,5% (85,9%-91,1%)	86,6% (77,5%-95,8%)	88,6% (86,1%-91,1%)	-	-	-
Czech Republic	99,3% (98,9%-99,8%)	100,0%	99,8% (99,4%-100,0%)	44,4% (42,7%-46,1%)	-	-
Germany[3,4]	99,5%	99,3%	99,5%	31,7%	-	-
Greece	80,9% (79,4%-82,4%)	68,2% (64,0%-72,4%)	79,2% (77,8%-80,6%)	-	-	-
Ireland [3,4]	98,8% (98,1%-99,5%)	-	-	43,9% (42,7%-45,2%)	-	-
Latvia	100,0%	97,9% (93,1%-100,0%)	99,9% (99,6%-100,0%)	11,8% (10,4%-13,2%)	-	-
Malta	99,6% (99,0%-100,0%)	92,5% (83,3% 100,0%)	99,6% (99,0% 100,0%)	-	-	-

	PTWs			Bicycles		
	Rider	Passenger	All	Rider	Passenger	All
Poland [3]	99,6% (99,4%-99,8%)	100,0%	99,6% (99,4%-99,8%)	16,3% (14,6%-18,0%)	-	-
Portugal [4]	99,8% (99,2%-99,9%)	99,2% (95,0%-100,0%)	99,6% (99,4%-99,8%)	42,3% (39,4%-45,3%)	-	-
Spain	99,5% (98,9%-100,0%)	96,1% (91,4%-100,0%)	99,2% (98,6%-99,8%)	33,4% (26,8%-40,0%)	-	-
Sweden	-	-	-	-	-	-
MS not participating in Baseline						
Italy [3]	96,5% (95,9%-97,0%)	96,6% (95,4%-97,5%)	96,5% (96,0%-97,0%)	33,5% (30,5%-36,6%)	-	-

[1] Only weekends have been considered for cyclists on rural roads. / [2] Minimum sample size not achieved for PTWs. / [3] No weighting. / [4] Only urban roads have been considered (only for cyclists in Portugal).

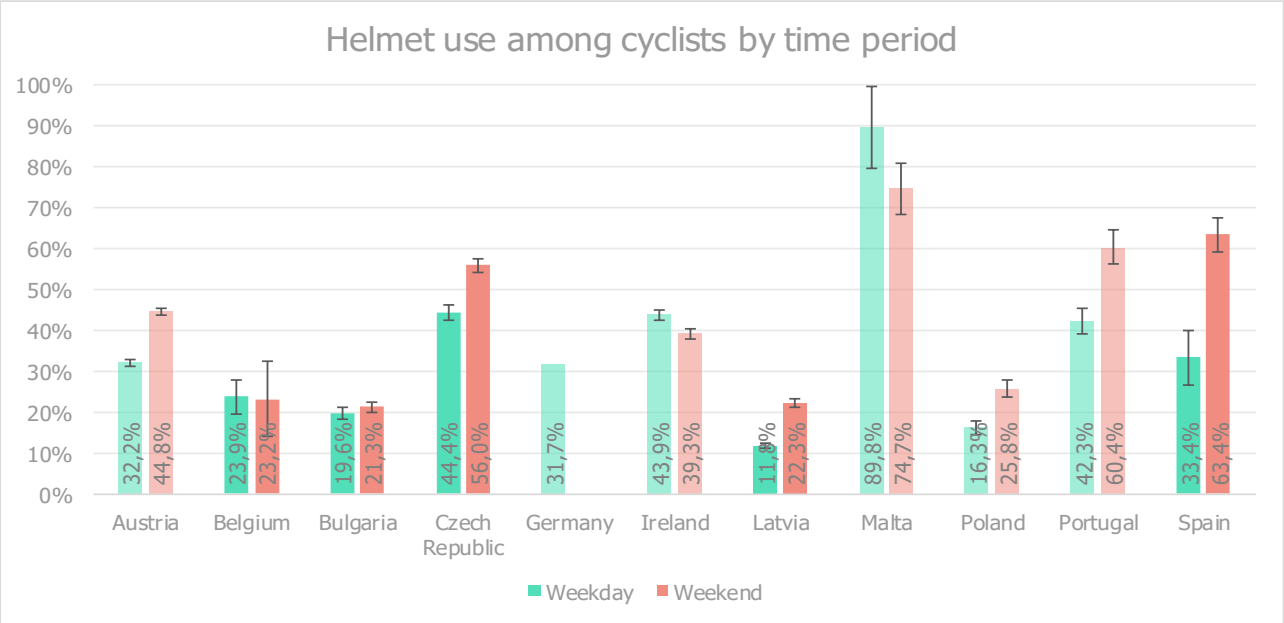
Table 15. National indicators per vehicle type at weekends, all roads included

	PTWs			Bicycles		
	Rider	**Passenger**	**All**	**Rider**	**Passenger** [1]	**All**
Austria [1]	99,9% (99,8%-100,0%)	100,0%	99,9% (99,8%-100,0%)	44,8% (44,0%-45,6%)	90,4% (86,6%-94,2%)	44,8% (44,0%-45,6%)
Belgium[2]	99,8% (98,5%-100,0%)	100,0%	99,8% (98,6%-100,0%)	23,2% (16,0%-32,3%)	73,4% (59,5%-83,9%)	24,6% (17,5%-33,4%)
Bulgaria	97,1% (96,5%-97,6%)	91,4% (88,9%-93,9%)	97,1% (96,6%-97,6%)	21,3% (20,0%-22,6%)	-	-
Cyprus	-	-	-	-	-	-
Czech Republic	99,7% (99,3%-100,0%)	100,0%	99,4% (99,0%-99,8%)	56,0% (54,3%-57,6%)	-	-
Germany	-	-	-	-	-	-
Greece	79,0% (76,2%-81,9%)	60,0% (51,7%-68,2%)	78,2% (75,5%-80,9%)	-	-	-
Ireland	98,7% (97,9%-99,6%)	-	-	39,3% (38,04%-40,6%)	-	-
Latvia	100,0%	100,0%	100,0%	18,7%	-	-
Malta	100,0%	99,7% (98,7%-100,0%)	100,0%	-	-	-
Poland [3]	99,4% (99,2%-99,6%)	100,0%	99,5% (99,3%-99,6%)	25,8% (23,7%-27,9%)	-	-
Portugal [4]	99,8% (99,1%-100,0%)	100,0%	99,9% (99,2%-100,0%)	60,4% (56,0%-64,6%)	-	-
Spain	99,3% (98,9%-99,8%)	96,5% (93,7%-99,3%)	99,0% (98,4%-99,5%)	63,4% (59,3%-67,6%)		
Sweden	-	-	-	-	-	-
MS not participating in Baseline						
Italy [3]	95,7% (95,0%-96,4%)	96,4% (95,0%-97,5%)	95,9% (95,2%-96,5%)	28,0% (25,3%-30,9%)	-	-

[1] Only weekends have been considered for cyclists on rural roads. / [2] Minimum sample size not achieved for PTWs. / [3] No weighting. / [4] Only urban roads have been considered for cyclists.

Regarding cyclists, the helmet use is higher during weekends compared to weekdays for all countries, except Belgium, Bulgaria and Italy. The KPIs on helmet use on weekdays varies from 11,8% in Latvia to 44,4% in Czech Republic. The highest KPIs at weekends are observed in Spain, Portugal (concerning only urban roads) and Czech Republic (Figure7).

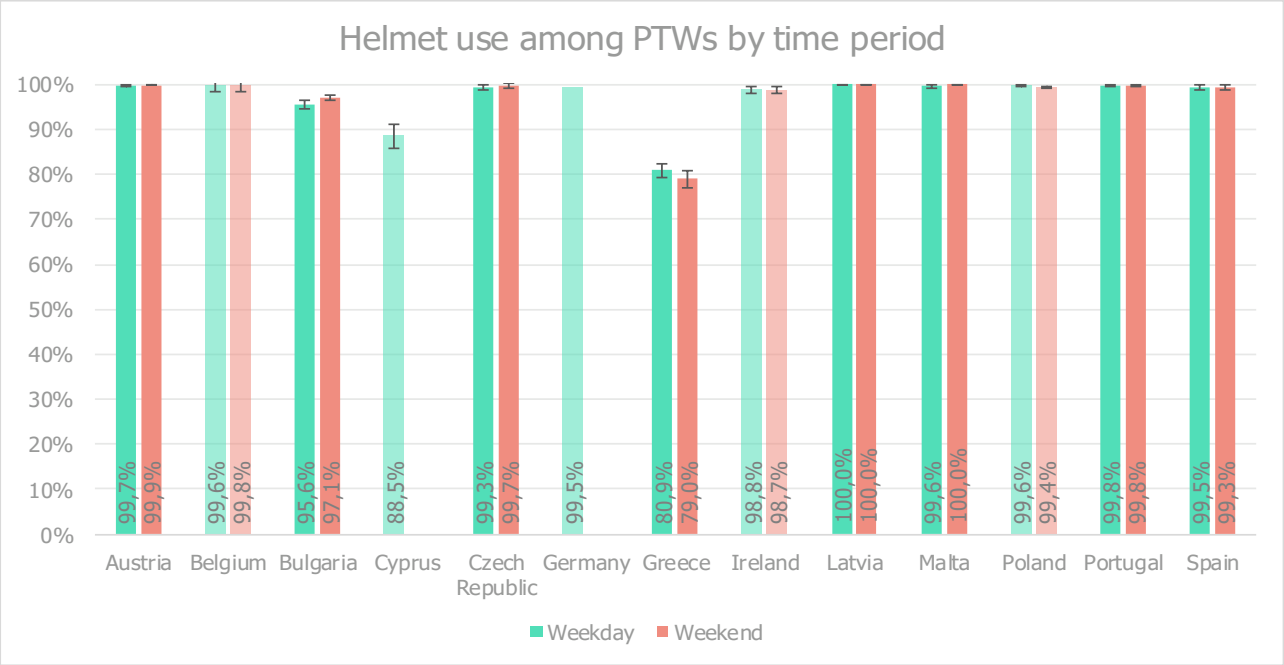
Figure 7. Helmet use among cyclist riders by country and time period (all roads included)



**Note: Countries with deviations in the methodology are shown with light colours (Sampling framework for Austria / no weighting for Germany, Ireland and Poland / min. sample not achieved for Malta/ only urban roads are considered for Germany, Ireland and Portugal)*

As far as PTWs are concerned, for most countries there is no high difference on helmet use depending on the day of the week, with most KPIs being above 99% for both time periods (Figure 8). Somehow lower KPIs are observed in Bulgaria, where more PTWs use a helmet at weekends compared to weekdays, while the opposite is observed in Italy. However, these differences are very low and not statistically significant when considering CIs.

Figure 8. Helmet use among PTW riders by country and time period (all roads included)



Note: Countries with deviations in the methodology are shown with light colours (Minimum sample requirements not achieved for Belgium and Cyprus / no weighting for Germany, Ireland, Poland and Italy / only urban roads are considered for Germany and Ireland)

3.5 Breakdown by Vehicle Type

In this section, data by vehicle type (e-bike vs. bike and moped vs. motorcycle) are shown for a limited number of countries (Table 16), for which data are available. Helmet wearing rates are higher for e-bike riders in Austria, Czech Republic and Germany (only for urban roads), while the opposite is observed on Portugal (only for urban roads).

Table 16. National indicators per vehicle type for cyclists, all roads included

	Bicycle Riders		Bicycle Passengers	
	E-bike	**Bike**	**E-bike**	**Bike**
Austria	61,8% (60,0%-63,6%)	35,1% (34,5%-35,7%)	-	91,3% (88,3%-94,3%)
Belgium	30,7% (24,6%-37,5%)	21,7% (16,2%-28,5%)	79,2% (55,3%-92,2%)	64,0% (47,7%-77,6%)
Czech Republic	64,7% (61,1%-68,3%)	48,7% (47,4%-49,9%)	-	-
Germany [1,2]	56,2% (54,2%-58,2%)	27,4% (26,7%-28,1%)	-	-
Portugal [1]	31,7% (26,8%-37,0%)	53,6% (50,8%-56,3%)	-	-

[1] *Only urban roads have been considered for cyclists* / [2] *no weighting.*

Concerning PTWs, separate KPIs for moped riders and motorcyclists are available in Austria, Belgium, Malta, Poland and Portugal, whose values are similar in all countries (Table 17).

Table 17. National indicators per vehicle type for PTW riders, all roads included

	PTW Riders		PTW passengers	
	Moped	Motorcycle	Moped	Motorcycle
Austria	99,0% (98,6%-99,4%)	99,9% (99,8%-100,0%)	100,0%	100,0%
Belgium[1]	99,1% (96,8%-99,8%)	100%	-	100%
Malta	99,6% (99,1%-100,0%)	100,0%	98,1% (94,3%-100,0%)	99,9% (99,1%-100,0%)
Poland[2]	98,8% (98,6%-99,0%)	99,7% (99,5%-99,9%)	100%	100%
Portugal	99,1% (97,5%-99,8%)	99,9% (99,6%-100,0%)	96,1% (82,1%-99,6%)	100,0%

[1] *Minimum sample is not achieved* / [2] *No weighting.*

3.6 Breakdown by Age Group and Gender

In this section, KPIs by age group and gender are shown for a few countries, for which data are available. KPIs for children have been estimated for four countries, with different age limits per country: 12 years old for Austria and Belgium, 17 years old for Czech Republic, 14 years old for Portugal and 16 years old for Spain (Table 18). The use of helmet for children is higher in all countries, however, in most cases the samples for these age groups are not adequate. Among these countries, in Austria, Czech Republic and Spain, helmet use among cyclists under the respective age limits is mandatory (Table 3).

Table 18. National indicators per age group, all roads included

	Bicycle Riders	
	0-14	14+
Austria[1]	78,2% (75,9%-80,5%)	34,6% (34,0%-35,2%)
Belgium[1, 4]	64,6% (51,7%-75,6%)	22,6% (17,3%-29,0%)
Czech Republic[2]	78,0% (75,0%-81,0%)	-
Portugal[4]	68,9% (55,7%-80,1%)	47,0% (44,5%-49,6%)
Spain[3, 4]	53,2% (28,8% - 77,6%)	42,3% (37,6%-47,1%)

[1] Children up to 12 years old / [2] Children up to 17 years old / [3] Children up to 16 years old / [4] Low sample for children.

KPIs by gender for cyclists are also available for the abovementioned countries. In all countries, the helmet wearing rates are higher for male cyclists compared to females (Table 19).

Table 19. National indicators per gender, all roads included

	Bicycle Riders	
	Female	Male
Austria	31,0% (30,1%-31,9%)	37,3% (36,6%-38,0%)
Belgium	20,9% (15,7%-27,3%)	25,4% (19,6%-32,1%)
Czech Republic	43,6% (41,6%-45,5%)	49,1% (47,4%-50,7%)
Portugal	41,5% (36,3%-47,0%)	49,2% (46,4%-52,0%)
Spain[1]	26,9% (19,1%-34,8%)	47,3% (42,0%-52,6%)

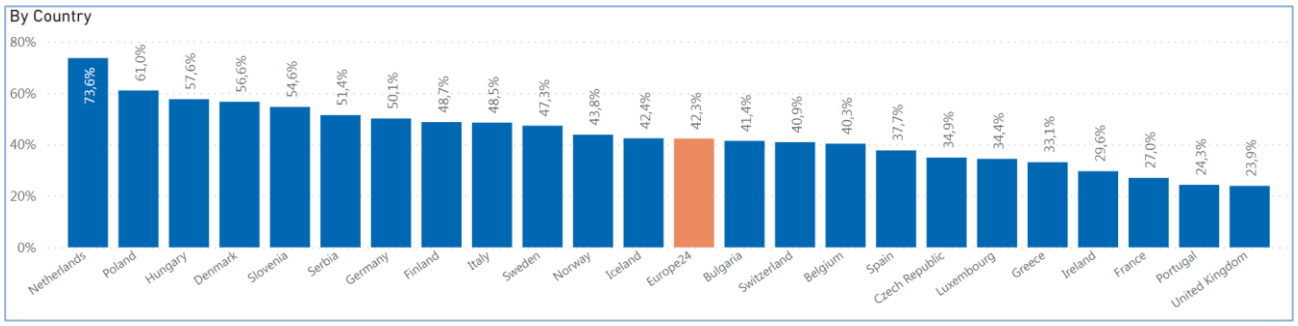
[1] Low sample for female riders.

3.7 Additional indicators

3.7.1 Exposure of PTWs and Cyclists

Most countries do not dispose exposure data by vehicle type and mostly for cyclists and PTWs. The best estimates of the exposure of PTWs and cyclists for all EU Member States can be found in the ESRA project (www.esranet.eu), based on the results of the self-reported survey. As shown in Figure 9, among the EU Member States, the highest use of a bicycle is found in the Netherlands, Poland, Hungary and Denmark (more than 56% of respondents declared that used the bicycle at least a few days a month), while the lowest use of a cycle is reported in Portugal, France and Ireland.

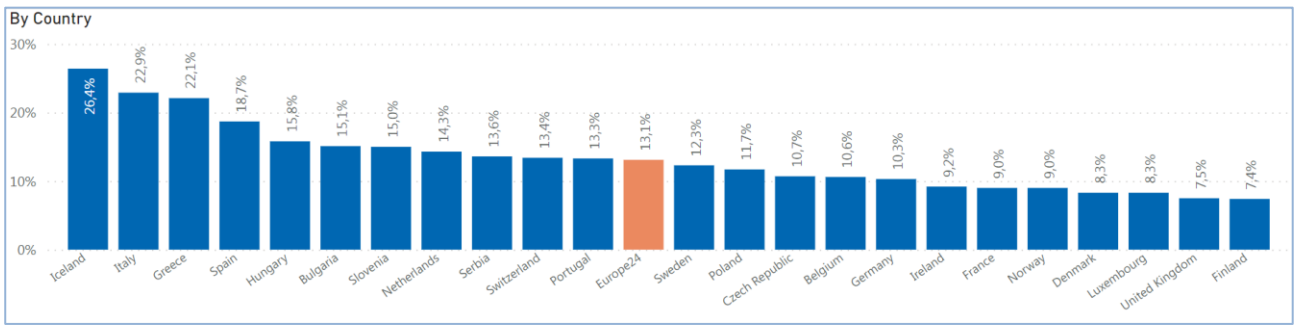
Figure 9. Exposure - % at least a few days a month bicycle



Source: ESRA 2 (www.esranet.eu)

Concerning the PTWs (Figure 10), the highest use of a motorcycle or a moped for at least a few days a month in the EU is recorded in Italy, Greece and Spain (more than 18%), while the lowest use is observed in Finland, Luxembourg and Denmark (lower than 9%).

Figure 10. Exposure - % at least a few days a month using a moped/motorcycle

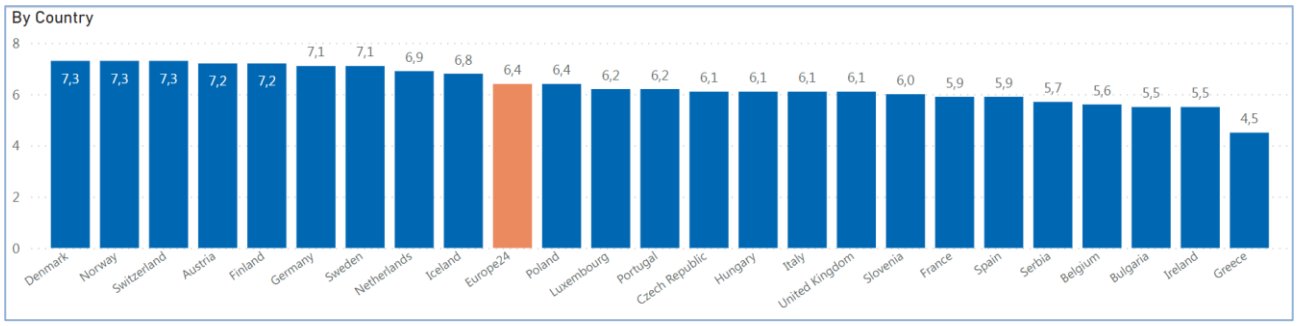


Source: ESRA 2 (www.esranet.eu)

3.7.2 Safety feeling

Within the same survey, respondents declared how safe they feel when using a bicycle. The mean score of an 11-point scale (where 0=very unsafe and 10=very safe) of the European countries is shown in Figure 11. Among the EU Member States participating in the ESRA2 project, people feel more safe when cycling in Denmark (7,3), Austria (7,2) and Finland (7,2) and least safe in Greece (4,5), Ireland (5,5) and Bulgaria (5,5).

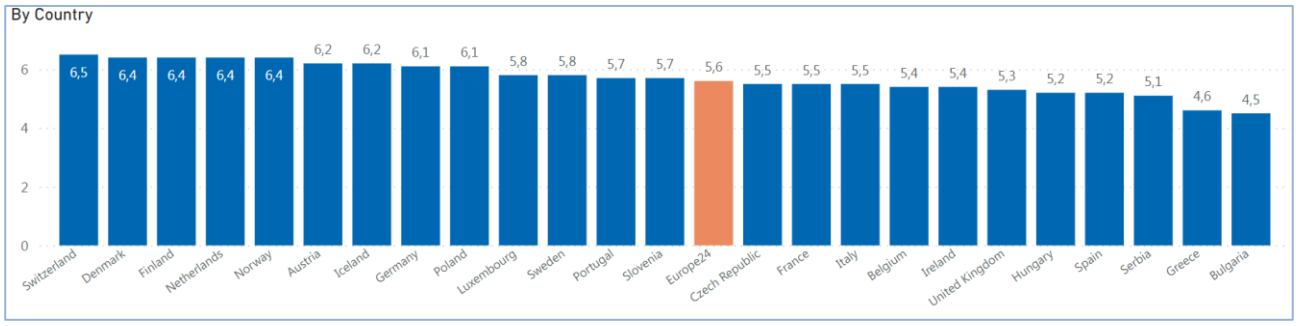
Figure 11. Safety Feeling - Cyclists



Source: ESRA 2 (www.esranet.eu)

Concerning the PTWs, the rating of safety feeling when riding a motorcycle or a moped varies from 6,4 in Denmark to 4,5 in Bulgaria (Figure 12).

Figure 12. Safety Feeling - PTWs



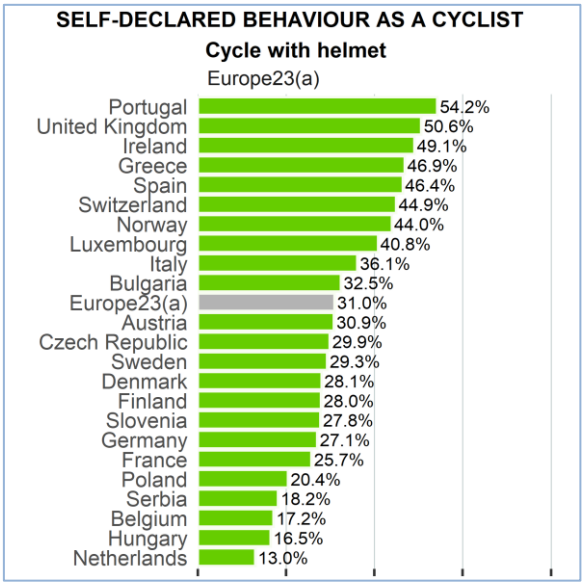
Source: ESRA 2 (www.esranet.eu)

3.7.3 Self-declared behaviour

The behaviour of cyclists and PTW riders concerning the use of a protective helmet has been explored within the ESRA survey, with those results being more related to the Baseline results. The participants of the survey were asked to declare over the last 30 days, how often they travelled as cyclists or PTW drivers without a helmet. Based on the percentages of cyclists and moped riders or motorcyclists that reported to travel without a helmet at least once in the past 30 days, the respective helmet use rates were estimated for each country (Figure 13 and 14).

As shown in Figure 13, the highest use of helmet among cyclists in the EU has been declared in Portugal and Ireland (54,2% and 49,1% respectively), while the lowest helmet use rates are found in the Netherlands (13%) and Hungary (16,5%).

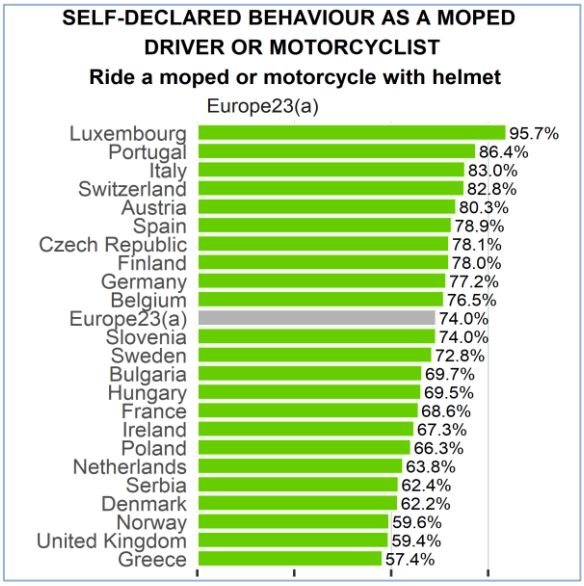
Figure 13. Self-declared behaviour as a cyclist



Source: ESRA 2 (www.esranet.eu)

Concerning the riders of mopeds and motorcycles (Figure 14), the highest helmet use rates among the EU countries have been declared in Luxembourg (95,7%), Portugal (86,4%) and Italy (83,0%), while the lowest use rates are declared in Greece (57,4%), Denmark (62,2%) and the Netherlands (63,8%).

Figure 14. Self-declared behaviour as a moped rider or motorcyclist



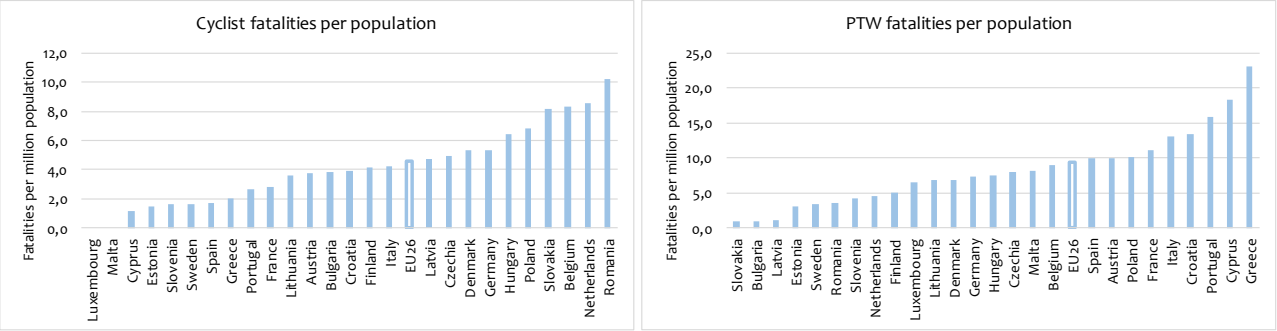
Source: ESRA 2 (www.esranet.eu)

3.7.4 PTW and Cyclist fatalities

It is also interesting to explore the ranking of the countries based on the road safety outputs. Thus, in Figure 15, the number of PTW and cyclist fatalities in road crashes per million population in 2019 are presented. Concerning cyclists, the highest fatality rate was recorded in Romania (more than 10 fatalities per million population), followed by the Netherlands, Belgium and Slovakia. On the other hand, less than 2 fatalities per million population were recorded in Cyprus, Estonia, Slovenia and Sweden and Spain.

Regarding PTW fatalities, the highest crash fatality rates were recorded in Greece, Cyprus and Portugal, while the lowest number of crash fatalities were recorded in Slovakia, Bulgaria and Latvia in 2019.

Figure 15. PTW and cyclist fatality rates per million population by country, 2019



Sources: EU CARE Database, Eurostat

3.7.5 Discussion

Helmet use rates for PTW riders and passengers are very high for almost all countries (above 90%), while the respective KPIs for cyclists are significantly lower, varying from 17,9% to 52,6%. More specifically, for cyclists the helmet use rates are higher on rural roads compared to urban roads for all countries. On the other hand, for PTWs, the prevalence of helmet use is almost the same on motorways and rural roads for almost all countries, while KPIs on urban roads are lower than those observed on the other types of roads. Regarding the two different time periods examined, the helmet use among cyclists is higher during weekends compared to weekdays for all countries, while for the respective indicators for PTWs, no significant difference was observed depending on the day of the week.

When comparing the KPIs on helmet use among cyclists and cyclist fatality rates per million population for 2019 in the EU Member States, a clear relationship cannot be easily identified. Helmet use rates among cyclists are relatively low in all countries that provided the respective data, given that for all countries helmet use for cyclists is not mandatory by law, except specific cases (e.g. children, on rural roads, e-bikes). The lowest helmet use rates were recorded in Latvia, Poland, Bulgaria and Belgium (below 25%), with the three of those countries (Latvia, Poland and Bulgaria) presenting cyclist fatality rates above the EU average. On the other hand, the highest helmet use rates among cyclists are found in Spain and Czech Republic (52,6% and 50,3% respectively), from which only Spain recorded fatality rate lower than the EU average. It should also be stressed, that a clearer picture of the safety level of the countries in terms of fatalities could be depicted through the use of exposure indicators, as in most countries, fatality rates are also associated with the bicycle use rates within the countries (e.g. about 74% of Dutch people cycle at least once a month).

KPIs for helmet use among PTWs are significantly high in all countries, except Greece, which is the country with the highest PTW fatality rate among the EU countries. It is observed, however, that relatively high fatality rates are present also in countries with high KPI values (e.g. Portugal, Italy), where high fatality rates can also be associated with the high traffic volume of motorcycles and mopeds in these countries..

Additionally, an initial comparison of the Baseline results coming from the roadside observation surveys and the ESRA 2 survey results based on the self-declared behaviour of riders shows that there is a similar pattern of the performance of the countries concerning cyclists, but this is not always the case for PTWs. Based on the self-declared behaviour of cyclists, the countries with higher helmet use rates than the European average are also among the countries with higher helmet use rates being observed within the Baseline project. This is also confirmed from the results of the roadside observations for Portugal - taking into account also available results only for urban roads.

However, KPIs for helmet use among cyclists for Bulgaria is lower than the declared performance based on ESRA survey, while the opposite is observed for Czech Republic.

Concerning PTWs, ESRA and Baseline results for Greece agree, while for the remaining countries, ESRA results vary from 66% in Poland to 86% in Portugal, while the KPIs from the roadside observations are above 96% for riders in all countries.

4 Conclusions on data quality and recommendations for the future

4.1 Comparability and quality of data

Within the Baseline project, 12 EU Member States provided KPI data on helmet use among cyclists and 13 countries provided KPI data on helmet use among PTW (moped and motorcycle) riders. Also, Italy, who did not participate in the Baseline project, provided data on helmet use, which are also presented in the current report. All countries collected data and provided indicators as close to the methodological specifications of the project as possible, while in a few countries, where the KPIs on helmet use have been collected in previous years, the same methodology was retained. In general terms, the performance of countries concerning the helmet use among cyclists and PTWs is successfully recorded and a first picture is depicted at European level. However, the comparative assessment of the results among the countries is not always feasible, mainly due to different methodological approaches or deviations from the minimum requirements suggested in the Baseline project. It is not therefore easy to draw clear conclusions as to the ranking of the countries in relation to their performance in all cases.

All Member States conducted roadside observations in order to collect data for both cyclists and PTWs. Most roadside observation surveys were carried out in 2021, about 2-3 months continuously for most of the countries, while in five countries observation surveys were carried out in two time periods (autumn and spring). Also, most countries collected data during spring and/or autumn, following Baseline guidelines, except Austria, where roadside observations took place during the summer.

Also, different methods of sampling of locations were selected among the countries. Concerning the KPI data collection for cyclists, a stratified random sampling of the observation locations was selected for Austria, Latvia, Malta, Poland, Portugal and Spain, a non-proportional stratified sample was selected for Belgium and a simple random sampling of locations was selected for Bulgaria and Czech Republic. Sweden and Germany provided data based on the observations carried out on urban roads, in locations and regions that have been used in previous national surveys. Concerning helmet use among PTWs, a stratified random sampling of the observation locations was selected for all countries, except Belgium, Bulgaria, Czech Republic and Germany. The minimum required number of different locations per road type (10 locations) was reached by all countries.

For most countries, data on cyclists were provided by road type and time period, with fewer countries providing data by vehicle type, age group or gender. Based on the Baseline guidelines, a sample of at minimum 2.000 observations (riders and passengers) should be collected for each road user type, i.e. PTWs and cyclists, while the respective minimum number of required observations per stratum is 500 riders and passengers. The minimum samples of cyclist riders and passengers are reached for all countries, except Cyprus and Greece, for which KPIs were not estimated. Also, the sample of observed cyclists on rural roads for Latvia was lower than the minimum required. Similarly, minimum samples of PTW riders and passengers are achieved in all countries, except Belgium and Cyprus. The respective minimum samples per road type are also achieved for all countries, except on motorways for Belgium, Czech Republic, Greece and Portugal and on rural roads for Belgium.

It is also noted that the sample stratification differs in some countries in comparison with the minimum strata proposed in the respective Baseline methodological requirements. More specifically, concerning the KPI on cycle helmet, the sampling framework of Austria includes observations during weekdays only for urban roads and during weekends only on rural roads (leisure areas). Additionally, helmet use data for cyclists were collected only on urban roads for Germany, Portugal and Sweden, while no motorways exist in Latvia and Malta (for PTWs indicator).

Regarding the passengers of both bicycles and PTWs, in most countries, the collected samples are very low, especially for cyclists on rural roads or PTWs on motorways or rural roads. Despite the fact that no minimum samples are required separately for passengers, the low samples affect the significance of the results and the comparability of the respective KPIs between drivers and passengers or among the countries. Therefore, due to the different sample sizes of riders and passengers, results should be interpreted with caution, even for the same country.

Finally, concerning the weighting methodologies applied for the calculation of the KPIs per country, six countries, applied the Baseline weight formula. In all these countries, two strata (road type and time period) were considered

for the post-stratification weighting and the calculation of the KPIs at national level. Austria and Latvia used traffic estimates for the weighting of data, which is also an acceptable method. No weighting procedures were followed by Germany, Poland and Sweden. However, it is noted that for these countries, since all other requirements have been followed, locations for helmet observations cover the whole area of the country in case of Poland and a large sample of observed cyclists on urban roads has been collected in Sweden and Germany, the respective KPIs have been included in the report.

In all countries, except two countries, almost all PTW riders wear a helmet. Thus, the different weighting methodologies applied by the countries do not affect significantly the comparability of the results, which, however, is not the case for the cyclists. The comparison of the performance of the countries in regards to the helmet use among cyclists is not always easy and the limitations or deviations from the methodology should be taken into account when interpreting the results.

4.2 Recommendations

The major protective systems for cyclists, moped riders and motorcyclists are safety helmets, which can prevent at a large extent the head and neck injuries, which are among the main cause of death, severe injury and disability among two-wheelers. The KPIs on helmet use are measured separately for the PTWs (moped riders and motorcyclists) and the cyclists, for whom, the national legislation differs in all Member States concerning the compulsory use of helmets, the restricted circulation of those vehicle types to specific road types, etc. These differences are depicted to the helmet use rates between PTWs and cyclists, as also confirmed within the Baseline project.

One of the purposes of the project is the data collection and calculation of the road safety KPIs in the EU countries, that will serve as a baseline for the monitoring of the evolution of their road safety performance within this decade. Thus, it is essential that the comparability of the KPI results over time will be ensured in the following years. Within this context, it is recommended that any changes in the methodology of the data collection and calculation of the KPIs in the future will not affect the comparability of the KPIs over time, but in parallel will allow the Member States to focus on those KPIs that are of higher importance for them and make the collection of the minimum required data more feasible.

The minimum required strata in the Baseline project were road type (motorways, rural roads, urban roads) and time period (weekday, weekend). Cyclists' behaviour seems to differ depending on the road type and time period, while the PTWs' behaviour differs on urban roads compared to the other road types only in a few countries and seems not to be depended on the type of the day. Thus, the same strata are recommended to be kept, providing also the opportunity to Member States to deliver KPIs only for specific strata (e.g. cyclists on urban roads). Considering also that in some Member States, almost all motorcyclists wear a helmet, the collection of the minimum required data for all strata may be a time and resource consuming task. It should, therefore, be allowed to deliver KPIs only for those strata that focus should be given, based on the same minimum data collection requirements, in order to ensure comparability of the KPIs among the countries as well.

KPIs for cyclists by gender and age group were provided by a few countries. The results showed that there is a difference in the helmet use by gender and age group, however, this is based only on data of a few countries, which in some cases do not dispose adequate samples. KPIs by gender and age group (with a focus on the helmet use among the children) is recommended to be further explored by more countries, which would also allow to identify the target groups that are of higher risk.

The minimum samples per road type or time period have been met for most countries, except specific road types, i.e. motorcyclists on motorways, cyclists on rural roads. The minimum required samples for the combination of the two basic strata (road type x time period) are not met in almost all countries. Also, in the case of cyclists, KPIs were provided either only for urban roads (where there is most traffic of bicycles) by some countries or a convenience sampling combining specific road types and time periods (weekday/weekend) was opted. On that purpose, the minimum samples should be revised, so that it will be feasible for the Member States to collect more comparable data for the different strata or combinations of strata, taking also into consideration issues such as, low traffic of specific transport modes in some countries or road types, different minimum samples for small countries, etc.

Another methodological requirement that should be re-evaluated concerns the sample size of passengers. In the Baseline project, no minimum required sample size for the passengers was foreseen in the methodological guidelines, despite the fact that a separate KPI for passengers was requested. However, the low number of passengers in almost all countries did not allow the calculation of reliable KPIs for passengers. Also, the comparison

between drivers and passengers was not feasible in all cases, while the inclusion of the passengers in the aggregate KPIs (including both riders and passengers) caused comparability issues among the Member States.

A significant limitation highlighted in the project is the lack of traffic volume data for PTWs or cyclists, that is mainly reflected at the weighting of the data and the calculation of the final results. An approach of weighting was suggested in the Baseline project, which however, was not applied by all Member States, especially those that did not dispose national road length data. Estimates of traffic share by road type and time period or proxies of traffic volume were used for the weighting of the results by a few Member States, which, however, do not allow to assess safely the comparability of the data. Therefore, minimum requirements for the weighting of the data should be defined, either for the calculation of the KPIs in one stratum or for the calculation of national KPIs (including more strata or combinations of strata).

Additional indicators could also be considered in relation to the behaviour of cyclists and PTW riders. Concerning the use of a protective helmet, transport modes could be included in the survey, such as e-scooters, speed pedelecs or other types of personal mobility that are increasingly used in most European countries over the last years. Also, whether the helmet is fastened correctly by the cyclists and PTW riders could be explored, which, however, may require a different data collection methodology. The helmet use among two-wheelers depending the purpose of trip (e.g. athletes, leisure, work-related purposes) could also be explored. Finally, the use of other types of protective equipment, such as protective clothing, could be observed. The use of protective clothing by PTWs riders and passengers highly depends on the season and the local weather, which may compromise the comparability of the data among the countries. For this reason, the selection of additional indicators to be collected at European level should take into account, among other issues, the feasibility of the data collection and the possibility of extracting comparable results among the European countries.

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6 Annex 1. Requirements for representative measurements on helmet use

6.1 Scope

6.1.1 Vehicles

The UNECE Transport Glossary[2] includes the following definitions for the vehicles concerned:

- BICYCLE: A road vehicle which has two or more wheels and generally propelled by the muscular energy of the persons on that vehicle, in particular by means of a pedal system, lever or handle (e.g., bicycles, tricycles, quadricycles, and invalid carriages). Included are cycles with a supportive power unit (e.g., electric bikes).
- MOPED: A two or three-wheeled road motor vehicle which is fitted with an engine having a cylinder capacity of less than 50cc and a maximum authorized design speed in accordance with national regulations. Where limitations concerning the engine displacement are not applicable, a restriction in terms of motor power may be in force. This relates to categories L1 and L2 of the UN Consolidated Resolution on the Construction of Vehicles (R.E.3).
- MOTORCYCLE: A two or three-wheeled road motor vehicle not exceeding 400 kg of unladen weight. All such vehicles with a cylinder capacity of 50cc or over are included, as are those under 50cc which do not meet the definition of moped. This relates to categories L3, L4, L5 , L6 and L7 of the UN Consolidated Resolution on the Construction of Vehicles (R.E.3).

Although optional, it is recommended to provide a variable "vehicle type" including different vehicle types for both KPIs. For PTWs, we recommend making at least the distinction between "moped" and "motorcycle"; for bicycles, we suggest making at least the distinction between "bicycle" (non-electric) and "electric bike / e-bike". Their specific categorization should be clearly defined and illustrated for readers.

6.1.2 Riders and passengers

The objective of the roadside observation study is to estimate the percentage of powered two-wheelers (P2Wers) (motorcycles and mopeds) and cyclists (including electric bicycles) wearing a protective helmet. Therefore, the theoretical population for these two KPIs refers to the total number of kilometres ridden over the national territory by P2Wers and by cyclists. Hence, by weighting the results by number of kilometres ridden (or a proxy of traffic volume), the percentage of riders wearing a helmet will also reflect the percentage of kilometres ridden with a helmet.

For cyclists, data for children (0-14 years old) should be shown separately. If national legislation makes cycle helmets compulsory for children, but using another age limit (e.g., up to 10 years old), this age category should be added (i.e., data should be shown separately for children aged "0-10", for those aged "11- 14" and for people older than 14"≥15").

6.1.3 Protective helmet

As Hakkert and colleagues (2007) have highlighted: "Under the term helmet, we understand a crash/safety helmet designed for two wheelers, whether motorized or non-motorized." Examples of types of helmets are shown in the figures below:

- Helmets for cyclists[3]:

- Helmets for motorcyclists (WHO, 2006):

As legislation on helmet use can vary between countries, it is requested that all countries document their legislation on helmet use regarding each type of vehicle.

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[2] https://unece.org/DAM/trans/main/wp6/pdfdocs/Glossary_for_Transport_Statistics_EN.pdf - see pages 39-40

[3] https://en.wikipedia.org/wiki/Bicycle_helmet

6.1.4 Road types

The KPI should cover use of helmets on motorways, rural non-motorway roads, and urban areas. Obviously, motorways are only relevant for motorcyclists and not for cyclists and moped riders. This is the assumption in the rest of this document. Rural non-motorway roads are to be interpreted as roads outside built-up areas and urban roads as roads inside built-up areas. The results should be presented separately for these three different road types.

The proportion of observations sampled for each of the three road types should be above 20% to ensure a minimal number of observations for each stratum, even if this would imply disproportional sampling. The three road types should be well defined in the methodology (e.g., typical characteristics, traffic signs, speed regimes, number of lanes, etc.).

6.2 Observation method

6.2.1 Direct Observation

The SWD prescribes direct observation as the data collection method and allows the use of cameras if appropriate. Direct observation should preferably be carried out along the roadside (or another convenient place). If the use of cameras is adopted, they should not be installed exclusively on one type of road so as to avoid selection bias.

For both KPIs, observations of helmet use on urban and rural roads can be carried out from a safe place along the road, preferably at locations where driving speed is reduced relative to the speed limit, such as intersections. For PTWs on motorways, observations of helmet use could be carried out at the last intersection before on-ramps, at the first intersection after an off-ramp, after the exit to a petrol station, or from the bridge over the motorway.

6.2.2 Observation procedure

For both KPIs on helmet use, the most straightforward approach involves observing one bike or PTW, encoding the data, and then observing the next passing bike/PTW. When it is not possible to code the observational data for all the road users who pass by, cyclists and PTW riders should be randomly selected from all the possible road users at the observation location. The easiest and most efficient way is after coding one observation to observe the next passing target road user.

The observations must be made by well-trained independent observers (not uniformed police or other officers) under the supervision of a coordinator. Observers should receive rigorous theoretical and practical training and be given clear guidelines about the road section and traffic direction they should observe, the duration of observation periods and how to manage any potential difficulty that would hamper the data collection. They should be given clear guidance on the procedure to be followed when observations cannot be performed (due to weather conditions, concerns with visibility, safety problems, etc.) (Hakkert & Gitelman, 2007). Wherever possible, it will be valuable to ensure consistency between observers (the interrater reliability) before the start of and during the fieldwork.

It is recommended that the KPIs on helmet use are measured by two observers (one for PTW riders and one for cyclists). If data for both KPIs are collected during the same measurement by only one observer, a rule should be defined to determine the next observation subject (cyclist or PTW) in the case of high traffic volumes. One observation session should last at least 30 minutes (ideally 1 hour), excluding the time needed for counting traffic and collecting environmental data (see section 5.2). Each observation location can be used for different observation sessions (at different time intervals) or each location can be assigned (randomly) to a specific time interval.

The fieldwork procedure should be described in the methodological report.

6.2.3 Temporal requirements

Data collection should be carried out during daylight hours; observations should cover all the daytime. One may organize the observation sessions during different periods of the day (e.g. morning, noon, evening) or taking account of peak hours (e.g. 07:30 to 10:30 (AM peak), 12:00-15:00 (Inter-Peak) and 16:00 to 19:00 (PM peak)). In such cases, it is recommended that each location is observed during all the different periods. Dates and hours of the measurements should be reported in the meta-data.

Helmet use has to be observed both during weekends and during weekdays, because the purpose and duration of riding may vary considerably between weekdays and weekends. The KPIs should be presented separately for weekdays (excluding bank holidays) and weekends.

When planning the observation periods, one should ensure a balanced combination of road types and time periods, in order to avoid a systematic sample bias (e.g. all motorway observations at the weekend and all other roads on weekdays; or all motorway sessions in the morning and all urban sessions in the afternoon). The same balance should be sought across all combinations of periods and other time considerations, avoiding, for example, all the sessions during the weekdays being planned for the morning only.

It is recommended to implement the measurement at the end of spring or at the beginning of autumn. In principle, all months are allowed except December, January, July, and August (in some Member States June also). However, for countries facing difficulties in reaching the minimal number of observations, the measurement can be extended to summer months. In the interests of representativeness, sessions during official feast days and holidays should be avoided.

Member States willing to measure helmet use during two seasons (in late spring and early autumn) can apply the minimal sample size requirements for the two measurements together. The data from both sets of observations can be combined to deliver the main and disaggregated indicators. When Member States have historical series of measurements, it is recommended to use the same period(s) of the year as for the earlier measurements.

6.2.4 Requirements for automatic detection via roadside cameras

SWD allows the use of cameras to collect data on helmet use by cyclists and PTW riders; after recording, the still or video images can be analysed to encode the data. In some applications, helmet detection is automatically performed by the software. There are some clear advantages in using cameras instead of observers, particularly in terms of, for example, reliability and duration of the observation sessions (including night-time use, although this not relevant for the Baseline project).

Possible disadvantages should however be evaluated, such as privacy/GDPR issues (identifiability of riders) and the risk of lacking key variables. This technology should be tested and validated before use. On account of privacy issues, faces should not be caught on camera. Each country will have to deal with national requirements regarding the ethics and protection of private lives.

It should be ensured that the cameras are installed on all types of road to avoid selection bias.

6.3 Sample size and choice of observation locations

6.3.1 Rationale behind the minimum sample requirements

The methodological guidelines for all KPIs are designed to ensure international comparability between KPI values while taking into account feasibility and affordability. To that end the methodological guidelines have been defined in such a way that accurate and representative results can be obtained for all parameters of interest at a reasonable cost.

Obviously, the larger the sample of observations and locations for observation, the more accurate the KPI estimates for the different strata will be (e.g. a KPI value for a particular type of road, or a particular part of the week). Increasing the number of observations and locations however implies increasing field work costs. Statistically, the required minimum sample size depends mainly on the desired accuracy of the final estimates, for which no absolute value can be determined a priori. Therefore, for the main KPI estimates a pragmatic evaluation was made of the expected confidence intervals at different sample sizes and population parameters. Giving priority to feasibility and affordability, as a rule of thumb the minimum total number of observations was set at 2,000, the minimum number of observations for different strata at 500. It was agreed that this should allow to identify statistically meaningful differences between countries at an affordable price. For some countries, this will imply disproportionate sampling of certain strata compared to the distribution of traffic volumes over different strata. This is however required to allow statistically meaningful international comparisons at the level of each of the strata at interest.

The same pragmatic logic was followed for determining the minimum number of 10 locations for observation for each of the required road types of interest. Once again, there is no statistical rationale for determining the required minimum number of locations to ensure representativeness of the observations for the entire country. This mainly depends on the amount of variance between locations and within a country. Giving priority to affordability, a rule of thumb was also used to define the minimum number of locations at 10 per stratum. In order to ensure representativeness for the entire country larger numbers of locations might be required for larger countries. Taking field work costs into account, it was however decided to only identify the minimum requirements and leave decisions on the final number of locations to the discretion of the member states. Equally importantly, in order to ensure representativeness of the measurement locations these should be randomly selected as far as possible.

The main objective in defining the minimum methodological requirements is to keep a balance between affordability of the field work and the requirements to make meaningful international and historical comparisons. Therefore, the emphasis is placed on the minimum requirements that can also be taken into account by smaller countries. It is however of interest to any member state to increase the accuracy of the KPI estimates by boosting the number of locations and the number of observations.

6.3.2 Sampling of locations

The selection of locations should be as random as possible, covering the geographical area of the country, optionally using regions like NUTS1 regions (e.g., stratified random sample). The basic process for the choice of locations consists of three steps:

(1) The required number of different locations (for the country or per region) is determined.
(2) The number of locations is randomly selected on the map using the entire area under consideration (e.g., country or region), taking a sufficient geographical spread into account. The specific requirements for each location do not have to be taken into account at this point. This step is to ensure a reasonable geographical spread of the randomly selected locations.
(3) The final locations that will be used for the observations are manually chosen in the area surrounding the locations randomly selected in the previous step. At this point, the final selection must be based on the location requirements (different road types), inclusion/exclusion criteria (if applicable), and practical considerations. This final selection may be done using Google Street View. Care should be taken to ensure that the different road types are also sufficiently geographically spread.

A convenient way of selecting locations randomly (step 2) is to use a GIS system (e.g. cartographic software like ARCView/ARCGIS) as such software can automatically select location points within defined areas randomly (e.g., https://desktop.arcgis.com/en/arcmap/latest/extensions/geostatistical-analyst/an-introduction-to-sampling-monitoring-networks.htm). If Member States have no GIS software, step 2 can also be carried out manually using a national geographic map, e.g., Google Maps/Google Earth.

A random selection of locations will often include locations with low traffic flow for each stratum. If traffic flow is too low, it is acceptable not to include these locations. A minimum traffic flow for selecting a location can be defined as at least 10 relevant vehicles (PTWs or cyclists) per hour. Also, locations where the composition of the traffic deviates significantly from normal traffic (e.g., locations where 90% of the cyclists are sports cyclists) should be avoided.

If it is not possible to identify 10 locations with at least 10 relevant vehicles per hour for the 1st stratification level indicators, we recommend different alternative strategies to reach the minimum number of observations:

- including summer months in the measurement period to increase the probability of traffic volume for P2Wers and cyclists;
- increasing the number of locations (with few vehicles per hour)

If these strategies do not allow to reach the minimum number of observations within factors of the 1st stratification level, it will be accepted to exclude these stratification level indicators. Countries facing this issue will estimate the KPI per available stratification level and no national KPI will be estimated.

The method used for location selection should be described in the methodological report. The rationale for choosing the observation locations should be provided. Basic characteristics of the locations should be recorded: coordinates (if possible), address or other geographical information, target lane or path and direction to be observed, traffic signs, speed regime, number of lanes, traffic flow and visibility of the traffic from the location.

6.3.3 Minimum sample size

A minimum of 2,000 observations overall is recommended for each of the two KPIs on helmet use (e.g., 2,000 PTWs and 2,000 bikes). For the first stratification level (e.g., road type), a minimum of 500 observations per stratum is recommended. Countries that are not able to achieve the minimum requested number of observations will need to indicate the reasons in the methodological report (see last paragraph in the section on expected results).

When considering the minimal sample size, it should be noted that this refers to number of observations that include the minimal requested data (i.e., excluding observations with missing values in relation to the minimal requested data). The minimum number of observations should be understood as the minimum number of vehicles observed. Some of the vehicles observed will have not just a rider but also a passenger.

Assuming a simple random sampling, the 95% confidence intervals for n=2000 and n=500 are, depending on prevalence (% of drivers wearing a helmet) levels:

Prevalence	Lower bound, n=2000	Upper bound, n=2000	Lower bound, n=500	Upper bound, n=500
50%	47,8%	52,2%	45,5%	54,5%
75%	73,0%	76,9%	71,0%	78,7%
90%	88,6%	91,3%	87,0%	92,5%

To summarize, the minimum required sample sizes to provide the helmet KPI are:

- **min. 500 observations per stratum**
- **min. 2,000 observations in total**

For more information on random sampling of locations and for determining the minimum sample size, please refer to the SafetyNet general recommendations for SPI (safety performance indicators): http://www.dacota-project.eu/Links/erso/safetynet/fixed/WP3/sn_wp3_d3p8_spi_manual.pdf

6.3.4 Stratifications and subpopulations

The SWD requires to take into account:

- Road types (3): motorways (only for motorcycles), other rural roads (or roads outside built-up areas), and urban roads (or roads inside built-up areas).
- Periods (2): weekday / weekend day.

Unless nation-wide surveys support the absence of major regional differences, countries might have to consider an additional stratum related to regions.

Since the overall estimate is expected to be representative for the total of all kilometres driven in a country, theoretically the optimal strategy to estimate the overall prevalence would be to sample all strata according to traffic volume of each combination of the different strata. This strategy would, however, be detrimental for the accuracy of specific low volume strata that are of interest. Certain road types could have a lower traffic volume than others, as do weekends compared to weekdays. As a result, a strictly proportional sampling would lead to much smaller confidence intervals for certain strata.

For representativeness, the recommended minimum numbers of locations are therefore:

- 10 locations per stratum in the first stratification level (i.e., in this KPI, 10 locations for each of the 3 road types; and 10 locations for each of the two periods (week/weekend))
- at least 2 locations for each stratification combination (e.g., 3 road types X 2 periods = 6 combinations and a minimum of 2 locations in each combination.).

6.4 Data analysis

6.4.1 Post stratification weights and statistical analysis

Since sampling will typically be nested in locations, for statistical analysis it is recommended to use models for two-stage stratified cluster sampling (e.g., 1st stage= road type and 2nd stage= period). Approximations assuming simple random sampling can be used as long as results are weighted according to traffic volumes.

For each level of stratification, results should be weighted according to traffic volumes by level of stratification. For these 2 KPIs, this implies that the results should minimally be weighted according to traffic volume data by type of road and period of the week (weekdays/weekend). Traffic volumes can either be inferred from existing national mobility data or estimated by using traffic counts during the observations. When traffic counts are used to infer traffic volumes per stratum, road network length by type of road should be considered (see Section 5.2).

If other stratification criteria are considered (e.g., regions), then the weighting should take them into account (e.g., traffic volume data by region, type of road and period of the week). It is recommended to use the exact values for each combination of stratification levels considered (e.g., traffic volume of PTWs on weekdays on motorways). If these

combined data are not available, the second-best option is to assume independence of all levels of stratification and use combinations of marginal totals to estimate specific combinations.

All methods used should clearly documented.

6.4.2 Traffic volume and traffic counts

The weighting by traffic volume for cyclists and PTWs in the country is ideally based on national mobility data (driven vehicle-kilometres). If such traffic volume data is not available, it is recommended to use a combination of data on road length with traffic counted during the observations. If no official data on road length are available, it is recommended to request estimates from experts from the relevant administration services.

For both KPIs on helmet use (among PTWs and among cyclists), traffic counts should be performed at each location and during each observation session. The purpose is to count all the relevant vehicles. For KPIs on helmet use, this means that each PTW or cycle who rides in the same direction as those who are being observed will be counted. Note that if the observers succeed in observing helmet use among all PTWs (or cyclists) who pass by, there will be no need for the traffic count as it will be equal to the number of observations.

It is recommended to count the traffic of PTWs and bikes for a minimum of 10 minutes (either 5 minutes before and 5 minutes after the observation, or 10 minutes in the middle of the observation session). These counts should then be extrapolated for the whole duration of the session.

It is stressed that traffic volume should also be counted even when national traffic volume statistics according to road type are available. This information is necessary to calculate the share of helmet users per observation session and to correctly calculate the confidence intervals and weighing factors.

6.4.3 Expected results, data delivery and methodological report

The main indicator is the percentage of riders wearing a helmet across all times and locations, separately for users of bikes and PTWs, and for riders and passengers. So overall there are 4 main KPIs for which a point estimate and a 95% confidence interval is to be calculated:

- riders of bicycles (including e-bikes)
- passengers of bicycles (including e-bikes)
- riders of PTWs (mopeds and motorcyclists)
- passengers of PTWs (mopeds and motorcyclists).

In some countries, the number of passenger observations is expected to be very low. Countries facing this limitation will not be included in the results on helmet use among passengers.

It is also recommended to distinguish values:

- for cyclists: values for children (0-14 years old) and older people separately; if national legislation requires children cyclists to wear helmets up to a certain age, this age category should be added (i.e. data should be shown separately for children aged “0-10”, for those aged “11- 14”, and for those older than 14“≥15”)
- for PTWs: values for mopeds and motorcycles separately.

For each of the 4 main KPIs, it is also required to calculate a point estimate and a corresponding 95% confidence interval for the disaggregated levels:

- road type (3 levels) (motorways, rural non-motorway roads and urban areas)
- period of the week (2 levels) (weekdays and weekend days)
- region (if applicable).

It is recommended to provide specific estimates for combinations of levels (including the confidence interval).

Together with the above estimates, a methodological report should be submitted that describes the specificities of the methodology of the field work and the statistical techniques used to weight and analyse the results, and to calculate the CIs.